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Original Paper

The Design and Relevance of a Computerized Gamified Depression Therapy Program for Indigenous Māori Adolescents

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Abstract

Background: Depression is a major health issue among Māori indigenous adolescents, yet there has been little investigation into the relevance or effectiveness of psychological treatments for them. Further, consumer views are critical for engagement and adherence to therapy. However, there is little research regarding indigenous communities' opinions about psychological interventions for depression.

Objective: The objective of this study was to conduct semistructured interviews with Māori (indigenous New Zealand) young people (taitamariki) and their families to find out their opinions of a prototype computerized cognitive behavioral therapy (cCBT) program called Smart, Positive, Active, Realistic, X-factor thoughts (SPARX), a free online computer game intended to help young persons with mild to moderate depression, feeling down, stress or anxiety. The program will teach them how to resolve their issues on their own using Cognitive Behavioural Therapy as psychotherapeutic approach.

Methods: There were seven focus groups on the subject of the design and cultural relevance of SPARX that were held, with a total of 26 participants (19 taitamariki, 7 parents/caregivers, all Māori). There were five of the groups that were with whānau (family groups) (n=14), one group was with Māori teenage mothers (n=4), and one group was with taitamariki (n=8). The general inductive approach was used to analyze focus group data.

Results: SPARX computerized therapy has good face validity and is seen as potentially effective and appealing for Māori people. Cultural relevance was viewed as being important for the engagement of Māori young people with SPARX. Whānau are important for young peoples' well-being. Participants generated ideas for improving SPARX for Māori and for the inclusion of whānau in its delivery.

Conclusions: SPARX computerized therapy had good face validity for indigenous young people and families. In general, Māori participants were positive about the SPARX prototype and considered it both appealing and applicable to them. The results of this study were used to refine SPARX prior to it being delivered to taitamariki and non-Māori young people.

Trial Registration: The New Zealand Northern Y Regional Ethics Committee; <http://ethics.health.govt.nz/home>; NTY/09/003; (Archived by WebCite at <http://www.webcitation.org/6VYgHXKaR>).

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KEYWORDS

computerized cognitive behavioral therapy; Māori; indigenous populations; depression; consumer opinions; participatory design

Introduction

Adolescent Depression in New Zealand

Depression is a major concern globally and population-based studies internationally have indicated that 12-month prevalence rates are as high as 6.7% in adolescents [1]. There appear to be conflicting rates of depression reported for indigenous young people (Māori, the indigenous Polynesian people of New Zealand), as these vary from being comparable to nonindigenous young people [2] through to being approximately two times higher than in nonindigenous populations [3]. In New Zealand, a recent nationally representative study showed that rates of depression for Māori high school students (13.9%) were comparable to New Zealand European young people (12.1%), with 18.3% of Māori girls and 8.7% of Māori boys reporting depressive symptoms in the clinical range on the Reynolds Adolescent Depression Scale-Short Form (RADS-SF) [4]. However, other studies of depression in New Zealand have shown significantly higher rates for Māori, with 16.4% of Māori girls reporting depressive symptoms in the clinical range on the RADS-SF compared with 12.7% of New Zealand European girls [5].

Computerized Cognitive Behavioral Therapy

The National Institute for Clinical Excellence in the United Kingdom recommends cognitive behavioral therapy (CBT) as a first line treatment for adolescents with mild to moderate depression [6]. However, access to therapists is often problematic and interest in computerized CBT (cCBT) has increased. Although cCBT has been found to be effective for adults with depression [7-9], it is still considered an emerging therapy for the treatment of depression in children and adolescents [10], with initial results for cCBT among adolescents appearing promising [11,12]. Research has demonstrated that cCBT has the potential to be a low-cost and easily accessible option for those in need of therapy [12].

However, indigenous minority adolescents rarely seek professional face-to-face help as a first treatment option for depression [13]. cCBT has the potential to increase access to therapy for these indigenous youth, if it can be delivered in a way that is acceptable and appealing to these young people.

Ethnic minority populations are largely missing from the efficacy studies that make up the evidence base for psychological treatments. This is often due to the inclusion of small samples, which limit the accuracy of statistical inferences [14-17]. Similarly, few studies capture qualitative information because of the small number of ethnic minority participants in studies to date. Ethnic minority opinions (including the perspectives of indigenous people in colonized countries who are often in a minority) are therefore missing in relation to the development of interventions generally, and cCBT programs in particular.

There are implications for those that design cCBT programs, in that the evidence base that they draw from to inform these

therapies is fairly limited for ethnic minority groups, with a review of cCBT for adults highlighting that future research in the field needs to specifically assess the acceptability of cCBT among indigenous minority groups [18]. Thus, one cannot assume that CBT theories will be applicable in the same way that they are for nonindigenous people as they are for indigenous minority groups. There is evidence that CBT can be applicable for ethnic minority groups [15,17], but computerization brings an extra set of challenges. For Māori, for example, there is a strong focus on the value of family, so that a therapy delivered by computer may be less acceptable to the Māori community than in cultures with more of a focus on individuals.

This study provides an opportunity to begin to understand some of these much needed “consumer opinions”. Not surprisingly, there has been little research published on psychological interventions for Māori [19-21]. Hence, there is a dearth of information that has recorded the attitudes and opinions of Māori toward the development of CBT programs [19] and attitudes of tangata whenua (indigenous people of New Zealand) to the development of a cCBT resource have never been captured before. Since the rates for depression are especially high for Māori girls (when compared to international rates) [1], it is imperative that Māori have input into interventions that will be developed and trialled, for their benefit. An approach to research, which actively involves Māori, can also serve as a potential model for research with other indigenous minority groups.

In New Zealand, Smart, Positive, Active, Realistic, X-factor thoughts (SPARX), which is a form of cCBT, has been funded by the Prime Minister’s Youth Mental Health Project, and this form of cCBT has been made available free of charge to anyone wanting to access the program on a national level since April 2014.

Smart, Positive, Active, Realistic, X-Factor Thoughts Computerized Cognitive Behavioral Therapy Program

SPARX (Smart, Positive, Active, Realistic, X-factor thoughts) is a free online computer program intended to help young persons with mild to moderate depression, feeling down, stress or anxiety. Through the game, the program teaches them how to resolve their issues on their own, using Cognitive Behavioural Therapy. Based in a 3D fantasy world, the game leads players through seven realms (each lasting between 30 and 40 minutes). In the beginning of SPARX, the user meets the Guide who explains what SPARX is and how it could help. Then the user customizes an avatar and starts to journey within the seven provinces in order to complete different quests. In the first level, gamers challenge GNATS (Gloomy Negative Automatic Thoughts). These GNATS fly towards the avatar and say negative things like, for example: “you’re a loser”. Further in the game, the user meets different characters, solves puzzles and completes mini games. As soon as a quest is completed, the Guide explains how to use new skills in order to feel better, solve problems and enjoy real life. Players complete one or two levels in the game each week, during three to seven weeks.

When we developed SPARX, our aim was to design it to appeal to all young people in New Zealand, regardless of ethnicity [11]. We utilized a participatory design approach, with input throughout from young people of all ethnicities, from CBT clinicians and from advisors from the major ethnic groups in New Zealand. This provides a potential model for the collaborative development of cCBT programs. The program's development included: a Māori cocreator (MS); input from Māori CBT experts; cultural guidance from a kaumātua (respected elder); and the computer game development company was led by a Māori woman. In the design of SPARX, we attempted to incorporate Māori symbolism within the intervention, albeit within a more general fantasyland format, and to deliver the intervention in a way we believed would resonate with Māori. Having incorporated these elements, we carried out this study to investigate taitamariki (Māori adolescents) and whānau/family opinions regarding the relevance of SPARX to Māori, including the cultural acceptability of designs and content, and of the perceived relevance of SPARX to Māori. The study took place during the beta testing stage of SPARX's development; the aim of the study was to obtain user feedback so that the findings could be used to inform the finalized version of the program. This is of international interest because of the lack of information about the relevance of cCBT programs cross-culturally, and to indigenous communities in particular.

Methods

Kaupapa Māori Methodology

Western research traditionally holds an individualistic approach to epistemology. However, the traditional Māori perspective has been to view the world in a collectivist way. Māori culture places an emphasis on the individual acting in a way that would seek to put the whānau (extended family) and iwi (tribe) needs before their own needs. This has implications for research from a Māori worldview, and this way of carrying out studies has come to be known as Kaupapa Māori research [22,23].

Kaupapa Māori research has emerged over the past two decades, alongside an increasing awareness and acknowledgement from academia of Māori epistemology, coupled with Māori ways (tikanga customs and protocols) of conducting research. Kaupapa Māori research encompasses an analytical approach that is about thinking critically, which includes critiquing Western definitions and constructions of Māori people and their worldview. It is also about valuing Māori self-determination and encouraging Māori participation in the research process [22]. Kaupapa Māori research does not exclude the use of other research methods, but seeks to integrate these in a culturally sensitive way that is beneficial for Māori [21].

Western psychological models such as CBT have tended to focus on an individual's internal psychological state, for example, a change in one's thoughts and feelings leads to improved mental health. In contrast, Māori culture emphasizes the importance of being connected to extended family (whānau), genealogy going back many generations (whakapapa), tribe

(hapu and iwi), environment (land, rivers, seas, and mountains), and spiritual (wairua) and physical health [24-28]. Each of these dynamics means that mainstream Western therapeutic approaches might have limited appeal or limited therapeutic power with Māori young people. cCBT, with its analytic focus on individual thoughts, behaviors, and feelings, without processes of cultural connection, might be considered antithetical to Māori world views. Alternatively, the use of Māori images, the use of the story telling, and opportunities for holistic learning processes utilized in SPARX might have some appeal.

It is important to also note that research that has been conducted in the past has often been detrimental to Māori communities [22]. The history of research within New Zealand has predominantly reflected a distinct patriarchal process in which the Māori worldview has often been marginalized [23]. In this research, we used a Kaupapa Māori approach to ensure that the method of engagement was inclusive of Māori input and respected Māori protocols.

Epistemological Orientation

The study was led by the first author, MS, who took a critical realist position, which posits that in order to understand the meaning of the data, it is essential to understand the context in which the phenomena takes place and the method by which the data are collected [24]. The first author, MS, is Māori and ensured that all study processes took into account Māori processes and protocols. For example, as suggested by other Kaupapa Māori researchers [26,29], MS was welcomed with a powhiri (formal welcome ceremony) when conducting the focus groups. He responded with a mihi (formal speech), after which waiata (traditional Māori song/s, which had been specially chosen to fit the context) were performed and kai (food) was then shared.

Participants

In total, seven focus groups were conducted, with a total of 26 Māori participants who were recruited through word of mouth (Table 1). There was no screening of participants, and they did not have to have depressive symptoms to participate. The three types of groups that were conducted were: (1) adolescents; "taitamariki", (2) "taitamariki mothers", and (3) family; "whānau". The taitamariki group was conducted with young people from a kapa haka group (Māori youth traditional performing arts group) and strongly identified as being Māori. This focus group was held at the kapa haka group's school marae (sacred meeting place). The second type of focus group included young mothers (age 16 to 18 years old). This group was invited to participate because of the high rates of depression among Māori females. The third type of group comprised interviews with whānau (families) that were held in whānau homes. Whānau involvement in all aspects of life, including mental well-being, is important for Māori, and is considered one of the four cornerstones of Māori holistic well-being [30]. The inclusion of feedback from whānau was thus seen as particularly important. Māori protocols (tikanga) were followed when conducting these interviews [29].

Table 1. Number and type of focus groups and participants.

Group	Group type	N	n (participants 16-18 years)	n (participants parent/caregiver of adolescent)
1	Taitamariki (adolescents)	8	8	-
2	Taitamariki mothers	4	4	-
3	Whānau (family)	4	2	2
4	Whānau	1	-	1
5	Whānau	3	2	1
6	Whānau	3	1	2
7	Whānau	3	2	1

Procedure

All participants were shown the prototype of SPARX on a computer and asked for feedback during focus groups. A semistructured format was used. The sessions lasted between 30 and 60 minutes. Feedback was sought about the design and applicability of the content of the SPARX program. At the conclusion of the focus group, participants were invited to complete a questionnaire about their views of the session and

the prototype SPARX program. The purpose of the questionnaire was to include rating scales so participants had the opportunity to quantify their views.

Focus Group Questionnaire

The questionnaire contained five questions, which consisted of four Likert scales (on a five point scale), four free-text spaces, and one closed question.

Table 2. Focus group questionnaire.

Questions	Rating scale
Q 1. How much were you able to express your opinions in the focus group?	1= "Not at all" 5= "Totally"
Q 2. Overall what did you think about the look and style of the game?	1= "Didn't like it at all" 5= "Liked it a lot"
Q 3. Overall what did you think about the content (messages and information to help people) in the game?	1= "Didn't like it at all" 5= "Liked it a lot"
Q 4. Overall what did you think about the cultural content in the game (Māori costume design and building/environment) designs?	1= "Didn't like it at all" 5= "Liked it a lot"
Q 5. Would you like to make any other comments?	No rating needed

Numerical Data Analysis

Numerical data were analyzed using descriptive functions of the Statistical Package for the Social Sciences 15.0. The free-text comments were analyzed using a general inductive approach [31].

Data Analysis

This qualitative research was conducted using a General Inductive Analysis (GIA) [32]. GIA involves collecting the raw data, processing it, and finally interpreting the data to derive concepts and themes from it [33]. GIA fits with the exploratory nature of this research, in that we were seeking to understand participants' experiences that are not fully understood yet. Inductive methods are also able to put into language peoples' experiences about the research question that is being put before them [34]. This fits with the aim, which was to gather important data about the design of the cCBT program and then to identify the many contextual variables that may be relevant from the data [35].

