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Designing A Consumer Health 2.0 Application To Analyse The Relationship Between On-Line Social Networks And Health-Related Behaviours

Nilmini Wickramasinghe
Epworth HealthCare & RMIT University, nilmini.wickramasinghe@rmit.edu.au

Say Yen Teoh
RMIT University, sayyen.teoh@rmit.edu.au

Carolin Durst
University of Erlangen-Nuremberg, Nuremberg, carolin.durst@fau.de

Janine Viol
University of Erlangen-Nuremberg, Nuremberg, janine.viol@fau.de

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Insights From An Investigation Of The Design Of A Consumer Health 2.0 Application To Address The Relationship Between On-Line Social Networks And Health-Related Behaviours

Wickramasinghe, N. Epworth HealthCare & RMIT University, Melbourne, AUSTRALIA
nilmini.wickramasinghe@rmit.edu.au
Teoh, Say-Yen, RMIT University, Melbourne, AUSTRALIA
sayyen.teoh@rmit.edu.au
Durst, Carolin, University of Erlangen-Nuremberg, Nuremberg, Germany
carolin.durst@fau.de
Viol, Janine, University of Erlangen-Nuremberg, Nuremberg, Germany
janine.viol@fau.de

Abstract

The rapidly increasing prevalence of obesity is a phenomenon often referred to as the "obesity epidemic". Literature suggests social networks to be one of the most important dimension of people's social environment that may enable or constrain the adoption of health-promoting behaviors. Given that online social networks are becoming more important in people's daily lives, this research in progress incorporated a design science research methodology for designing a Health 2.0 Facebook application to investigate the relationship of online social networks and health-related behaviors in the context of obesity. Specifically, the application enables medical and healthcare practitioners to (1) understand the effect of obesity propagation in online social networks; (2) identify potential online intervention strategies to disseminate health-related information to the right group of people and (3) to offer services fostering positive health-related behaviours or to promote behaviour change advice.

Keywords

Online Social Networks, Health 2.0 Application, Design Science Methodology, Obesity.

INTRODUCTION

One of the serious concerns in healthcare in this 21st century is obesity. Today, there exist more than one billion overweight adults out of which at least 300 million are medically obese (WHO, 2011b). Not only is obesity itself problematic but it also leads to various secondary disorders such as diabetes, heart diseases and cancer (WHO, 2011b), which in turn add burdens to already challenged healthcare delivery systems, most especially in terms of costs caused by obesity and the likelihood of recovery (Wickramasinghe, Bali, Goldberg and Troshani, 2012). It is evident that the far reaching impact of obesity affects not only individual health outcomes but also the economy of healthcare delivery for countries. By 2030 costs attributable to obesity are projected to account for 16-18% of total US healthcare costs (Wang et al., 2008).

The causes of obesity are multifaceted and result from a confluence of several factors. Individual medical conditions may determine a person's susceptibility to gain weight but cannot explain the dramatic increase in the number of obese people worldwide (WHO, 2000). Changes in individual behaviours leading to an increased intake of high-caloric foods and a decrease of physical activity are suggested to be a key contributor to the global obesity epidemic (WHO, 2011b). Moreover, social networks have been identified as one of the most important dimensions of people's social environment that may enable or constrain the adoption of many behaviours, including health-promoting behaviours (McNeill et al., 2006).

Previous studies have focused on the spread of obesity within traditional (offline) social networks (Christakis and Fowler, 2007; Fowler and Christakis, 2008). As ideas, behaviours and trends are passed on within people's social environment, a person-to-person spread of obesity within social networks has been suggested (Christakis and Fowler, 2007). Lately, the dramatic growth of electronic (online) social networks has resulted in a blurring of the boundaries between the real and virtual world (BVDW, 2010). Online social networks have become part of many people's everyday life and are – just as "real world contacts" – suggested to influence the diffusion and adoption of health-related behaviours (Ma et al., 2010). Given that online social networks are becoming more important in people's daily lives, this paper designs the Health 2.0 Facebook application Calorie Cruncher, which aims to support the investigation of the relationship between online social networks and health-related behaviour in the context of obesity.