The qualitative method utilized for this research was thematic analysis [36]. Thematic analysis was favored over methods such as discourse analysis, as the study aimed to organize and summarize the content of the interviews rather than analyze the way in which participants constructed their own experiences [35].

Braun and Clarke's [36] six-step process of thematic analysis was used to identify, analyze, and present the main themes from both the focus group and the free-text data using NVivo8 (computer software to conduct qualitative analysis). Initial codes were generated during the first reading of the data, and codes that were similar, but distinct, were kept separate. A second reading of the data confirmed the coding of the themes. An independent researcher read one third of the transcripts and their themes were compared to the themes that MS identified. Any differing opinions about themes were discussed until agreement was reached about which themes to include. By carrying out a qualitative study, we have endeavoured to ensure that the data collection has been exploratory and that preconceptions have been kept to a minimum.

Ethics

The New Zealand Northern Y Regional Ethics Committee granted approval for this study (NTY/09/003). All participants provided their own written consent. No inducements were offered.

Results

Identified Themes

A number of themes were identified from the data, and these have been organized into four categories: (1) computerized therapy has good face validity and is seen as potentially effective and appealing, (2) cultural relevance was viewed as being important for the engagement of Māori young people with SPARX, (3) whānau are important for young peoples' well-being, and (4) ideas for improvement of SPARX for Māori.

Computerized Therapy has Good Face Validity and Is Seen as Potentially Effective and Appealing

Taitamariki and whānau generally considered that SPARX could help young people with depression and considered that SPARX would be able to teach skills to help deal with depression.

SPARX is like a computer game that can help with depression. Participants acknowledged this assisted with engagement. Participants described SPARX as being a resource that could help adolescents who are experiencing depression.

This game is more about helping you through it (depression) though I just realized it now (in response to MS asking what are your initial thoughts). [Group 6 Female Participant 1]

SPARX was able to teach skills. Most participants connected with the characters in SPARX and thought they could teach them skills. A skill that most participants understood and felt motivated to complete was the breathing/relaxation skill.

How everything in there we knew and everything that gets you thinking, especially when they said to breathe. It makes you want to breathe with it and it is only a video game (comment during spontaneous discussion). [Group 3 Male Participant 1]

The main thing was probably breathe in, breathe out. It is a good exercise. [Group 2 Female Participant 2]

It is good to breathe when you get angry. [Group 2 Female Participant 3]

It calms you down (in response to MS asking about what messages did you take away). [Group 2 Female Participant 4]

Cultural Relevance Was Viewed as Being Important for the Engagement of Māori Young People With Smart, Positive, Active, Realistic, X-Factor Thoughts

Most of the participants valued the Māori designs on the characters and there was a range of opinions about whether participants found them relevant. Participants were also interested in the whakapapa (genealogy) of the characters in SPARX. Participants acknowledged that the characters were

able to teach skills and wondered whether the Guide character could be a role model for taitamariki.

Māori designs within the SPARX environment were relevant for Māori. Most participants noticed the Māori designs and thought that the inclusion of the designs helped to enhance the engagement and gaming experience of SPARX.

Hey, that is cool...Yes, it snuck up to me. And poutama's (Māori art design, symbolizing a climb up toward a goal) got a good meaning too. That is really cool. That is like telling them to get happier. So it makes you feel like you have got to try. [Group 5 Female Participant 1]

Yes, I was feeling that too (in response to discussion led by MS asking for feedback about the graphic designs in SPARX). [Group 5 Female Participant 2]

The participants spoke of the value of Māori designs in SPARX. Most participants in the focus groups thought that the Māori designs on the outfits of the main SPARX characters were a good idea. Most recognized the hybrid nature of the design of the characters (see [Figure 1](#) for an image of a SPARX character), whereby they were seen as being Māori, but existed in a different context, such as a medieval fantasy environment. No participants reported that the Māori designs limited the appeal of the program.

I reckon he looks mean as. He looks like a medieval Māori (in response to MS asking for opinions about the Guide). [Group 5 Female Participant 1]

There were some differing views. A small number of participants, both taitamariki and parents/caregivers, did not understand the hybrid concept of the designs (see [Figure 2](#)).

It looks like a couple of people from the medieval time that have nothing to do with anything Māori, they don't really look Māori (spontaneous discussion about what is seen as applicable for Māori). [Group 3 Female Participant 3]

It is important that SPARX characters include their whakapapa (genealogy). Participants thought it was important that the characters include their whakapapa in the SPARX program. For example, some participants wanted to know some information about the characters' values, for who they may be fighting for, and the origin of the hapu (clan) of characters. It was also thought that being more formally introduced to the characters could help make them seem "less like strangers".

Because you could say which tribe you are from and then pick your tribe and stuff and different tribes have a different dude or something (comment during discussion about what is seen as culturally applicable). [Group 7 Male Participant 1]

The Guide could be a role model for taitamariki. Participants acknowledged the Guide could be utilized as a role model for taitamariki.

Actually one of my mates has stopped himself from being depressed and one of the reasons why he killed himself was his family was too hard to get to and there was nothing to help him on his journey. I think some

young people find it hard to talk to their parents...If we had a role model, we would go straight to them. But some young people don't really have role models in terms of what they want to do. But not many people have people to look up to, to help them on the way and maybe the video game (SPARX) would be something to help them along. And maybe at the end of the game you could guide them to actually go and talk to their parents or wherever they are living and talk to them. Get them to sit down and help them do what they want (a spontaneous response nearing the end of the focus group from a young person that had been listening, but not saying much throughout the group). [Group 3 Male Participant 1]

Whānau Are Important for Young People's Well-Being

Whānau expressed a range of opinions about when they needed to be informed that their taitamariki were using SPARX. Whānau thought that they would benefit from having resources to support them while their taitamariki were using SPARX. There were also differing opinions about where whānau would want their taitamariki to be using SPARX.

Some feelings from parents about the inclusion of whānau in the process varied. Some parents expressed that they wanted to know more about SPARX before their taitamariki used the program, while other whānau preferred to be informed when their taitamariki were either using SPARX or had completed it. Some parents were comfortable with not being informed, as long as their taitamariki could talk to someone about their depression and get the support they needed, such as from extended whānau or a clinician.

I am very much a traditionalist, and if it was my child, I would like to know before they got onto the computer that they were going through this type of depression...I would prefer some kind of means of being able to identify that there is a problem and actually being with them, right beside them, as they work through it. So if they get an opportunity to sit on the computer on their own then I am aware of that, but I wouldn't want them to spill their feelings to a computer first. I would be very hurt if that was my child (comment during spontaneous discussion about how whānau can support their youth). [Group 3 Male Parent 1]

The resources that could be used for whānau to help them understand about depression were discussed. There was a range of opinions about how SPARX could be used with whānau members. However, most participants in the focus groups agreed that it was important to think about extra resources that whānau could use to support them while their taitamariki completed the SPARX program. This could include having an extra module within SPARX that was applicable to whānau members. Alternatively, a booklet could be developed that provided psychological education to whānau about depression.

I think you should have another disc (SPARX) for the parents... something anyway just so then they can help the child through that (in response to MS asking

about what resources are needed for the treatment of depression). [Group 6 Female Participant 1]

The range of location sites for use of SPARX by taitamariki is noted. Whānau were open to a range of different localities where their taitamariki could be using SPARX. This varied from SPARX being used at a high school, a library, a health service, or in the whānau home.

If they want to get dropped off at the library that is fine, if they want to do it in their room and close the door, that's fine. If they want me out of the house, that's fine (in response to MS asking about what resources are needed for the treatment of depression). [Group 3 Male Parent 1]

Ideas for Improvement of Smart, Positive, Active, Realistic, X-Factor Thoughts for Māori

Participants suggested that SPARX needed more activities for Māori males, and that the puzzles and challenges needed to be more difficult. SPARX also needed to include language that reflected taitamariki understandings about depression.

SPARX needs activities that appeal to male adolescents. These added activities would need to direct male adolescents to participate in physical challenges such as fishing, skate boarding, kapa haka, or mau rākau (traditional Māori martial arts). The reasons given were that SPARX contains a lot of text, and male adolescents may not want to sit down at a computer and read a lot of text.

I think it (SPARX) is pretty good, but I would probably get lost on the computer because I don't know if many Māori boys or the other kids like using computers because I definitely don't and I get lost straight away and I just think I would just sit there. I don't want to just sit there and watch and listen to video games or something. Maybe SPARX needs relaxing things like fishing or something or more activities to do in the game (in response to MS asking what would be good about using a program like SPARX for young people with low mood). [Group 3 Male Parent 1]

The use of language in SPARX for adolescents may not be adequate. Participants thought that adolescents do not always have the necessary language to be able to identify that they may be experiencing depression. Adolescents may need education about what terms to use to describe how they are feeling. Conversely, it was thought that mental health professionals needed to listen more carefully to the colloquialisms of adolescents and then use these in their clinical practice.

You know what you were talking about with regard to the language, how you need to teach young people a whole new language, maybe it is the other way round. Maybe it is them teaching us the language and then us interpreting it (spontaneous discussion about what else SPARX may need to be maximally useful for young people). [Group 7 Female Parent 1]

SPARX has too much text to read for some participants. A majority of participants indicated that the text needed to be shortened so that it was more manageable to read.

Does it read alright the text? [First Author, MS]

Yes, it does. It is just a lot of words. And it could probably be shortened or you could get straight to the point and maybe the facts are at a different stage or before something. [Group 6 Female Participant 1]

Developers should include the Māori language within SPARX. Even though SPARX was designed as a program for all ethnicities, some of the participants stated that it was important to incorporate Māori language in the text as a way to help taitamariki to connect and have ownership of the SPARX program.

It might just give it a little bit of ownership back to those young people (to have Māori terms in the text), this is my language...It is not an American thing; it is actually a Māori thing or a New Zealand thing (in response to MS asking would it be helpful if there

were Māori words in SPARX). [Group 7 Female parent 1]

Developers should increase the use of audio rather than text. The audio clips were thought to help support those taitamariki who struggled with the amount of text or who simply do not like to read.

What if you had a voice over instead of the writing? [Group 2 Female Participant 3]

Yes, that is another good point. We are going to do that. [The First Author, MS]

Not many people our age like to read. [Group 2 Female Participant 3]

I don't like reading (spontaneous discussion about how there was too much text in the prototype of SPARX). [Group 2 Female Participant 1]

Figure 1. Picture of the poutama (staircase) design.



Figure 2. Picture of character from SPARX.



Focus Group Questionnaire

Nineteen of the 26 participants completed a questionnaire. These results demonstrated that; most participants were able to express

their opinions in the group; most people liked the graphic style of SPARX; the majority liked the content of SPARX; and most liked the cultural content of SPARX. In [Table 3](#), the Likert rating scale ranged from 1 to 5, 5 = highest rating.

Table 3. Results of focus group questionnaire.

Number of participants	Questions	Mean	SD
n=19	How much were you able to express your opinions in the focus group?	3.95	1.17
n=19	Overall what did you think about the look and style of the game?	4.2	0.8
n=19	Overall what did you think about the content (messages and information to help people) in the game?	4.00	0.88
n=19	Overall what did you think about the cultural content in the game (Māori costume design and building/environment) designs?	4.2	0.6

Discussion

The Participants' View

This is a unique study, as it is the first, to our knowledge, to gather the opinions of ethnic minority indigenous people about their experiences of a computerized therapy program and to do so using a research methodology developed by Māori people to ensure good outcomes for Māori people participating in research. Participants were positive about the prototype version of SPARX, and their views were used to refine and improve on the final version of SPARX. Cultural relevance was viewed as being important for the engagement with SPARX among Māori young people. The incorporation of Māori symbols and the use of a Māori actor to provide the voice over for the character of the Guide all led to acceptance of SPARX by Māori, and their inclusion was seen as key in the dissemination of the SPARX program. Participants' highlighted specific opportunities to improve SPARX for Māori, and the ideas from these focus groups were incorporated into the final design of SPARX. Participants also highlighted specific opportunities to improve SPARX for Māori.

Participants' thought that learning a simple relaxation exercise was particularly beneficial, thus indicating that some skills can be learned without the aid of a therapist. This finding is in keeping with the literature [37], which purports that cCBT programs without direct therapist input can teach skills. This has implications for primary care settings and school environments where CBT expertise is not always available, but where programs like SPARX could make evidence-based interventions accessible to a wider client group.

Although SPARX was designed to appeal to more than one cultural group, SPARX does contain: Māori specific artwork; Māori-based characters; some Māori language; and the Guide character (who is the virtual therapist and main character, after the user's avatar) has a distinct Māori-English accent. Feedback from the focus groups confirmed the importance of the cultural relevance of the design. Most of the participants noticed the Māori designs within the SPARX environment and thought the designs enhanced the engagement with the program. Culturally adapted mental health interventions, targeted to a specific cultural group, are thought to be approximately four times more effective than interventions provided to groups from a variety of cultural backgrounds [38].

Māori, like other ethnic groups, are not homogeneous. The SPARX prototype was not, and perhaps cannot be, applicable

to all Māori. Durie [26] emphasizes this point when asserting that one approach does not fit for all Māori.

The graphic designs in SPARX represented a "leap forward" in terms of contemporary tikanga (Māori protocols) employed within modern game design, and this process has provided some much needed information about the process of adapting nonindigenous interventions for use by indigenous people, about the efficacy of these interventions for indigenous people, and, more pointedly, for Māori [19].