BACKGROUND

Consumer health informatics is arguably one of the most rapidly expanding areas within medical informatics and is playing a key role in paving the way for healthcare delivery in today's 21st century (Eysenbach, 2000). Central to this discipline is the goal to provide consumers the information and support required in order that they can make informed choices and be empowered to take a central role in their own health and wellness regimen (ibid). Moreover, consumer health informatics has been able to develop due to advances in various technologies especially Web 2.0. Web 2.0 technologies are nowadays applied in various areas, such as education, travelling, dating or job seeking (BVDW, 2010). In the context of healthcare, Health 2.0 applications combine health data and health information with (patient) experience through the use of ICT (Bos et al., 2008). Embracing patient-centered health-informatics, Health 2.0 applications may become an effective self-care information and disease self-management tool in the future. Given that consumer health informatics in general and Web 2.0 technologies in particular have the potential to provide consumers with information and support and perhaps even influence health and wellbeing choices, we decided to investigate this more closely by examining the impact of using online social networks to foster healthier lifestyles in the context of obesity.

Social networks consist of a finite set of actors or people and the relationships between them (Wasserman and Faust, 1994). Most commonly, those relationships are categorized into strong and weak ties (Kneidinger, 2010). According to Granovetter (1973) strong ties are intimate bonds between family members or close friends that are maintained regularly and permanently. Tending to be concentrated in particular groups, strong ties are of informal nature and occur between network members with a shared social identity. In contrast, weak ties emerge as non-intimate bonds between acquaintances. Maintained infrequently and inconsistently, weak ties may be formal contacts and are more likely to link members of different small groups (Rostila, 2011). Weak ties tend to generate informational support whereas informal and strong ties are associated with the provision of emotional support (Rostila, 2011).

According to a 32 year longitudinal obesity usually spread in a large offline social network (Christakis and Fowler, 2007). In which, the susceptibility of a person to become obese increases when close members in the social network become obese (Christakis and Fowler, 2007). Thus, the chance of becoming obese is positively correlated with the closeness and strength of the relationship. Though the design and findings of their study have been criticized, e. g. in Cohen-Cole and Fletcher (2008), a number of papers supports their line of argument. Talking about epidemic diseases in social networks, Gershenson (2011) distinguishes between communicable diseases transmitted through e. g. bacteria and viruses, such as influenza and HIV, and non-communicable diseases, e. g. cancer and diabetes, that can – by definition – not be transmitted. However, he acknowledges the diffusion of ideas and behaviours, as well as contagious trends and habits, provides a powerful substitute for physical mechanisms to spread diseases and results in a so-called "social infection". Thus, the risk factors for non-communicable diseases, such as overweight and obesity, can be spread across social networks. In addition, the relationship between social influence, network structures and obesity was also identified as an important factor in obesity (Hammond, 2010).

Online social networks are applications that allow users to build a semi-public or public profile within a bounded system, to create explicit linkages to other users and to communicate by sharing information or sending messages between each other. Organized around people, online social networks are structured as egocentric networks within which the individual is at the centre of their personal network (Kaplan and Haenlein, 2010). Online social networks exhibit a high similarity to offline social relationships, as they offer similar functionalities as unmediated spaces (Arnaboldi, et al., 2011). They display people's (extended) offline social network and are primarily used to maintain and reinforce existing offline relationships (Boyd and Ellison, 2007). Online social networks can be of a general nature or address a special or niche subject. For instance, online health communities allow people to seek information, communicate with others with the same or similar problems, to share health guidance and compare treatment and medication strategies (Hwang et al., 2010). Maloney-Krichmar and Preece (2005) investigated an online health community for two and a half years and found that this community provided emotional support between its members. The accessibility from everywhere at any time, anonymity of the medium as well as the access to greater expertise are regarded as the main benefits of this online health community (Maloney-Krichmar and Preece, 2002). Having studied an online health social network for six months, Ma et al. (2010) found that users' weight changes correlate positively with the number of their friends and their friends' weight-change performance. The study revealed that the online influence and its propagation distance appear to be greater than in real-world social networks (Ma et al., 2010).