Whānau are important for the well-being of young people [39]. This study is the first to take these opinions into account in the development of a cCBT program, to our knowledge. Whānau noted the cultural designs and thought it helped to engage taitamariki with the SPARX resource. Family members were keen to be involved in the lives of their young people and to have the resources to help them support their young people.

Indigenous minority adolescents often do not access help for depression [13]. The flexibility and privacy of cCBT, and the ability to design computerized interventions that look appealing to indigenous young people, may help reduce some of the barriers these young people face in accessing help. In addition, this approach could support those whānau and taitamariki who live in remote areas [40].

Strengths

In this study, we gathered views from young people and their families from an indigenous ethnic minority group, a group frequently neglected in trials of therapeutic interventions. In New Zealand, there has been an attempt to develop a social policy about whānau ora (healthy families) [41]. The SPARX resource, and the approaches taken in its development, may be one particular way to help achieve whānau ora.

Based on the results of this study, we were able to improve SPARX for Māori; for example, we included audio files for the text wherever possible as a direct result of the feedback obtained from participants in this study.

Limitations

This is a small study, limited to focus groups and one individual interview. The views, therefore, are not reflective of all Māori. Conducting individual interviews may have provided a greater range of in-depth opinions; however, focus groups allowed for richness in interaction between participants, which individual interviews would not have provided. The findings of this study were not based on a clinical population. We thought that within

this minority indigenous population depression is common and help seeking is low.

Therefore, we did not want to create a barrier to Māori peoples' participation in this study.

Implications for Computerized Cognitive Behavioral Therapy Research and Delivery

It is important for researchers to consult with indigenous groups when developing programs for these young people. These processes can then lead to greater engagement with the specific program. Once a program has been developed, it is essential that support be provided to indigenous families to help families encourage and support their young people with depression when using cCBT. Traditional Māori (and other indigenous) families will want to be a part of how their young person engages with a cCBT self-help resource, and they will want to know when and where their young people are using it. Hence, family

resources need to be developed alongside a cCBT program so that information is provided to the family about what program their young person is using. This collectivist approach to cCBT and its delivery contrasts considerably with the often individualistic focus of cCBT delivery to date.

Conclusions

In general, taitamariki and whānau supported the contemporary tikanga approach to the graphic designs that were used for the characters and environment within SPARX. These findings are important, as a resource like SPARX, which has sought to engage indigenous youth in its creation (and subsequent formal evaluation), has never been developed previously. This study provided information that was utilized in the further refinement and development of SPARX to help ensure maximal applicability to taitamariki and provides a potential model for other cCBT interventions.

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Conflicts of Interest

The Intellectual Property for SPARX is owned by Uniservices at the University of Auckland. MS, TF, ML, KS, SM are co-developers of SPARX and can benefit from any profits generated from SPARX.

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Abbreviations

CBT: cognitive behavioral therapy

cCBT: computerized CBT

GIA: General Inductive Analysis

RADS-SF: Reynolds Adolescent Depression Scale-Short Form

SPARX: Smart, Positive, Active, Realistic, X-factor thought

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Original Paper

Therapists' Perceptions of Social Media and Video Game Technologies in Upper Limb Rehabilitation

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Abstract

Background: The application of technologies, such as video gaming and social media for rehabilitation, is garnering interest in the medical field. However, little research has examined clinicians' perspectives regarding technology adoption by their clients.

Objective: The objective of our study was to explore therapists' perceptions of how young people and adults with hemiplegia use gaming and social media technologies in daily life and in rehabilitation, and to identify barriers to using these technologies in rehabilitation.

Methods: We conducted two focus groups comprised of ten occupational therapists/physiotherapists who provide neurorehabilitation to individuals with hemiplegia secondary to stroke or cerebral palsy. Data was analyzed using inductive thematic analysis. The diffusion of innovations theory provided a framework to interpret emerging themes.

Results: Therapists were using technology in a limited capacity. They identified barriers to using social media and gaming technology with their clients, including a lack of age appropriateness, privacy issues with social media, limited transfer of training, and a lack of accessibility of current systems. Therapists also questioned their role in the context of technology-based interventions. The opportunity for social interaction was perceived as a major benefit of integrated gaming and social media.

Conclusions: This study reveals the complexities associated with adopting new technologies in clinical practice, including the need to consider both client and clinician factors. Despite reporting several challenges with applying gaming and social media technology with clinical populations, therapists identified opportunities for increased social interactions and were willing to help shape the development of an upper limb training system that could more readily meet the needs of clients with hemiplegia. By considering the needs of both therapists and clients, technology developers may increase the likelihood that clinicians will adopt innovative technologies.

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KEYWORDS

virtual reality; technology adoption; rehabilitation; therapy; social media; gaming; stroke; cerebral palsy; hemiplegia

Introduction

Video games are a form of virtual reality systems that offer real-time, immersive, computer-based environments with which users interact and explore [1,2]. Video game systems have gained attention as components of rehabilitation. Studies have examined video gaming as an intervention to target a range of impairments, including balance, mobility, cognition, and upper extremity functioning [3-5]. Video games are a promising tool because they can provide challenging, repetitive, task-specific, reward based, and intensive conditions needed to promote brain remodelling after neurological injury [3]. Cerebral palsy (CP) and stroke are the leading causes of neurological disability in children [6] and in adults [7], respectively, and video game therapy is an emerging area of research with both these populations [8]. While knowledge regarding the effectiveness of gaming in rehabilitation is limited, findings to date are promising (for a recent review, see [9]). Gaming-based rehabilitation is safe and feasible [1], and controlled trials and cohort studies have demonstrated positive effects of gaming for upper extremity function both in adults post stroke and in children with CP [4,8,10].

Social media, a companion interactive technology, has transformed communication and is progressively influencing healthcare. Nevertheless, in contrast to video game, little research is available on the application of social media in the field of rehabilitation [11]. Social media refers to a wide variety of online platforms (eg, Facebook and Twitter) that allow users to exchange information, links, and opinions at a highly interactive and rapid pace [12]. In rehabilitation, social media is a platform with the potential to promote physical, cognitive, and psychosocial health outcomes. In recent years, the global adoption of social networking platforms by users has prompted scholars to explore how and why these sites are being used. These platforms are well suited for individuals with disabilities because they can reduce social isolation, which is identified as one of the most disabling limitations for this population [13,14].

While gaming technologies and social media offer much promise for improving clinical outcomes, limited research has explored perceptions of these technologies from the viewpoint of clinicians working in rehabilitation [4,15]. Numerous factors may influence a clinician's decision to adopt these types of interventions in clinical practice. An analysis of gaming in rehabilitation revealed a number of barriers to adoption, including concerns about how to design effective, efficient and easy-to-learn systems, challenges with platform compatibility, immature engineering processes, ethical challenges, limited awareness and unrealistic expectations by clinicians, and perceptions that video game use eliminates the need for clinicians [16]. One study examined clinicians' perspectives of adopting a rehabilitation specific system, GestureTek, and identified time-to-learn, knowledge of clinical applicability of the system, and poor patient motivation as barriers to its use, while educational opportunities and social influences were facilitators [17].

To date, scarce research has examined clinicians' views and acceptance of commercially available or rehabilitation-specific video gaming technology as interventions [17,18]. Moreover, clinicians' perspectives regarding social media are notably limited. Research is needed to understand the synergy between social media and evidence-based practice [19]. Because clinicians are instrumental in mediating clients' use of technology for rehabilitation, it is pertinent to understand their perceptions. If their views are not understood or incorporated in the development of these technology-based interventions, use may be limited. Thus, the two purposes of this qualitative study were (1) to explore occupational and physical therapists' perceptions of how young people and adults with hemiplegia use social media and gaming technology in daily life and rehabilitation, and (2) to identify barriers to the use of these technologies in rehabilitation. We applied the diffusion of innovations theory as a framework to explain factors influencing occupational and physical therapists' adoption of these technologies with their clients. This theory provides a relevant framework for interpreting our research because it emphasizes users' perceptions of the innovation, rather than the attributes of the innovation as most influential in understanding adoption decisions [20]. This theory proposes an innovation-adoption process that individuals, acting as decision making units, undergo, beginning with acquiring knowledge of an innovation, forming an attitude toward the innovation, then implementing the new idea, and finally seeking confirmation of the decision [21].

Methods**Study Setting**

This study took place at two rehabilitation centres in British Columbia (BC), Canada. Hospital-based rehabilitation in BC is publicly funded, and residents have the option of obtaining additional private therapies under a fee-for-service provision model.

Participants

Purposive sampling was used to recruit occupational therapists or physiotherapists with at least 1 year of experience who were currently providing rehabilitation to children with hemiplegia secondary to a diagnosis of CP or adults with hemiplegia secondary to stroke. A purposeful selection approach was used to achieve a heterogeneous sample of therapists who represented a broad spectrum of experiences and contexts in providing therapy to individuals with hemiplegia. Participants were recruited through managers and supervisors in different clinical settings (both public and private) via an email providing a brief description of the study. All participants provided informed consent. Ethical approval for this study was obtained from the local university ethical review boards (REB #: H12-00220).

Data Collection

The 2 focus groups that were conducted at separate therapy facilities within the Lower Mainland of Vancouver, BC

comprised (1) participants representing two publically funded child development and rehabilitation centres, and (2) a private clinic that provides outpatient therapy to both adults and children with neurological conditions.

Each focus group of between 4-6 participants lasted 90 minutes. Participants completed a questionnaire to provide demographic and clinical practice information. The focus groups were facilitated by the author Sandy K Tatla (ST), an occupational therapist with group facilitation and neurorehabilitation experience. The facilitator's assumptions entering the focus group sessions were shaped by her experiences providing rehabilitation to clients and her interest in understanding factors that influence technology use in clinical practice. A research assistant generated field notes to offer an additional perspective of the focus group findings and to provide a nuanced context of each group, thereby providing insight about the behaviour of participants and their relationships and interactions with each other. During the introduction, the facilitator reiterated the purpose of the study and encouraged an open climate for all participants to express their opinions freely.

The discussion was based on a semi-structured focus group guide, which included a selection of open-ended questions developed in conjunction with a team of experts with experience using focus group methodology. The interview questions were pilot tested with five physical and occupational therapists and refined to ensure clarity (Textbox 1). The focus groups were audio-recorded and transcribed verbatim. The primary author (ST) reviewed all transcriptions to confirm the content and to identify any discrepancies in interpretation.

Data Analysis

An inductive process of thematic analysis was used to analyze the focus group transcripts. This process offered a flexible and useful research tool to provide a rich and detailed account of the data and also permitted unanticipated insights to be generated [22].

Though flexibility is a key advantage of thematic analysis, a structured coding approach promotes consistency amongst individuals conducting the data analysis [22,23]. First, each individual familiarized themselves with the data by reading and re-reading each transcript and recording initial ideas (ST, NVB, KL, KM). Next, initial codes were generated by each individual to organize the data in a systematic way across the entire data set. Following initial coding, emerging themes were identified and data relevant to each potential theme were collated. Themes were then reviewed in pairs (ST and NVB; KL and KM) to determine if the themes related to the coded extracts and the entire data set, and the thematic map of the analysis were produced with consensus. Both pairs of "coders" met as a group, led by a researcher with expertise in qualitative research (LH), to refine the specifics of each theme. Finally, the primary author and focus group facilitator (ST) met with each participant to verify the accuracy and completeness of the themes. One participant was unavailable for member checking because of scheduling conflicts. The remaining nine attendees reported that the themes accurately represented the depth of discussion and cross section of opinions.

Textbox 1. Focus group questions

Questions

- Please tell us about the typical upper extremity home exercises that you prescribe for patients.
 - Probes:
 - Desired range of motion, repetitions, frequency, duration.
 - Is equipment required?
 - Do your clients usually need someone to assist them with the exercise?

- Please tell us about the types of splints and other devices that your clients use to enable them to complete their upper extremity home exercises.
 - Probes:
 - Is equipment required?
 - Do your clients need someone to assist them with their exercises?
 - Weight, length, restrictions, for which activities, for what duration?

- To your knowledge, do your clients use social media, computerized programs or games at home?
 - If so, what types do they use?
 - Devices: iPads, desktops, iPhones, etc.
 - Systems: Wii, Kinect, etc.
 - Social media portals: Facebook, Twitter, Linked-in, Google Plus, Skype, YouTube,
 - Games: Super Mario, Wii fit, Angry Birds, Sudoku, Dance dance revolution, multiplayer games, Farmville etc.

 - How do they use them?
 - How frequently do they use them?
 - What kind of assistance would they require?
 - What are the barriers for your clients to using these tools?

- Tell us your thoughts about using social media to help motivate patients to practice their home exercise programs.
 - Probes:
 - Could it be beneficial? If so, why? If not, why not?
 - What might some of the obstacles / challenges be?
 - What features of social media would be important for the research team to incorporate in the design of a rehabilitation tool or the creation of a new tool?
 - What features of social media would be important for the research team to avoid in the design of a rehabilitation tool?
 - Anything else you wish to add?

- Tell us your thoughts about using games to help motivate patients to practice their home exercise programs.
 - Probes:
 - Could it be beneficial? If so, why? If not, why not?
 - What might some of the obstacles / challenges be?
 - What features of gaming would be important for the research team to incorporate in the design?
 - What features of gaming would be important for the research team to avoid in the design?
 - Anything else you wish to add?