Individual behaviours and lifestyle choices shaped by the offline and online social environment are driving - if not significantly impacting - the global obesity epidemic (WHO, 2011b;). Individual behaviours, in particular health-related behaviours such as physical activity, diet, sleep, smoking, alcohol consumption as well as adherence to medical treatments and help-seeking behaviour (Hyyppä, 2010), appear to be of significance in this

context. Hence, investigating the relationship between online social networks and health-related behaviours, including dietary and physical activity patterns, forms the focus of this research.

To better understand this relationship, we ground our study on multiple disciplines including sociology, information systems, network research and social network analysis (Steiny, 2009). Based on evidence of studies focusing on the relationship between offline social networks and health-related behaviours, we propose that online social networks influence an individual's health-related behaviour and subsequently his or her health and thus we design an online-social network application to test this.

This paper focuses on the design of an appropriate Health 2.0 Facebook application in order to collect data on individual health-related behaviours over time in an online social network setting and thereby demonstrate the role for online social networks to influence health-related behaviours (Figure 1). Specifically, we adopted a design science research methodology that incorporates explorative interviews with 14 study participants to assist us in identifying variables that facilitate a better understanding of the relationship between online social networks and health-related behaviours. The results from the interviews were then used to inform the design of the proffered Health 2.0 Facebook application as is appropriate when following a user centred design protocol.
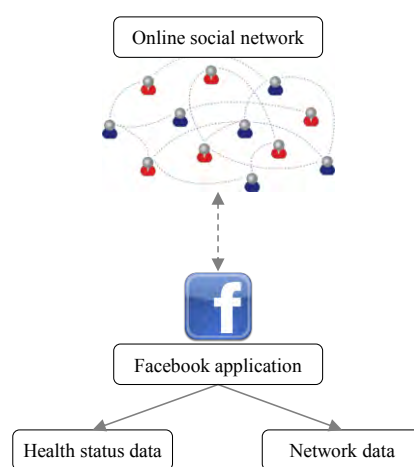

Figure 1: Conceptual Design

DESIGN SCIENCE RESEARCH METHODOLOGY

The design science research methodology (DSRM) process model developed by Peffers et al. (2007) is one of the most influential design science research methodologies for information system research. The model is consistent with the principles and guidelines of design science research established in previous research studies such as Hevner et al. (2004). Table 1 explains the application of the DSRM to the Facebook application Calorie Cruncher developed in this paper.

Table 1. Design science research methodology (DSRM) adopted from Peffers et al. (2007)

DSRM Activities	Activity description	Application in this study
Problem identification and motivation	Identify and describe the importance of the problem	Data collection for the measurement of the influence of Facebook friends on the individual's body weight, design implications for the Health 2.0 Facebook application
Definition of objectives for the application	Define the artefact that accomplishes the objectives	Design of an application that incorporates different features based on different mechanisms that influence health-related behaviours.
Design and development	Identify the requirement for the solution and create the artefact	Design of the Calorie Cruncher Facebook application based on 14 qualitative interviews
Demonstration	Use artefact to solve problem	Proof of concept of the Calorie Cruncher Facebook application
Evaluation	Iterate back to the design of the artefact	Identification of areas to improve the Calorie Cruncher application
Communication	Publish and communicate the results	Conference publication to communicate and discuss the results in order to develop this project further

The step-by-step application of the DSRM in designing the Facebook application Calorie Cruncher is illustrated as follows:

Problem Identification and Motivation

Taking into account the growing importance of online social media and particularly online social networks, the motivation of this study is to address an important gap in literature, that is, to measure the influence of different online relationships on the individual's body weight (Moore, 2010). However, such investigation requires a large dataset containing personal online social network data, as well as information on an individual's health-related behaviours. Thus, we chose to use data from the most popular social network site Facebook by designing a Health 2.0 Facebook application to collect the required data that would lead to higher data reliability and a more efficient data collection process than the use of self-reported survey data (McCarty, 2002; Vitak et al., 2011).

Definition of Objectives for the Application

We designed the application according to the steps of the DSRM. The solution used for the data collection needs to fulfil the following objectives:
1. Provide access to user profiles on Facebook
2. Provide access to the users' network of friends (full personal networks)
3. Provide access to the users' interaction with their Facebook friends
4. Gather data on the users' health status and health-related behaviours

An application in the area of fitness and sports should facilitate the collection of longitudinal data to facilitate a better understanding of people's behaviour over the course of time and thus enable the detection of causal inferences.

Application Design and Development

The design and development requirements of the Facebook application are determined through qualitative interviews to determine the artefact's desired functionality and its architecture. By exploring the influence of people's offline social networks on their health-related behaviours and body weight, the findings of the interviews will inform the design and the development of the application's features. Moreover, the identified factors will be used to refine the presented model as intervening variables, which facilitate a better understanding of the relationship between online social networks and health-related behaviours.

Design Sampling

Using a purposeful sampling approach (Flick, 2009), the interviewees were selected based on the criterion of currently experiencing problems with overweight and obesity or having experienced weight issues in the past. Table 2 gives a short overview of the interviewees. The interviewees were contacted via Facebook and email and received an information sheet including a project description prior to the interview. Each of these interviews lasted between 40 and 70 minutes and was conducted face-to-face or by telephone or Skype call, according to the interviewee's preference.

Table 2. Overview of the interviewees

Interviewee	Age	Sex	Occupation	Marital status	Weight status[1]
1	29	f	Student, journalist	Single	Obese
2	26	f	Dental assistant	Single	Overweight
3	28	f	Dental assistant	Engaged	Overweight
4	26	f	Works in the public sector	In a relationship	Normal
5	26	f	Sales assistant, works free-lance as a educationalist	Single	Overweight
6	21	f	Management assistant in office communication	Single	Obese
7	22	f	Student, waitress	Single	Normal

[1] According to the BMI classification of the WHO (2011a), a person with a BMI of less than 18.5 is considered underweight. A BMI greater than 25 is regarded as overweight and above 30 is regarded as obese.

8	24	m	Hairdresser	Single	Normal
9	24	m	Media designer	Single	Overweight
10	39	m	Real estate agent	Married	Obese
11	23	m	IT Technician	Single	Normal
12	24	m	Student	Single	Overweight
13	39	m	Senior Manager	Married	Obese
14	35	m	Senior Manager	Single	Overweight

All selected interviewees were required to either currently engage in activities to lose weight or to have substantially reduced their body weight in the past. We included people from different stages of the weight loss process in the sampling, since the study participants needed to be aware of their weight issues, as well as be able to reflect on the influence of their real-world social networks in different stages of the previous weight gain and current weight loss process. Being a member of Facebook was a third requirement.

Design Data Collection

The interview guideline included six sections addressing different areas, such as the process of weight gain and weight loss. Data was collected through semi-structured interviews composed of open-ended questions. Dealing with the very delicate and personal topic of obesity, this method provides several advantages (Hopf, 2007): The exploratory interviews left room for spontaneous questions and allowed for in-depth exploration of the relationship between the interviewees' personal traits, social environment and their health-related behaviours. Interacting directly with the interviewee, it was easily possible to control the interview's flow, to avoid misunderstandings, to shift the interview's focus to particularly interesting aspects or to neglect certain areas of interrogation if the interviewee did not seem comfortable with the questions. Open-ended questions were advantageous as the interviewees had to make answers based on their personal experiences (Flick, 2009).