- Tell us your thoughts about using robotics to help motivate patients to practice their home exercise programs.

- Probes:
 - Could it be beneficial? If so, why?; If not, why not?
 - What might some of the obstacles / challenges be?
 - What features of robotics would be important for the research team to incorporate in the design?
 - What features of robotics would be important for the research team to avoid incorporating into the design?
 - Anything else you wish to add?

Results

Summary

Ten occupational and physical therapists drawn from three multidisciplinary rehabilitation centres participated in one of two focus groups. The sample contained 4 occupational

therapists and 6 physiotherapists between the ages of 25-65, with a range of 3-25 years of experience providing therapy (Table 1). Participants in each focus group were employed in various contexts, including the school system, in-patient hospital settings, and community-based settings (either in a clinic or at clients' homes). Based on Canadian statistics, our sample was representative of the clinician population [24].

Table 1. Demographic characteristics of participants (N=10).

Characteristics	n (%)
Gender	
Males	2 (20%)
Females	8 (80%)
Age (years)	
20-34	5 (50%)
35-49	4 (40%)
50-64	1 (10%)
Profession	
Occupational therapist	4 (40%)
Physiotherapist	6 (60%)
Primary practice area	
Neurorehabilitation (general)	5 (50%)
Neurorehabilitation (pediatric)	4 (40%)
Orthopedic rehabilitation	1 (10%)
Experience (years)	
<5	4 (40%)
6-9	1 (10%)
10-14	2 (20%)
15-19	1 (10%)
20-24	0 (0%)
>25	2 (20%)

Nine key themes associated with therapists' perceptions of how clients use technology in daily life and rehabilitation were identified (Textbox 2). These nine themes were qualitatively clustered into the following three groups (1) use of social media and gaming technologies in daily life and rehabilitation of persons with hemiplegia, (2) the barriers to the application of

the these technologies for rehabilitation, and (3) the potential benefits and the desirable features of video gaming and social media platforms for rehabilitation. Thematic analysis of the focus group findings demonstrated the presence of recurrent concepts and ideas, which was verified by all coders, indicating that data saturation was achieved with our sample.

Textbox 2. Identified themes and sub-themes

Themes and sub-themes

- Use of social media and gaming technologies in daily life and rehabilitation of persons with hemiplegia
 - Limited use of video gaming and social media in therapy
 - Clients vary in their use of gaming and social media in their personal lives
- The barriers to implementing social media and video gaming for therapy
 - Age appropriateness of social media use
 - Privacy concerns related to social media use
 - Transfer of training
 - Lack of accessibility of gaming systems to meet clients' needs
 - Reconciling therapist role within the gaming context
- Potential Benefits and Desirable Features
 - Social-Emotional Features
 - Rehabilitation Features
 - Usability Features

Use of Social Media and Gaming Technologies in Daily Life and Rehabilitation of Persons With Hemiplegia

Limited Use of Video Gaming and Social Media in Therapy

Clinicians shared that they used video gaming to target lower but not upper limb training because their clients become frustrated with trying to use their impaired hand.

I almost never use gaming for the upper extremity. I almost exclusively use the Wii balance board, and very rarely. I get them to use just [their lower extremity], because usually if they are that affected, it's quite frustrating to try to use the controller with the upper extremity. [P8, Group 2]

Clinicians working with children reported that the integration of motivating activities was not specific to video gaming or other technology, but rather was an inherent part of how they deliver therapy. Therefore, video gaming was one of many different ways of motivating clients for therapy.

You can make up a game with zero equipment, you can use whatever families have in the house, too. So, really, tailoring it to what is of interest to the child and getting them involved. [P2, Group 1]

However, the therapists also shared that tablets were used specifically for their motivating features during therapy.

the one thing that got the child to use their severely neglected arm to do anything was a little assist under his hand from his mom while he pushed the animals on the iPad, and I was like dancing and singing and had lots of fun toys, but the iPad was what got him to move his arm. [P4, Group 1]

Clients Vary in Their Use of Gaming and Social Media in their Personal Lives

Overall, therapists said the types of video gaming and social media platforms that were used by their clients varied based on clients' interests, values, and resources. For example, therapists perceived that some pediatric clients value and choose to purchase tablets. "Many of the parents have decided the iPad is really important and they've invested in it." [P2, Group 1]. The user-friendly interface, interactive games, and educational applications on tablets were perceived as appropriate for children. Computers and tablets for personal gaming and communication were also important for some adult clients.

I've had a few younger stroke clients in their 40s and 50s, and the number one thing they mention to me is "I want to be able to use my computer. I want to play solitaire and I need to update my Facebook so my friends know what's happening to me. [P6, Group 2]

However, therapists found that some clients had no interest in using any of these forms of technology. "...the majority of my clients are adults and I'd say none of them use technology." [P9, Group 2]

The Barriers to Implementing Social Media and Video Gaming for Therapy

Age Appropriateness of Social Media Use

The therapists revealed concerns about the age appropriateness of social media, a factor that prevented them from using video gaming on social media sites with their clients. "One of the things that really came to mind for me was the age and I think that we really need to be considering that kids under 13 are not allowed on Facebook." [P4, Group 1] Another participant shared her perception that her adult clients prefer to use email and view social media sites as inappropriate for their age-group.

They're sitting in front of their computer emailing everybody, but they're not using Facebook. I know a lot of them consider it to be a child's thing. Like a lot of them have this thing where, that's what my kids do. That's not what I do. [P7, Group 2]

Privacy Concerns Related to Social Media Use

Therapists considered their role in protecting clients' confidentiality and questioned using social media as part of rehabilitation because of concerns about privacy and security protection. "...if we are talking to the patient as a therapist... how much control do we have as therapists about who gets their information and how it is shared because there is always that issue of confidentiality." [P3, Group 2] For younger clients, therapists considered the challenges of resolving parents' concerns with the children's needs for autonomy.

If parents and therapists are deciding what games to choose for a particular child, how do you manage what's available with what the children can access? Parents want to know how much control they can exert and if they will be able to 'protect' their child from what they don't want them involved in...and yet the autonomy and access for those older kids is going to be a big piece of the motivation for them... [P4, Group 1]

Transfer of Training

Therapists in this study also questioned how to achieve a balance between video gaming and other forms of therapy and how video gaming fits within traditional forms of therapy.

If, as a therapist, you are focused on the social media, and playing games, you're going to start moving away from true participation in therapy. A movement game where clients are sitting in front of the screen isn't the same as going outside and moving their bodies. [P2, Group 1]

Lack of Accessibility of Gaming Systems to Meet Clients' Needs

Therapists perceived a gap in the gaming market for individuals who have physical and cognitive limitations and saw challenges with implementing gaming in therapy related to cost, equipment requirements, and set-up. They also felt a lack of tailoring prevailed within the games and gaming interfaces that limited individualization to meet the varying physical, cognitive, social and developmental needs of clients with CP or stroke. "If they have to spend too much time learning the game, I think they'll get frustrated and move on, and a lot of my clients won't be able to do it." [P9, Group 2]. "The trickiness is to find the 'just right' challenge. Each individual is so different, has such different needs so that's, I mean, a huge task." [P4, Group 1]. Some therapists were concerned about overuse injuries and compensatory movements that could create negative effects for clients. "We need to consider how clients can use compensatory strategies to play the games, and that can be harmful for their recovery." [P5, Group 2] Another shared, "One issue that I've run into specifically with some systems is that it doesn't seem to detect the motion of somebody in a wheelchair." [P6, Group

2] Therapists in this study perceived commercial systems were not accessible in meeting the unique needs of their clients.

Reconciling Therapist Role Within the Gaming Context

Therapists also acknowledged that a lack of openness to changing how they delivered therapy could be an impediment to using gaming technologies. A therapist expressed the process she went through to adjust to a less active role when more sophisticated technology was integrated into therapy.

Therapeutically, ten minutes is a long time, like you kind of feel like you need to be doing something as a therapist that feels therapeutic. But for them to do it, I really did see the value of them again learning a strategy and then implementing the strategy and seeing the success of that strategy, which helped me as a therapist to say, okay, slow down, you don't have to be in this front end pace, just let them be. Therapy is happening, even if you are not doing a lot, even though I am sitting and giving them verbal cues, therapy is still happening, and that was a bit of a shift for me as a therapist. We're used to setting up cones, and you know, they might be doing something, but we're moving the cones so we feel as therapists, yes, we are providing therapy, because I, my values are moving the cones... right? [P10, Group 2]

This therapist's experience describes psychological processes associated with behavioral change that therapists may undergo as they adjust to integrating technology and different approaches to their practice.

Potential Benefits and Desirable Features

The Potential of Gaming and Social Media to Promote Opportunities for Social Connection and Increase Motivation for Practice

All therapists' perceived social connection with peers was a key benefit of clients using video gaming embedded in social media. They also felt that the ability of clients to engage in gaming and social media in their own homes would help clients feel safe to interact with their peers in an environment where their disability was not obvious to others.

Having your peers involved is huge... A lot of our kids don't get to participate in normal activities because of their limitations. So this is normal and nobody has to be involved in seeing the adaptations that child may be trying to use, it's just a normal activity. [P1, Group 1]

Another said,

Because they can link up with other people, children, family members and in a way, compete in a non-competitive environment. So they can be involved in a game whether they are getting assistance or not, and the person doesn't have to be anywhere near them and it's not stressful because often for these kids it is stressful when they are in a group together. But here, they can be involved in Farmville, or something, when they couldn't potentially be involved in their local basketball team. [P4, Group 1]

Therapists considered the social networking opportunities for clients as a potentially strong motivator for increased practice and adherence to therapy.

I think the interesting thing about compliance too, people tend to do that if it's more like a social thing, so you know, people will go to a gym if their friend will go with them. So if there was some way to kind of get social, I think they would be more motivated to do it. [P8, Group 2]

Another said, "It would be interesting for those that are interested as a way to connect with other stroke survivors. [P6, Group 2]

Therapists also shared some of their experiences with gaming being a potential motivator for more frequent practice.

I think it works. I think, honestly, I have a kid. I can't get him to stand for like a minute and then I take him in front of a Wii and he will stand for forty-five. You see, it works. It's super humbling sometimes. [P9, Group 2]

They also stated that gaming could help overcome boredom as an additional rehabilitation tool that a therapist could employ.

The more tools you have to try and get someone motivated or participating in their exercise program, is good. It's what we are looking for. [P10, Group 2]

Another said,

I find there are only so many ways I can make grasp/release entertaining, right? Like blocks, eventually it's just grasp and release for a really long time. [P9, Group 2]

Clients' experience and familiarity with social media and gaming were thought to influence their motivation to use these technologies for therapy. "I think if it's something that they're (the clients) using already that it would be a great motivating tool, but if it's something that you're trying to get them into, as well as motivate them to do on top of their exercises, I don't think it would be as effective." [P7, Group 2].

Desirable Features of Gaming Systems for Rehabilitation

A summary of features that the therapists were seeking in gaming systems are described in [Textbox 3](#). Therapists identified the need for future systems to be able to record and report empirical data of clients' progress in a meaningful way. One feature that was repeatedly mentioned was being able to track a client's progress in a meaningful way. "Maybe they can

automate, so as soon as you get off it sends a report." [P7, Group 2] "It's empirical data, basically, without you sitting there and counting." [P8, Group 2]

Therapists were seeking gaming systems that offered a variety of games to appeal to different ages, genders, interests, and physical and cognitive abilities, and they desired gaming that incorporated a variety of movements. For example, games that promoted bimanual activities were considered useful. "Yeah, I like the idea of being able to stabilize with one hand and then do another activity because it's very functional to our daily life." [P4, Group 1] The ability for the system to support grading of task difficulty and allow for success was felt to be important.

there needs to be a level of difficulty that you can make gains but there also has to be success. If you're just failing all of the time, you give up, and it's not fun [P3, Group 1]

Whether it's a game for lower functioning individuals...we're working on just a basic exercise, there need to be maybe six different options within that... [P8, Group 2]

Therapists also reported that sensory feedback would be a useful feature to include in a gaming system. "If there would be a vibration or different textures, that would create increased awareness of the affected limbs." [P4, Group 1] There was consensus that positive feedback is an important feature of gaming systems.