Design Data Analysis

The data coding was supported by the qualitative data analysis software NVivo. Using Mayring's (2000) approach of inductive category building, free nodes with respect to e.g. the interviewees' family and friends environment, reasons for weight gain and motivation to lose weight were created while going through the interview material. Following this process resulted in 154 free nodes at the end of the first stage of coding. An example for a free node coding in *"comparison with others"* is *"My friends do sports, too, and that motivates me to engage in physical activity as well [...]"* (Interviewee 9). Next, some free nodes were deleted or merged to eliminate redundant nodes. Finally, the free nodes were classified into categories along the interview guideline and organized into tree nodes. Table 3 shows a sample of tree node coding for the tree node "social pressure" that belongs to the category of *"keeping up the weight loss motivation"*. Other tree nodes in this category include *"attractive for men/women"*, *"clothes shopping"*, *"better fitness"* and *"set goals"*, for instance.

Concluding the coding procedure, the remaining redundancy was removed by merging some more tree nodes into other nodes which led to a final number of 131 nodes.

Table 3. Example tree node coding

Tree nodes		References
Social pressure	Slim friends	8
	Bad conscience	1
	Comparison with others	21
	Competition with others	4
	Common weight loss	5
	Sports together	8

Design Results

Social networks may influence health-related behaviours in three ways:

Firstly, social networks are suggested to influence people's norms and *value system*, which subsequently have an impact on their health-related behaviours. The family social environment was mentioned as an important determinant of norms in terms of eating behaviours, e.g. the number of meat servings per week (Interviewee 10). On the other hand, Interviewee 14 stated that the family social environment would also shape a person's value

system in terms of their perception of beauty and food preferences. Thus, the formative influence of family members on people's value system starts from early childhood, whereas the influence of friends may only become more important when a child grows up.

Secondly, *social control and pressure* emerging from social connections may also shape health-related behaviours. These factors operate implicitly when people make food selection decisions, e. g. to go for a salad instead of pizza, after comparing themselves or competing with people around them (Interviewee 7). *"In the gym, I met many sportive and body-conscious people who have now become my friends. Even if I don't aim for a six pack, which some of my friends have, it does motivate me."* (Interviewee 8). Thus, feedback elements, such as comparison and competition with other users, were included in the application. According to Interviewee 7, 8 and 13, social pressure was created through key people, e.g. friends who did sports together or persons who they perceived to have expert knowledge, such as a gym instructor. Interviewee 7 stated: *"I need a coach, I am used to having a coach. I've always had someone who told me 'Do that exercise again'. This is why I really like the gym. Because I have coaches who don't care if it hurts and tell me to do it again. I need a good kick in the butt."*

Moreover, "self-initiated control" includes realistic goal setting. Goals may refer to e.g. the improvement of sports results (Interviewee 13), reaching a certain weight at a certain point in time in the future, such as the beginning of the holidays (Interviewee 2), or decreasing the trousers size (e.g. Interviewees 4 and 6). Setting goals seems to be a particularly feasible strategy for disciplined and ambitious individuals (Interviewee 13). Features like goal-setting or the tracking of sports activities should thus be implemented in the Facebook application.

Thirdly, social relationships may provide *emotional support* (Rostila, 2011) for individual health-related behaviours. Recognition of the interviewees' success and progress in the weight loss process made them feel more attractive, admired and socially accepted. However, a negative influence on people's emotional state is best illustrated by the fact that people engage in eating as a redirection activity due to experiencing emotional distress, e.g. resulting from their relationships with spouses (Interviewee 7). Also, a feeling of loneliness resulting from a lack of friends was mentioned as a reason for less physical activity on the one hand (Interviewee 9) and comfort in eating on the other hand (Interviewee 2). Considering this, we incorporated an award system and features enabling the comparison with other users in this Facebook application.

Design Implications

Based on the pilot study, we incorporated the three factors identified (1) value system, (2) social pressure and control and (3) emotional support as intervening variable in the presented model (Figure 3) to facilitate a better understanding of the relationship between people's social networks and their health-related behaviours.