The positive feedback I think is an important piece because you see they're working really hard and they've had a lot of things happen...there are a lot of barriers for them, so to get some negative feedback from a video game is not a necessary thing for our clients right now. It really needs to be positive. [P5, Group 2]

Finally, therapists wanted a system that is simple to set up for themselves and for their clients and appears typical, rather than specific to the rehabilitation setting. "Nothing too complicated, but very simple to use, very simple instructions." [P8, Group 2]. "If you could make it as mainstream as possible." [P2, Group 1] Another therapist noted,

Frustration is often a really big part of their lives, so if the interface and tools are seamless, I think it will be great. But if those are barriers, that can increase the frustration that they already experience regularly. [P4, Group 1]

Textbox 3. Desirable features of gaming systems

Desirable features

- Socio-emotional
 - Ability to play with peers without disabilities
 - “I think this plays in with the social media, but I think peers and having your peers involved is huge.” [P2]
 - Feedback & encouragement
 - “The positive feedback I think is an important piece because you see they’re working really hard and they’ve had a lot of things happen...there are a lot of barriers for them, so to get some negative feedback from a video game is not a necessary thing for our clients right now. It really needs to be positive.” [P5]
 - Variety of games that are developmentally appropriate
 - “...have different sizes of pictures and fonts to make it adaptable.” [P3] ”have like, one-liner instructions rather than long instructions so that it’s very specific.” [P7]
 - Games that appeal to different ages, genders, interests
 - “You need to have a variety of games to match people’s ages and leisure interests. So, offering golf for an older individual and maybe a little bubble flower game for a younger child.” [P5]
- Rehabilitation
 - Capacity to reinforce therapeutic goals
 - “There needs to be a level of difficulty that you can make gains but there also has to be success. If you’re just failing all of the time, you give up, and it’s not fun.” [P3]
 - Capacity to grade movements
 - “Whether it’s a game for lower functioning individuals...we’re working on just a basic exercise, there need to be maybe six different options within that...” [P8]
 - Capacity to target bimanual movements
 - “Yeah, I like the idea of being able to stabilize with one hand and then do another activity because it’s very functional to our daily life.” [P4]
 - System that can overcome compensatory movements
 - “Using sensors or vibration or something to help give feedback when a client is compensating would be helpful.” [P5]
 - Meaningful assessment to track progress
 - “Maybe they can automate, so as soon as you get off it sends a report.”[P7] “It’s empirical data, basically, without you sitting there and counting.” [P8]
- Usability
 - Easy to set up and learn to play
 - “So, just having something that’s very easy to set up. As a therapist, I don’t want to spend more than 10 minutes of my one hour with the client teaching them how to play the game before they even get to play.” [P6]
 - Simple, light, attractive
 - “Nothing too complicated, but very simple to use, very simple instructions.” [P1]
 - “Not too heavy.” [P4]
 - Sensory feedback (vibration, texture)
 - “If there would be a vibration or different textures that would create increased awareness of the affected limbs.” [P4]
 - Mainstream games
 - “If you could make it as mainstream as possible.” [P2]

Discussion

Principal Findings

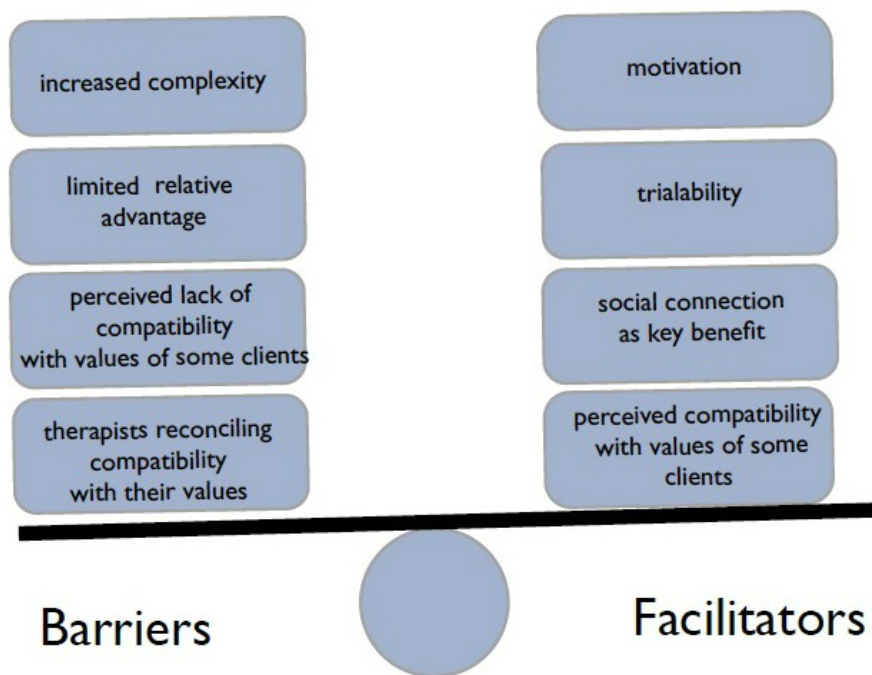
Overview

These data highlight the importance of understanding therapists' perceptions of gaming and social media use by therapy clients. Therapists are key stakeholders who determine the appropriateness of interventions, designing and implementing rehabilitation programs by combining their clinical reasoning with the needs and preferences of their clients. Through this process, they tailor interventions to meet the unique needs of each client, modify the challenge and difficulty as the client's abilities change, and respond flexibly to the client's learning and performance needs [2]. Their acceptance or resistance to gaming and social media for rehabilitation can potentially influence the type of care their clients receive and the outcomes from their rehabilitation. These findings indicate the

complexities of implementing new technologies in therapy. Despite reporting several challenges with social media and gaming adoption, therapists were open to helping shape the development of interactive gaming systems.

The diffusion of innovations model describes five characteristics that most influence the rate of adoption of an innovation [21,25]. The characteristics are (1) relative advantage: the degree to which an innovation is perceived as better than the ideas before it, (2) compatibility: the degree to which an innovation is perceived as being consistent with existing values, experiences, and current needs, (3) complexity: the perception of an innovation as difficult to understand and use, (4) trialability: the degree to which an innovation can be modified and experimented with, and (5) observability: the degree to which the results of the innovation are observable. Figure 1 presents a diagram applying the diffusion of innovation theory to the focus group themes related to therapists' adoption of social media and gaming (the innovation) in clinical practice.

Figure 1. This figure presents a diagram applying diffusion of innovation theory to the focus group themes related to therapists' adoption of social media and gaming (the innovation) in clinical practice.



Complexity

Findings from this study suggest that the therapists perceived video gaming and social media systems as complex for their clients and themselves. Complexity barriers included the complexity surrounding client privacy and security issues, maintaining patient confidentiality, and particularly for children, balancing parental needs and comfort levels related to game selection and social media platforms with a child's sense of autonomy. Importantly, therapists also reported that they perceived that commercial gaming systems presently lack accessibility features to meet the complex and variable needs of clients with hemiplegia.

Relative Advantage

Therapists in the focus groups weighed the relative advantage of video gaming and social media use to enhance adherence to exercise programs against traditional therapy programming. For example, therapists in these focus groups perceived that the majority of their adult patients engage in limited use of social media and online gaming; instead, most are using email in their daily lives. Moreover, therapists perceived that children under 13 years old do not use social media, and that privacy issues act as a barrier to its use. Some clinicians considered how to balance therapeutic gaming with other forms of therapy, as they thought that movements produced while gaming are not as effective at improving functional abilities as clients engaging in physical activities outdoors.

All clinicians acknowledged social connectivity as an important potential advantage of social media use, particularly when combined with gaming. They felt that gaming and social media allowed clients to engage with peers in an environment where their impairments are not obvious to others. Some therapists considered social interaction with gaming as a potentially motivating feature that could promote practice and adherence for upper limb therapy.

When conceptualizing video gaming as a therapeutic tool, these findings indicate the need for the benefits to both the clients and the therapists to be clear. Potential gaming and social media benefits to clients can include enhanced socializing with peers, real time feedback, and increased intrinsic motivation [9]. Therapists can also benefit from automated practice of repetitive movements, programmable levels of assistive or resistive training to meet a variety of patient needs, and objective evaluation of the clients motor abilities (including speed, strength, and range of motion) [15]. Although the therapists in this study acknowledged some of these benefits (ie, social connection and intrinsic motivation), other potential benefits of these tools were not identified; rather, therapists reported these characteristics as features they would like to see in future systems. These findings indicate the need to increase therapists' awareness of current video gaming and social media technologies, and the evidence the feasibility and effectiveness of these specific applications, so that they can make well-informed decisions when considering whether or not to adopt different technologies with their clients. Nonetheless, it is important to recognize that the body of evidence in this area does not clearly identify the superiority of video gaming over conventional therapy [26]. A recent systematic review found video gaming therapies to be associated with small but tangible benefits compared to conventional control therapies in adults post stroke [9]. However, this review found studies to date to be generally weak in quality, with the direction and magnitude of these effects dependent on the etiology of the impairment, and functions targeted by therapies (eg, balance versus upper extremity abilities) [26].

Compatibility

Therapists appeared to be questioning the compatibility of social media and gaming with the values, past experiences, and needs of their clients and themselves. While recognizing that some clients value specific types of technology, such as iPads, personal computers, and the Wii, therapists perceived that others engage little in technology use. They reported that technology as part of therapy can be a great motivational tool if clients and families already use it in their daily lives.

Therapists identified their role in selecting and adapting games and activities as key to meeting the unique physical, cognitive and socio-emotional needs of each client and supporting the rehabilitation process. They described the inherent clinical reasoning involved in tailoring activities to meet the needs and interests of each client (eg, moving cones), and that they were reconciling how these values fit within delivering interventions using gaming systems. Participants appeared to have concerns about the potential for videogames being used in place of a therapist, rather than as a tool during therapy sessions.

Trialability and Observability

The therapists in our study did not perceive that current gaming systems allow them to easily observe and track client progress during gaming-based interventions and were seeking systems that allow them to assess changes in their clients' abilities. In addition, the therapists seemed to have limited awareness of how social media and gaming can be used in rehabilitation. Some therapists questioned whether gaming therapy could translate to observable functional improvements in a client's daily life.

Implications

This study explored therapists' perceptions of social media and video game technology in the daily life and rehabilitation of their clients. This study is part of a larger programme of research, Functional Engagement in Assisted Therapy through Exercise Robotics: Intrinsic Motivation Factors (FEATHERS), that is using an integrated knowledge translation approach to develop and to implement an interactive gaming system for upper extremity rehabilitation of hemiplegia in children with CP and in adults secondary to stroke [27]. Thus, these data have important implication for our group (and others) in the development of video games and social media as an assistive technology. For example, a strong potential benefit of games and social media in rehabilitation is the possibility for increased socialization and information transfer between clients and therapists, which is a major component of the FEATHERS project. Clients will have the choice to share their scores and progress with their peers in their own social networks.

Clearly, concerns related to privacy when using social media were raised and need to be addressed when using these systems. Institutional policies that optimize health care delivery for patients are needed to provide guidance in this area [19]. Therapists also expressed interest in the capacity of gaming systems to track client performance as well as ways to detect compensatory and/or cheating motions during therapy. The findings from this study and others [28,29] suggest the benefits of designing interactive gaming systems using a collaborative team-based approach from the outset and consisting of experts that intersect a number of disciplines, including engineers, software and gaming developers, occupational and physical therapists, other rehabilitation professionals, and patients can lead to the development of well designed systems that meet the needs of this client population. While capacity to build features on to motion controlled gaming systems after the fact (eg, add-ons to the Kinect, PS Move, or Wii) is available, clearly identifying this functionality as desirable might allow therapists and other clinicians to start a dialogue with designers to build the functionality into the system (rather than to add on to the system ad hoc).

Understanding and addressing what therapists and clients perceive as barriers to therapy increases the likelihood of adopting the technology and increases the likelihood of continued use. Strategies for promoting clinicians' adoption of technologies to clinical practice include maximizing desirable features and minimizing barriers to use in the design phase, continuing education and professional development once the technology is released, and mentorship from a clinical opinion

leader [30]. In addition, straightforward and easy-to-follow research syntheses or clinical synopses can be developed [31]. Finally, strategies to monitor clinicians' use of gaming technology are necessary to determine how and the extent to which knowledge has diffused amongst clinicians, and can be used to determine whether or not further knowledge translation is required [32]. Overall, provider acceptance may be more favourable when a balanced use of varied strategies that target work processes, individual knowledge and skills, and formal roles and responsibilities are provided to support implementation [33].

Limitations

The transferability of these findings is limited by the relatively small sample of participants drawn from rehabilitation settings in BC, Canada. As participants generally worked in urban centres, viewpoints of therapists working in remote or rural areas of the province were not captured. Furthermore, the transferability of findings to individual therapists over 49 years may also be limited by the presence of a single therapist in our sample representing this age range. Nevertheless, recurrent concepts, ideas and themes were found in our groups, indicating that data saturation was achieved with the sample included in our study. Future qualitative studies with a larger sample of therapists representing more diverse age ranges and geographical locations can build upon these initial findings. A strength of this study was that participants included both occupational and physical therapists providing therapy to individuals with hemiplegia across different age groups and in diverse contexts, ranging from hospital, clinic, community and school settings. This study has provided some preliminary information regarding the experiences of clinicians providing rehabilitation to adults and/or children with hemiplegia, demonstrating common themes amongst both client groups. Future qualitative studies can build

upon these findings to explore the experiences of therapists working with each client group independently to identify if further considerations for each group are needed.

Conclusions

Promoting access to therapy and adherence to therapeutic exercises at a sufficient intensity to induce neuroplastic changes is a current challenge for health care providers [34]. Novel interventions and approaches to rehabilitation delivery are needed to achieve these dosages and the inherent reward systems within mainstream gaming and opportunities for social connection with social media render these technologies as potentially valuable tools. Preliminary, compelling evidence exists to suggest positive effects of video gaming on function compared to conventional therapy control groups [3,35-37]. Indeed, a number of studies have explored the application of video gaming technology to promote rehabilitation outcomes [4,9,28,35,38]. Early studies on commercial gaming are suggesting benefits, but more, larger randomized clinical trials RCTs are needed before the clinical efficacy of commercial gaming interventions is understood.

When considering the adoption of innovations, the diffusion of innovations theory highlights the importance of features, such as the complexity, relative advantage, compatibility, trialability and observability of the innovation. The FEATHERS project is using an integrated knowledge translation approach to develop a novel social media and gaming platform for upper limb rehabilitation. Through an iterative and collaborative design process, this qualitative study identifies therapists' concerns, allowing us to address perceived barriers within the system design. Furthermore, the implementation of ongoing knowledge translation strategies can optimize and support the adoption of this technology into clinical practice by more readily meeting the needs of clinicians.

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Conflicts of Interest

None declared.