To facilitate a better understanding of the relationship between people's social networks and their health-related behaviours, the three factors (1) value system, (2) social pressure and control and (3) emotional support will be included as intervening variables in the presented model.

Table 4. Summary of the interview findings and design implications

Intervening factors	Summary of findings	Design implications
Value system	▪ Social networks are an important determinant of norms in terms of health-related behaviours ▪ Social networks are a source of informational support ▪ Enabling the comparison with others, social networks influence an individual's norms and values	▪ Facilitate documentation of sports activities ▪ Provide information such as nutritional information or information of calorie expenditure ▪ Include comparison features
Social pressure and control	▪ Social networks influence health-related behaviours by providing role models ▪ Social networks exert social control and create social pressure through competition with others	▪ Enable monitoring of friends' sports activities ▪ Include competition features
Emotional support	▪ Social networks are a source of emotional support (e.g. recognition) ▪ A lack of social contacts negatively effects health-related behaviours	▪ Provide a social network "on the go" ▪ Allow users to obtain feedback from their online social network

Table 4 provides an overview of the main findings of the qualitative interviews according to the three factors with the derived design implication for the Facebook application.

Demonstration

The beta version of the Calorie Cruncher application was launched in October 2012 and attracted 30 active users as of today.

Data Collection

As shown in Table 5, the Facebook application Calorie Cruncher successfully fulfilled the four main objectives of this solution by collecting online social network data, including (1) users' profile information, (2) users' network of friends and (3) users' interaction data, as well as (4) users' health data.

Table 5. Data collected via the Calorie Cruncher application

Online social network data			Health data
Users' profile information	*Users' network of friends*	*Users' interaction data*	
- User ID - Gender - Birthday - Work and education history - Hometown - Current location - Activities and interests	- Friends' user IDs - Friendship status between the user's friends	- Status updates - Wall posts - Check-ins - Picture IDs - Comments and likes on the previously mentioned interactions - Picture tags	- Body height - Body weight - Activity level - Health-related behaviour

All Facebook IDs are made anonymous to protect the privacy of the participants. With regard to the users' profiles, we collect information on gender, age, work and education history, hometown, their current location and their activities and interests – depending on the completeness of the Facebook profile information. The access to data from friends' networks enables us to triangulate and identify complete personal networks, which facilitate the calculation of network-based measures like density or the identification of cliques within an individual Facebook network. Concerning the users' interaction data, the solution collects information on status updates, wall posts, check-ins and picture IDs and the respective Facebook Likes and comments on those interactions. Additionally, we have access to picture tags to identify if one or more Facebook users are in the same picture. With respect to the health data, Calorie Cruncher gathers data on the user's health status, tracks activities and monitors the body weight over time.

Implementation of Design Implications

The Facebook application Calorie Cruncher was developed based on the findings and implications derived from the qualitative study. Users of this application can "crunch" (burn) calories or take in calories, as well as share these activities with their friends. In addition to the basic features of the application, we implemented the design implications based on the identified intervening factors (see Figure 2), which should ensure the frequent use and spread of the application on Facebook in order to monitor health data and online social network data over time.

When (new) users first use the application, they need to create a profile by filling in information related to their health status, e.g. height, body weight and activity level. Afterwards, users can add new activities that can be either physical activities (crunching) or food intake activities.

Calorie Cruncher works like a diary that documents all activities (*value system [1]*). By providing statistics on the user's activities and BMI measures, the application enables the monitoring of the user's activities over time and, additionally, provides statistics on the activities of friends (*value system [2]*). On the landing page (*screen 1*) of the Calorie Cruncher, the application shows health radar which indicates the current health status of the user (*value system [3]*).