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Abbreviations

CP: cerebral palsy

FEATHERS: Functional Engagement in Assisted Therapy Through Exercise Robotics

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Viewpoint

Digital Games for Type 1 and Type 2 Diabetes: Underpinning Theory With Three Illustrative Examples

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Abstract

Digital games are an important class of eHealth interventions in diabetes, made possible by the Internet and a good range of affordable mobile devices (eg, mobile phones and tablets) available to consumers these days. Gamifying disease management can help children, adolescents, and adults with diabetes to better cope with their lifelong condition. Gamification and social in-game components are used to motivate players/patients and positively change their behavior and lifestyle. In this paper, we start by presenting the main challenges facing people with diabetes—children/adolescents and adults—from a clinical perspective, followed by three short illustrative examples of mobile and desktop game apps and platforms designed by Ayogo Health, Inc. (Vancouver, BC, Canada) for type 1 diabetes (one example) and type 2 diabetes (two examples). The games target different age groups with different needs—children with type 1 diabetes versus adults with type 2 diabetes. The paper is not meant to be an exhaustive review of all digital game offerings available for people with type 1 and type 2 diabetes, but rather to serve as a taster of a few of the game genres on offer today for both types of diabetes, with a brief discussion of (1) some of the underpinning psychological mechanisms of gamified digital interventions and platforms as self-management adherence tools, and more, in diabetes, and (2) some of the hypothesized potential benefits that might be gained from their routine use by people with diabetes. More research evidence from full-scale evaluation studies is needed and expected in the near future that will quantify, qualify, and establish the evidence base concerning this gamification potential, such as what works in each age group/patient type, what does not, and under which settings and criteria.

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KEYWORDS

diabetes mellitus; video games; self-care

Introduction

Challenges of Managing Blood Glucose Control in Children and Adolescents With Type 1 Diabetes

Type 1 diabetes is a chronic condition generally manifested in childhood or the early teenage years. While genetic and environmental factors are involved, the precipitating factors are unknown. Autoimmune destruction of the insulin-producing cells in the pancreas means that daily administration of insulin is necessary. A high degree of self-management and regular monitoring is required to achieve and sustain the level of glycemic control necessary, and to offset visual problems, nerve damage, renal impairment, and other long-term complications [1].

Children with type 1 diabetes have to monitor their blood glucose and diet, administer insulin, and participate in physical activity during school hours, which represent a large portion of a child's waking hours [2]. This situation can feel overwhelming and burdensome, if not stigmatizing, as the child tries to mingle with his or her peers who do not have diabetes.

Adolescence is a time of transition from childhood to adulthood, when physical and psychosocial changes can have an impact on the management of long-term conditions developed in earlier childhood. Deterioration in diabetes control is often experienced in adolescence [3] due to myriad factors, including increased insulin requirements related to growth and other hormonal changes [4]. This deterioration is also due to variable compliance with treatment regimens as the young person gradually becomes more independent of parental involvement and takes ownership of glucose monitoring and insulin administration. This may be compounded by social environments and peer pressure where experimentation with risk-taking behaviors occurs, for instance, around alcohol, illicit drugs, and sexual activity—evidence suggests that adolescents with diabetes may be more vulnerable to conform to peer norms [5]. Furthermore, suboptimal glycemic control may also be a deliberate choice, in particular the desire to avoid hypoglycemia in social settings. Psychosocial difficulties that can surface in adolescence, including depression and low self-esteem, may in addition contribute to poor self-management and indifferent control. Problems with weight gain, especially in girls, can trigger disordered eating and have significant adverse effects on diabetes control, given that insulin omission is an adaption used commonly to enhance weight loss [6].

Thus, there is a greater challenge facing the young person with type 1 diabetes during the adolescent years, highlighting the need to motivate and develop enhanced coping skills to confront the added burden of diabetes compared with their nondiabetic peers. Detection and recognition of these factors is endorsed in the health care professional approach to management of adolescents with type 1 diabetes. Guidelines have been developed on best practice, including educational provision, decision support, and transition to adult services [7,8]. However, education provided by conventional approaches appears to have less effect in promoting self-care in adolescents [9]. As well, while techniques such as motivational interviewing to aid self-management through behavior change may be helpful for

adults, this is less likely to be successful with adolescents who have diabetes [10]. Generating educational opportunities that optimize self-care behavior through problem solving and target setting have been advocated for this group through the use of modern technology [11]. Communication technologies may increase the frequency of contact between the patient and health care professional, but it remains unclear whether this results in improved outcomes [12].

There is, therefore, a pressing need to find innovative solutions at scale that encourage children and young people with diabetes to continually engage with glucose monitoring and therapy compliance during the transition phase to emerging adulthood. Solutions should assist decision support, be personalized, be responsive to individual needs, and demonstrate acceptability alongside measurable outcomes in increased self-management, quality of life, and crucially, maintenance of good glycemic control.

Challenges in Access to Information and Education to Aid Self-Management of Type 2 Diabetes

Type 2 diabetes constitutes about 90% of diabetes globally. It is a progressive condition related to the body's ineffective use of insulin. Genetics, age, and ethnicity are important risk factors, however, excess body weight and physical inactivity contribute significantly to the development of type 1 diabetes. It is often managed by lifestyle interventions initially, but with a gradual stepwise increase in oral therapies leading to injectable therapy for a large proportion of sufferers in order to achieve an acceptable level of glycemic control. The ultimate goal must be prevention of type 2 diabetes through improved prediction of those at risk and participation in lifestyle and behavior changes that will reduce or delay the onset of type 2 diabetes. However, optimizing quality of life through prevention of diabetes-related long-term complications, such as blindness, renal failure, amputations, and the high level of cardiovascular morbidity related to poor glycemic control, is essential to reduce direct and indirect health care costs associated with diabetes comorbidities [13,14].

Despite the high prevalence of type 2 diabetes, access to information, education, and support can be fragmented across communities. Contact with trained health care professionals can provide for some of these needs, although implementing and sustaining advice from health care professionals can be difficult [15]. We should aspire to reducing people's dependence on health professionals and increasing their sense of control and well-being [16].

In addition, many people with diabetes feel isolated and want to connect with others who can empathize with their experiences. This connection is needed at the time of diagnosis when feeling overwhelmed by the new "label" and the information to be assimilated, or later when struggling with the burden of living with a chronic disease, when new therapies are introduced, or when problems arise. Participation in information exchange through social or peer-to-peer interaction may be an important strategy to aid self-management and thus promote compliance with lifestyle measures and medical interventions that will culminate in the maintenance of good glycemic control.

Devices and apps that combine technology with entertainment and social interaction could prove a significant advance in the acquisition of skills to sustain self-reliance for individuals with type 2 diabetes at varying stages of their condition and to benefit biomedical, psychosocial, and lifestyle measures.

Digital Games for Diabetes

The Internet and mobile health offer tools to enhance self-care through access to education and information and general support for people living with diabetes [17]. There are further benefits to be realized for health care providers through reduction in hospital attendance and admission, travelling times for staff and patients, and time away from family or employment [18]. It is important that digital interventions meet expectations and realize optimal outcomes during use. Human factors research and patient codesign of apps and content are essential to achieve these goals [19].

Digital games are an important class of digital interventions in diabetes, made possible by the Internet and a good range of affordable mobile devices (ie, mobile phones and tablets) available to consumers today. Gamifying disease management can help children, adolescents, and adults with diabetes to better cope with their lifelong disease [20,21]. Gamification and social in-game components can be used to motivate players/patients and positively change their behavior and lifestyle, for example, help them develop the good habit of regular self-measurement of blood glucose [11,22]. Games would offer rewarding experiences in the form of “achievements” that can be shared with other players, progress points, and/or in-game virtual currency rewards—that can be spent to “buy” in-game power-ups—to help achieve all of this.

Moreover, video exergames—games involving physical exercise and burning calories, for example, those played using Kinect [23] or the global positioning system (GPS) functionality of mobile phones [24]—can help obese patients with type 2 diabetes become more active and fit. Games can also be used to educate and train health care professionals about various aspects of diabetes [25]. However, these uses are not the focus of this paper.

In this paper, we provide three short illustrative examples of mobile and desktop game apps and platforms for type 1 diabetes—one example of a game for mobile devices (Monster Manor)—and type 2 diabetes—two examples of games for mobile and desktop platforms (Empower) and for mobile devices and Facebook (HealthSeeker). We provide these examples to support our discussion of the potential of gamification and digital game mechanics as adherence tools in the management of diabetes, and how these mechanics might work, including the underpinning psychological mechanisms for behavior change.

The featured game apps were developed by Ayogo Health, Inc, based in Vancouver, BC, Canada. They target different age groups with different needs (ie, children with type 1 diabetes vs adults with type 2 diabetes). They are each briefly described, and we also provide some highlights of the received users’ feedback. We do not provide a detailed user evaluation of these game examples, as this was not the focus of this paper, although

we do hint in our text at some previous and ongoing evaluation studies involving these games—the results of some of these evaluation studies were still under embargo at the time of writing in September 2014. In all the mentioned evaluation exercises, Ayogo and its partners followed the established ethical procedures and norms when dealing with patients, and parents of children, with diabetes.

It should be noted that this paper is not meant to serve as an exhaustive review of all digital game genres available for type 1 and type 2 diabetes. There are many other digital game offerings for diabetes besides the three illustrative examples below. For example, the Juvenile Diabetes Research Foundation (UK) offers a couple of online, Web browser-based, type 1 diabetes games aimed at children and teenagers [26]. In addition, Boehringer Ingelheim and Eli Lilly & Company have an educational digital game exclusively for type 2 diabetes called Complications Combat—online [27] and for iOS [28].

The Ayogo Model

The Ayogo Model used in designing the game apps presented in this paper is an evidence-based approach to designing games and gamified apps to build self-efficacy—the belief in one’s own ability to manage and demonstrate self-control—among people managing chronic illness and diabetes in particular. This approach blends Design Thinking, evidence from cognitive and behavioral psychology, and video game design.

Design Thinking is a method of rapid, empathic problem solving. It begins with primary user research and observation to uncover insights about the root needs of the player (or patient). For example, players/patients with type 1 diabetes can be expected to provide different insights than players/patients with type 2 diabetes. A Design Thinking process would be expected to unveil different root needs that, in turn, shape different player behavior goals for persons managing type 1 or type 2 diabetes.

The Ayogo Model also incorporates into its solutions an understanding of cognitive biases and related user interaction with Web and mobile technology. For example, the model asserts that designs should seek to reduce choice complexity, leverage defaults for decision making, tap into social/group/herd decision making, and harness loss aversion.

Furthermore, the model looks to video game design for excellent examples of persuasive technology, and applies these techniques to the health challenge of managing diabetes. The resulting designs are most akin to casual mobile video games. The three main elements that social video games, and games in general, share with the Ayogo Model approach to developing health apps are:

1. Narrative. Providing context and reassurance to players with chronic illness, narrative reassures the player that the information they will find in the game/app is relevant to them. Playful and delightful narrative and visual elements can reframe illness as a challenge that can be overcome. Narrative and iconography that provide common cultural references help players/patients recognize that the app is *for them*. The player may write their own goals into the visual narrative of the game.

2. Progression. The game or app breaks difficult health goals into incremental, progressively difficult small steps. Through common game elements such as levels, headers, experience points (XP), collections, and visualization, the player receives feedback and rewards for progressing toward their goal through the app.

3. Social interaction. Based on analysis of games such as HealthSeeker and Empower (both of which are described below), the Ayogo Model found evidence that designs that maximize opportunities to generate “incoming messages” to players will sustain player engagement longer than games that do not. The success of this approach is also seen in the phenomenal success of Facebook and other social media sites. This can be done in games by leveraging the social graph, designing for reciprocal obligations, gifting, and by sending scripted messages of encouragement and empathy toward others. Social features are used to address players’ desires to connect with others facing a shared adversity.

The theoretical underpinnings of the Ayogo Model are further discussed later in this paper, following the presentation of the illustrative examples.

Illustrative Examples of Games That Used the Ayogo Model

Monster Manor (Type 1 Diabetes)

Ayogo created Monster Manor (Figure 1) in collaboration with Sanofi to help families who struggle with the challenge of managing type 1 diabetes [29,30]. Children between ages 6 and 10 with type 1 diabetes are expected to take on increasing responsibility for testing and logging their own blood glucose. By incorporating a casual-play collecting game, Monster Manor

provides a fun and rewarding experience for those children who struggle with this growing responsibility. Testing and logging blood glucose within the game’s built-in tracker generates positive feedback to keep children engaged in this crucial aspect of their self-care. Users were involved in the design of the game. Interviews with parents whose children tested early and successive versions of the app, and who were asked about their and their child’s feelings regarding Monster Manor, were internally gathered and analyzed by Ayogo for the purposes of informing and refining the game’s user experience (UX) and design.

Although it is theoretically easy to cheat in Monster Manor about blood glucose measurements (or even input unrealistic values) to get in-game rewards, it should be stressed that the game has a pretty narrow focus and audience, and is primarily intended to encourage *supervised* children to engage with their logging tools. For a variety of reasons, regulatory and otherwise, Monster Manor is not interpreting the data that children enter in any way. The app developers could certainly have gone another step and built (complex and expensive) integrations with hardware blood glucose meters (cf, Bayer DIDGET working on the Nintendo DS and hard-tying the rewards to actual measurements via a blood glucose meter [31]). However, this would have probably quadrupled the budget for the project and the marginal utility of doing that would not have quadrupled given the app’s goals and narrow audience (ie, kids supervised by their parents). Typically, the software is installed on the parent’s device (eg, iPad) and used there, so ultimately the parent can monitor everything the child does and the values they enter. Having the child work independently on their own handheld device would change the scope quite a bit.