Moreover, each user has an overview of the latest activities of all Calorie Cruncher users (*screen 1*). This feature supports the idea of social pressure and control as the users can see their activities and vice versa (*social pressure and control [1]*). Achievements or rewards are included to support the concept of gamification (Yee, 2006). The award system used in the Calorie Cruncher application is based on the comparison of the calorie consumption across all users. If a user "crunches" more calories than the other members of the Calorie Cruncher community, he or she can become "the cruncher of the day" and win a golden cup (*social pressure and control [2]*).

Figure 2: Screenshots of the Calorie Cruncher application

With regard to emotional support, we included features which foster the socializing aspect (Yee, 2006) of the Calorie Cruncher application and provide users with a sports club network "on the go". Users can document activities performed with other Facebook friends, who do not need to be users of Calorie Cruncher. Moreover, every Calorie Cruncher user can like – and in this manner support – the activities a user performed (*emotional support*). All activities can be shared on the Facebook wall, which allows the user's Facebook friends to like and comment those activities as well. Hence, a connection between Calorie Cruncher activities and the Facebook wall can be established and other Facebook members may be encouraged to start using the application.

Evaluation

The Facebook application Calorie Cruncher successfully collected all the required online social network data and the users' health data as shown in section 0. The challenge lies in the cleaning, preparation, aggregation and management of the data in order to use them for further analysis. One of the demanding aspects is the identification of meaningful relations in online social networks. Most users only communicate with a very small and distinct number of people out of their total number of online friends (Byron et al., 2009). These close online friends can be expected to exert a higher influence on the individual, and they are identified by the frequency of interaction (Ellison et al., 2007). In this case interaction measures have to be developed based on the raw data set.

With regard to the design of the Calorie Cruncher application, we are still in the pilot stage, since as of today we only have 30 active users. More promotion is planned in order to boost the user base in order to collect more substantiate data.

CONCLUSION

Obesity is an issue that is only going to grow in impact and importance on any public health agenda. While our sedentary lifestyle caused mainly by our growing reliance on technology has been identified as a leading contributor to the obesity epidemic, technology also can hold a key to its cure as we have shown in the preceding. Specifically, there appears to be a role for on-line social networks and Web 2.0 to enable better and healthier lifestyles to ensue. Our pilot study, using the application calorie cruncher we developed, has served to provide directional data towards this. Moreover, our research also adds to the growing field of consumer health informatics, a field where technology is central to facilitating better communication, information sharing and thereby patient empowerment to address a variety of healthcare issues. What we have tried to identify in our pilot is that to move forward successfully in this regard it is necessary to subscribe to a robust and systematic approach. We proffer a user centred design approach as it enables the users' needs to be always upper most when design the application and thus ensuring that there is a high likelihood that users will embrace the application.

Implications for Practice

Lessons learnt from our pilot testing data on this newly designed Health 2.0 Facebook application would enable medical and healthcare practitioners to (1) understand the effect of obesity propagation in online social networks; (2) identify potential online intervention strategies to disseminate health-related information to the right group of people and (3) to offer services fostering positive health-related behaviours or to promote behaviour change advice.

By exploring the social aspects of obesity and the effect of obesity propagation in online social networks, this research finding will create awareness and help to facilitate appropriate health-related behaviours using innovative consumer healthcare technologies. Findings from this research will serve to inform the development of possible online intervention strategies.

Limitations and Future Research

This application is designed based on interviews with a small number of participants. However, after the pilot study and demonstration, we were able to collect sufficient data to enable deeper analysis.

Further research will take a closer look at the interactions and provide more precise results regarding the relationships of the participants' friends. Network measures, such as network constraint, clustering coefficient and cliques, could provide better insights into the network structure and enable the analysis of the impact of different relationships on health-related behaviour and body weight (Moore, 2010). Moreover, we plan to conduct this research in different countries. The collection of longitudinal data will also be used to test for phenomena like induction and homophily in online social networks (Christakis and Fowler, 2007). Our study has served to try to open the door to this possibility and illustrates the possible benefits in the context of obesity, a serious healthcare concern globally. We close by calling for more confirmatory research in this area.

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