Figure 1. Screenshots of Monster Manor. Children can input their blood glucose measurements using an on-screen numeric pad and earn virtual coins to buy various in-game items that are essential for progression through the game.



Empower (Type 2 Diabetes)

Empower is a gamified digital health platform that helps patients to habituate a doctor-prescribed program of medication

introduction and lifestyle change over 30 to 90 days. It motivates and supports patients as they adopt a new curriculum of doctor-prescribed behaviors specific to their condition. It does this by delivering educational content that connects to real-world

healthy activities. Empower is designed to employ peer-support and reciprocity through social gameplay to motivate action and sustain repeat engagement.

A diabetes-focused iteration of Empower was play-tested over several weeks with results gathered by a third-party market research group (n=27). All players were women aged 35 to 60, who had been diagnosed with diabetes within the last 12 months (most diagnosed within the last 6 months). None of the players had a preexisting social relationship. The full results of the test are covered by a nondisclosure agreement made at the time of writing (September 2014), but the test confirmed that the app was building self-efficacy as players valued peer support from others with diabetes, and social features sustained repeat engagement with educational content.

Adults with type 2 diabetes want to connect with others who can empathize with their experiences. Therefore, in Empower, players/patients can share tips, participate in on-topic discussions, and provide peer-to-peer encouragement. Field testing of Empower with guided, but free, text commenting (1100 comments) resulted in no negative comments posted, no adverse drug events reported, and no posts flagged by users for content moderation.

Empower achieves effectiveness through progressive mastery. Newly diagnosed patients may feel overwhelmed by all the information that comes with diagnosis. Empower provides the most important information to patients in actionable, repeatable, progressive, small steps that build confidence in one's ability to manage one's condition. In-game quizzes give patients feedback on their mastery of the health curriculum.

Game mechanics, such as levels, collections, experience points, user interface (UI), progression, summary charts, among others, help patients visualize how far they have come.

Empower uses narrative—cumulative episodes in a story—to connect the content and game elements with the target audience. The narrative helps patients to recognize themselves in the game and allows them to find meaning in using the app.

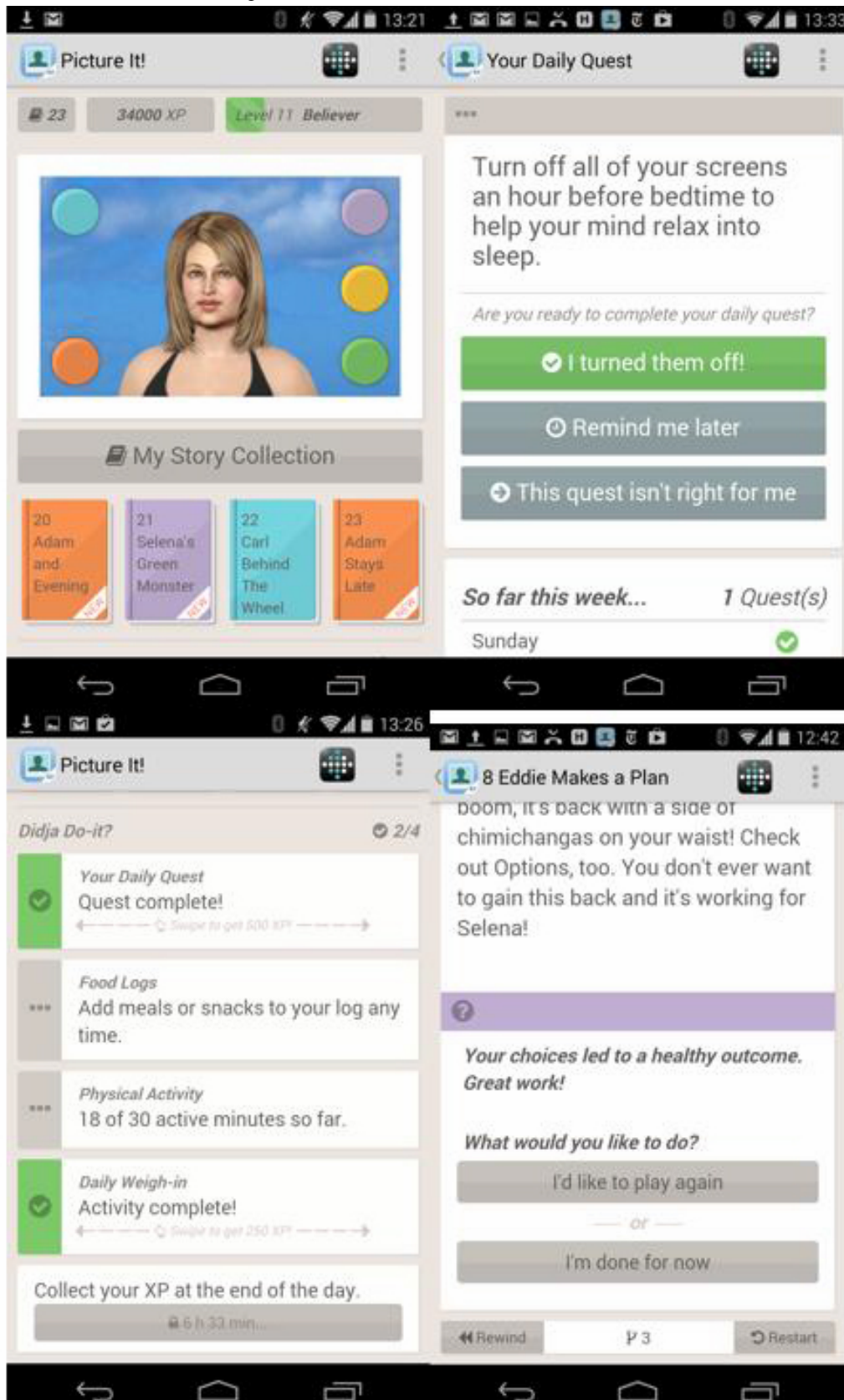
Players enjoyed unlocking narratives that were suspenseful (eg, cliff hangers in a series of related stories), educational (eg, choose your own adventure with players controlling the decision-making path to a positive or negative health outcome), and entertaining (eg, relatable, humorous, or emotionally engaging).

It takes time to change behavior, so Empower is designed to lightly engage players over a period of months. The stickiness of social engagement and the addictiveness of variable rewards are key ways in which Empower may achieve long-term engagement.

Empower is currently being used as a foundation for the following two apps:

1. Type 2 Travelers is a desktop and mobile app developed in collaboration with Merck Sharp and Dohme that is intended to support adults with type 2 diabetes. It is based on the Empower platform and features players' avatars and in-game virtual currency [32].
2. Picture It! (Figure 2) is a mobile version of Empower with biometric integration (fitbit [33]), but without peer-to-peer support, for patients preparing for bariatric surgery through weight loss and new habit formation. It is currently being evaluated in an A/B test by an integrated health care network in California (n=60). Pilot-test results were under embargo at the time of writing (September 2014).

Figure 2. Screenshots of Picture It! with fitbit integration.



HealthSeeker (Type 2 Diabetes)

HealthSeeker [34], released in 2010, was the first-of-its-kind health game on Facebook to help people with diabetes improve their health through lifestyle changes (Figure 3). The game is

also available as an app for Android and iOS devices. HealthSeeker resulted from a collaboration between industry and advocacy partners. Ayogo partnered with the Diabetes Hands Foundation (DHF), who provided creative vision and execution for the project. The Joslin Diabetes Center of the

Harvard Medical School developed and reviewed all medical content. The project was supported by Boehringer Ingelheim Pharmaceuticals, Inc.

HealthSeeker combined a supportive social networking environment with important information on managing diabetes for adults living with diabetes or who are prediabetic. The HealthSeeker game was also localized and translated to Spanish to engage Hispanic players, under the name *Explorando tu Salud Paso a Paso*. Game players chose missions to help them achieve specific lifestyle goals, such as eating healthier, achieving an optimal weight, or lowering blood sugar levels.

HealthSeeker was designed with the Transtheoretical Model [35] in mind. Gamification elements were strategically employed to motivate the player as they pass through Stages of Change. Primary research by the partners determined that a diagnosis of diabetes is often accompanied by a sense of loneliness. This insight prompted a social design. The game drew upon the player's social graph—their network of Facebook friends—to motivate repeat engagement with the technology. People with type 2 diabetes used the game to progress from contemplation of necessary lifestyle changes to preparation and action. The game was structured around small actionable missions developed by clinicians at the Joslin Diabetes Center. All features were social, including the ability to challenge and share the mission with others, share and celebrate by tweeting and posting accomplishments, and player-to-player gifting of virtual kudos for achievements.

The app was promoted to diabetes educators as an innovative patient engagement tool for patients who are enticed by technology and motivated by more timely feedback from other users. A distinct advantage of this technology is the immediate reward of positive feedback for behavior change efforts. Educators may also find that patients are better able to make choices from a variety of examples that are realistic, measurable, and achievable in the short term, which may subsequently lead to longer-term rewards. The use of words like “mission” and “kudos” instead of “behavioral goals” or “objectives” adds a softer, if not clearer, definition of what is expected of the patient. Educators also appreciate that the HealthSeeker examples are easily translated into action steps for people without diabetes as well, making the behavior more realistic to implement [36].

Before the game was retired, nearly 20,000 players had tried HealthSeeker—more than 3700 completed missions and more than 42,000 healthy actions were taken, including 20,500 healthy meals eaten (source: Facebook app statistics). HealthSeeker won several awards and generated over 83 original news stories/blog posts and over 275 million media impressions (source: Ayogo statistics).

The Joslin Diabetes Center did a qualitative evaluation of the game and found players responded positively to the game and were motivated to achieve appropriate blood glucose levels through appropriate diet, increasing exercise, strengthening social support, and reducing stress [36].

Klauser et al [37] looked at social player analytics in HealthSeeker to understand how socially-engaging gameplay behavior influenced player interaction. Their results showed that actively social players solved more missions than players without friends. They concluded that a “well-connected social network can improve a user's success to solve health missions and therefore help to live healthier.” The core engagement metric for HealthSeeker was how many healthy missions were completed. User-centered metrics that were analyzed included:

1. Missions: A mission is a small collection of repeatable health actions that must be accomplished within a set time period. For example, *Over the Rainbow: The Fruits and Veggies Mission*. See Figure 4, part a.
2. Challenges: Peer-to-peer requests to participate in a mission. See Figure 4, part b.
3. Kudos: A virtual gift with encouraging message. See Figure 4, part c.
4. Invitations: See Figure 4, part d.
5. Friends: See Figure 4, part e.
6. Actions: See Figure 4, part f.

The average number of missions players completed within the first 2 months of play was 6. Players who sent at least one challenge from a friend completed twice the average, or 12 missions. Players who received at least one challenge—whether they accepted the challenge or not—completed, on average, 18 missions. Social elements that allowed players to send and receive challenges increased player engagement.

The key insight of “the power of the incoming message” is that design can foster peer comments, “likes,” and encouragements, which are seen in HealthSeeker as effective at stimulating and sustaining intrinsic motivation to build good health habits. This design principle is now applied by Ayogo wherever possible in other health game designs.

HealthSeeker illustrates how various game mechanics can be applied in a complementary and effective way within a single social game, offering feedback through game points, completion status, progress bars, and automated congratulatory messages. Game mechanics can also offer sociability in the form of peer-to-peer challenges and messaging, urgent optimism through immediate challenge, plus perceived high likelihood of success (eg, “You can do this now”). Other feedback mechanisms are progressive mastery (ie, as the player progresses, they “level up” to harder challenges), loss aversion (ie, strive to retain points—failing to complete within time frame halves points), virality (ie, when completed, a pop-up reward appears giving experience points, with option to “Tweet this” or Facebook “share” or “challenge a friend”, all for bonus experience points—see Figure 4, part g), player status based on experience points in game, Achievement Badges (see Figure 4, part h) that can be collected, and reciprocity and repeat engagement encouraged by gifting of Kudos.

Figure 3. Screenshot of HealthSeeker on Facebook.

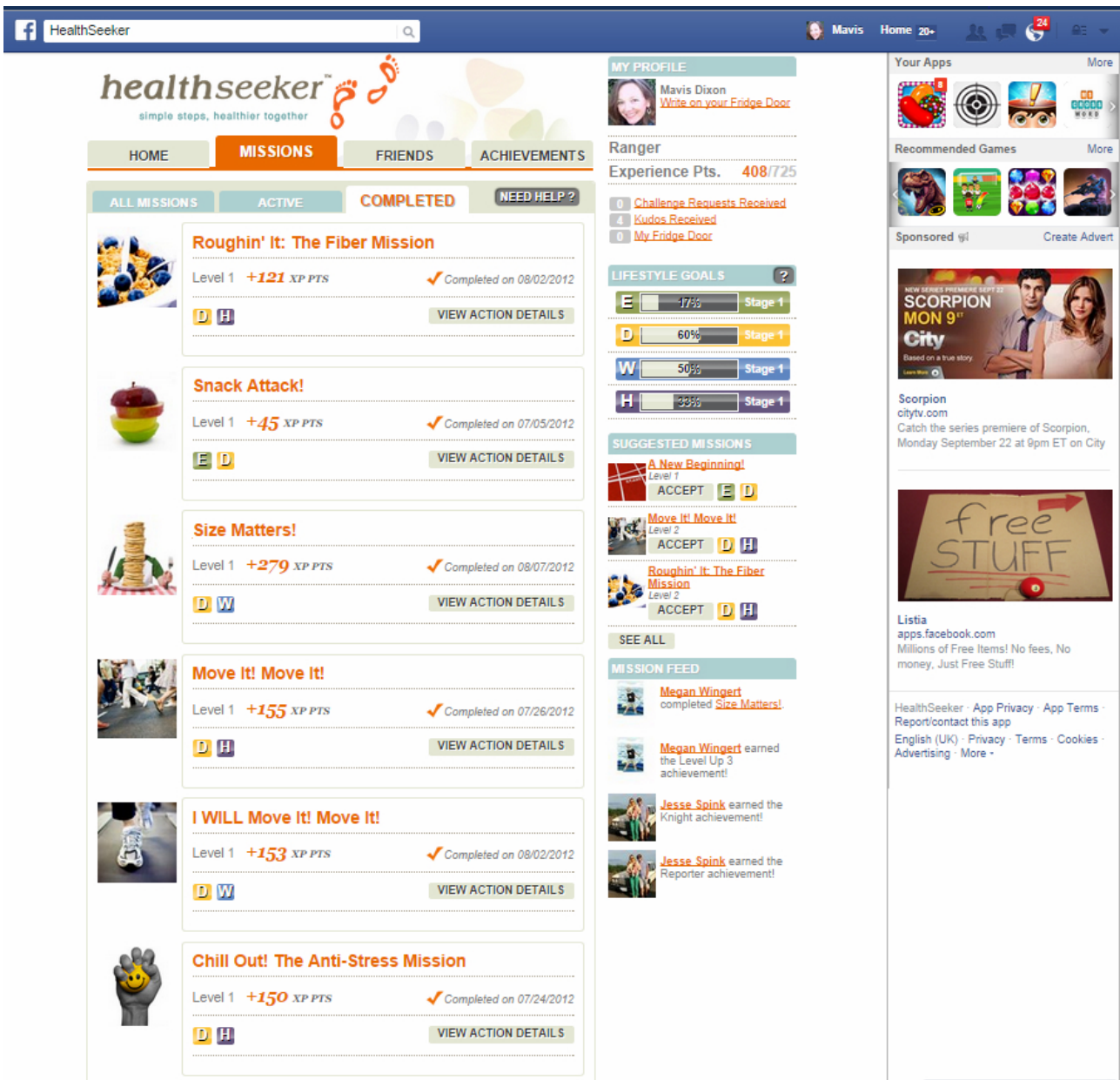
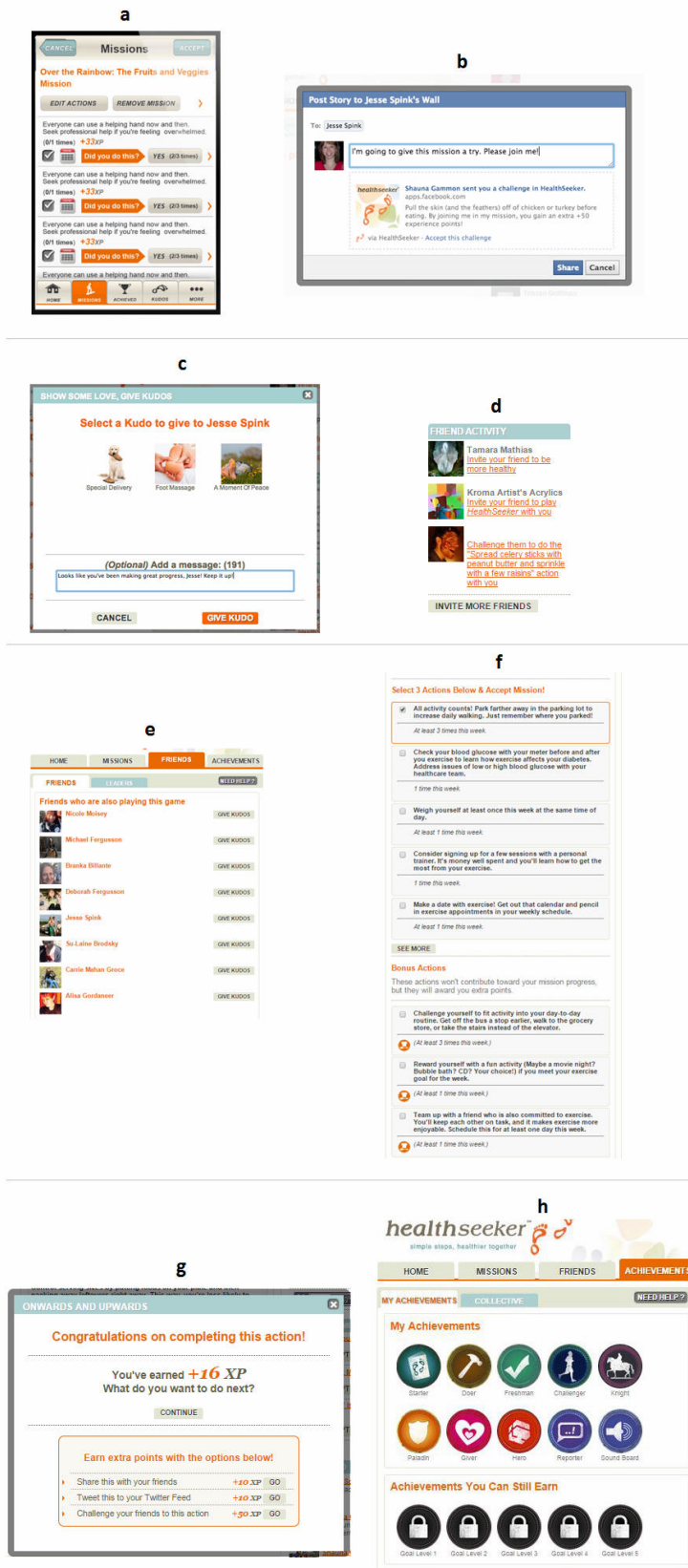


Figure 4. User-centered metrics analyzed in HealthSeeker: (a) Missions, (b) Challenges, (c) Kudos, (d) Invitations, (e) Friends, and (f) Actions. Additional HealthSeeker features are shown in (g) earning XP and social media sharing of players' accomplishments, and (h) Achievement Badges.



Discussion

On Gamification and Its Underpinning Principles

Conceptualizing gamification for healthy behavior change, Hamari et al [38] simplified it into three components: motivational affordances, psychological outcomes, and behavioral outcomes (Figure 5). Motivational affordances include the following game features: points, leaderboards, achievements/badges, levels, stories, goals, feedback, rewards, progress, and challenges. Psychological outcomes include motivation, attitude, and enjoyment, while behavioral outcomes include whatever intended behavior was targeted, such as healthier eating, monitoring blood glucose levels, or exercising for a specific amount of time or intensity [38,39]. Gamification features are not dissimilar to validated behavior change elements, including providing feedback on performance, goal setting (ie, self-efficacy), and comparison with others, to name a few [40].

Self-efficacy is an important concept to understand when building tools that support people with diabetes in managing their disease [41]. In his book on social cognitive theory, Bandura [42] explains that self-efficacy is a prognostic factor for increasing healthy behaviors. Bandura identified four sources at the heart of self-efficacy: (1) one's personal experience of success or failure, (2) vicarious experiences—observing others' success or failure, (3) verbal or social persuasions, such as messages people receive from peers and family members, and (4) physiological and affective states. Improving self-efficacy has been shown to improve health outcomes for adults with type 2 diabetes and obesity, as well as for children and teenagers with type 1 diabetes.

Designs for people with diabetes should, therefore, build self-efficacy by (1) providing a series of progressive, small successes or achievements related to diabetes management, (2) creating vicarious experience through social features that allow peer-to-peer sharing of successes and tips on how to manage

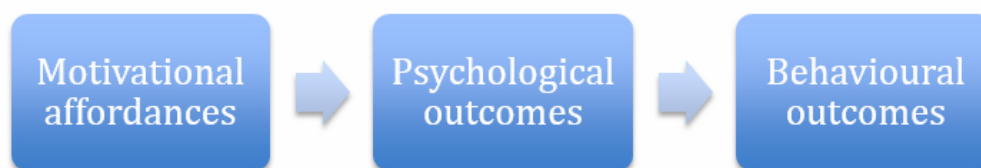
diabetes, (3) maximizing incoming social messages of encouragement, and (4) providing empowering and empathic messages and narratives.

A design approach to health games that is consistent with both Bandura [42] and Krichbaum et al [41], and touches on the above four sources of self-efficacy would be expected to be helpful in diabetes self-management.

The Ayogo Model presented earlier in this paper incorporates an understanding and application of self-efficacy [41,42], cognitive biases [43,44,45,46], persuasive technology (ie, captology [47,48]), and empathy-triggering mechanisms via oxytocin-releasing actions (ie, human oxytocin-mediated empathy [HOME]) [49,50]. HealthSeeker and the other games presented in this paper offer examples of how gamification should and can go beyond Points, Badges, and Leaderboards (PBL) in order to effect the desired health and behavior-changing outcomes [51].

Another important and overlapping concept is self-regulation, or the ability to control our own behavior, which can be described as the process involved in the continuous pursuit of goals and in dealing with different obstacles along the way. Self-regulation is construed as a systematic process that involves conscious efforts to influence thoughts, feelings, and behaviors, in order to achieve a goal in the context of a changing environment or challenging disease condition [52]. Providers of medical assistance to diabetes patients should positively present monitoring (ie, measuring blood glucose) as a *measure of performance* as opposed to a measure of disease (ie, diabetes) [53]. This has implications for the design of games in diabetes. Mainstream video games have long similarly measured and motivated players' performance. To achieve this, the games often have a tracking system and feature some in-game goals. Games can motivate both extrinsically (eg, via use of in-game rewards and recognition) and intrinsically (eg, by nurturing those conditions leading to a sense of autonomy and competence by the player/patient).

Figure 5. Gamification features (adapted from Hamari et al [38]).



Some Concerns and Limitations of the Presented Games

Gamified interventions could have limitations influenced by users' age, culture, clinical state, digital-/health-literacy levels [54], and/or other relevant personal traits. According to Gartner, the vast majority of gamification projects taking place today are lacking in some respect and thus "run the risk of falling into disuse, once their novelty wears off" [55]. The mere application of video game concepts to the health arena must take into consideration all clinical and individual users' aspects of the health issues to be addressed. As well, without researching and applying the pertinent evidence-based psychological knowledge

of behavioral change strategies, the credibility of this class of solutions and users' long-term adherence to them will be put in danger. That is why the authors believe that more evidence, guidelines, and validated models are needed to support the application of gamification to diabetes and other medical conditions, and to ensure its long-term success, wide adoption, and sustainability.

Exercise is highly recommended by diabetes clinicians [56]. Monster Manor (for type 1 diabetes) does not have exercise guidelines. HealthSeeker did have activity-related content. But the difficulty of managing blood glucose before, during, and especially after exercise should be carefully considered in future

game apps of this type, whenever in-app information or guidelines are offered to patients regarding exercise.

The difficulty in managing childhood diabetes occurs largely during school time, which forms a large proportion of the day and is a period during which the child is not supervised by the parent. During the pilot test of Monster Manor, Ayogo discovered that the app was not usable at school for most children in the test population. Future iterations would revise the use case to accept this difficulty—that many children are currently limited to playing the game on their parents' mobile phones outside school time.

Achieving “optimum” diabetes control can lead to a heightened risk of hypoglycemia. Designers of game apps should be mindful of this when attempting to influence a patient's self-management, to avoid iatrogenic (ie, app-induced) hypoglycemia, although this has not been reported so far with any of the presented games. The team of designers should always include in its membership qualified diabetologists to clinically inform and guide the development of these games, which is the approach already adopted by Ayogo.

Conclusions

This paper provided a brief taster of some of the games on offer for people with type 1 and type 2 diabetes belonging to different age groups. This paper was not meant to serve as an exhaustive survey of all available digital games for diabetes from different providers, nor as a formal summative evaluation of this range of games (or of any individual game example). However, we believe our paper has provided enough “food for thought” to appreciate the main challenges facing people with diabetes—children and adults—in coping with their lifelong condition. We have highlighted and showcased some of the potential benefits to be gained from deploying gamified digital interventions and platforms as adherence tools, and more, in diabetes. Further research evidence from full-scale summative evaluation studies of existing games is needed, and indeed expected in the near future, that will quantify, qualify, and establish the evidence base concerning this gamification potential and how to best harness it, such as what works in each age group/patient type, what does not, and under which settings and criteria. Frameworks such as the one described in Graafland et al [57] will prove helpful in gathering this evidence in a consistent way.

Authors' Contributions

MNKB conceived, planned, and drafted the manuscript with insights and text/figure contributions from SG, MCD, and MJF (Ayogo game examples and gamification/game mechanics), SMM (clinical diabetes), and FMR, TMB, and SPY (psychology of gamification and behavior change).

Conflicts of Interest

SG, MCD, and MJF are employees of Ayogo Health, Inc, and the three games/platforms described in this paper were developed in collaboration with pharmaceutical companies (named in the paper). However, none of those companies were involved in, or influenced, the conception and writing of this paper.

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Abbreviations

- DHF:** Diabetes Hands Foundation
- GPS:** global positioning system
- HOME:** human oxytocin-mediated empathy
- PBL:** Points, Badges, and Leaderboards
- UI:** user interface
- UX:** user experience
- XP:** experience points

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