Quitty

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Published in:
Proceedings of the 8th Nordic Conference on Human-Computer Interaction

DOI (link to publication from Publisher):
10.1145/2639189.2639195

Publication date:
2014

Document Version
Early version, also known as pre-print

Quitty: Using Technology to Persuade Smokers to Quit

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ABSTRACT
Health is an important topic in HCI research with an increasing amount of health risks surrounding individuals and society at large. It is well known that smoking cigarettes can have serious health implications. The importance of this problem motivates investigation into the use of technology to encourage behavior change. Our study was designed to gather empirical knowledge about the role a "quitting app" can play in persuading people to quit smoking. Our purpose-built app *Quitty* introduces different content types from different content sources to study how they are perceived and motivate health behavior change. Findings from our field study show that tailored content and push-messages are considered the most important for persuading people to stop smoking. Based on our empirical findings, we propose six guidelines on how to design mobile applications to persuade smokers to quit.

Author Keywords
Persuasive technology; smoking cessation; health behavior change; online participation;

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Health is an important topic in HCI research, due to the increasing amount of health risks surrounding individuals and society at large. Over recent years there has been an increased focus on the risks caused by the serious health implications of obesity, smoking, alcoholism, medication abuse, improper diet and diabetes. Our increased understanding of the cause and effect of these issues has given us an opportunity to find avenues for preventing them from happening. Awareness of the potential health risks alone does not appear to be sufficiently persuasive in encouraging people to change their behavior, and recent studies have shown that more than 50% of illness across different age groups continues to be caused by personal behavior [29].

A prime example of an issue that needs to be tackled in terms of changing health behavior is the continued prevalence of cigarette smoking. Smoking can cause cancer, lung disease (COPD), heart disease and poor blood circulation to mention a few of the many health risks [27]. Nearly six million people worldwide die each year from smoking related diseases, due to their intake of chemicals that exist in cigarettes [35]. Besides the health risks, the issue also has an impact on the economy within social welfare and health systems, in terms of treatment of people afflicted with smoking related illness [28]. In response to these problems, an increasing number of anti-smoking organizations worldwide are investing money and effort to reduce the number of smokers, both in terms of preventing people from starting and making people quit.

Figure 1: *Quitty*: smoking cessation application

In smoking cessation, intense, intimate and personal interventions have a high success rate, but at the same time participation rates in these kinds of programs are usually low [31]. Younger smokers, who form the majority of the smoking population, tend to seek advice from telephone help lines rather than attending clinics [12]. The number of smokers who get involved in smoking-cessation interventions is a small proportion of the smoking population, but the majority of these prefer assistance in the form of self-help programs [5]. These minimal-contact cessation programs have the potential to reach far more smokers, but cessation rates are usually low because they only provide "one size fits all" generic support [31].

NordiCHI '14, October 26 - 30 2014, Helsinki, Finland

http://dx.doi.org/10.1145/2639189.2639195

Emerging technologies, such as smart-phones, offer a resourceful means to increase the demand, reach and use of cessation treatments, by providing smoking-cessation services that will engage smokers in real-time and wherever they are [3]. Based on the success of print-based tailored smoking cessation interventions, there has been research interest in evaluating the effectiveness of technology-based tailored smoking cessation materials. Evaluations of personal computer and Internet-based interventions for smoking behavior [34][25][15] report significant and improved behavioral health outcomes for these kinds of interventions. However, Stretcher et al. [32] state that the active components of technology-based smoking cessation programs are not well understood.

We see this as an opportunity to investigate the contribution that mobile technology might make in helping smokers to quit. Our approach is to create a smoking cessation app, *Quitty* (fig. 1), which adds the dimension of mobile availability as a just-in-time intervention, with the aim of understanding which forms and sources of information have the greatest influence on persuading health behavior change for smokers. Although there are a significant number of smoking-cessation iPhone apps, reviewing them shows that they don't use evidence-based cessation techniques. Through our study we are able to present guidelines on how to design tailored content for mobile applications, based on empirical findings, to effectively persuade smokers to quit.

This paper is structured as follows. First, we present related work in the field of smoking cessation. We then present details of the design of *Quitty*, followed by our research design and user study. The findings of our field study are followed by a discussion and reflection on those findings, including the presentation of six design guidelines. Finally, we conclude and propose future work within HCI for technology and smoking cessation research.

RELATED WORK

Research on smoking cessation in the health domain has been ongoing for several decades. We can learn from these findings in creating technology to support health behavior change. Health practitioners are aware of how much patients can do in order to achieve personal improvement in health, but how self-help assistance is designed has a crucial impact on whether or not the patient will succeed in changing their behavior [18].

Azjen's Theory of Planned Behavior (TBH) [1] states that a person's perceived behavioral control, i.e., how much control they *think* they have over performing a particular behavior, directly influences their behavior. If a person thinks they lack control over changing, then he or she is less likely to be able to change that behavior. TBH has been used to inspire behavior change in smoking cessation [20] where perceived behavioral control was the strongest predictor of behavioral intentions in a general population of smokers. Van den Putte et al. [34] found that conforming to social norms has a big influence on how people act, including willingness to quit smoking. It is therefore important to support users of a system in believing that quitting is within their control, and that they have the support of the community in doing so.

Prochaska and Velicer proposed the Transtheoretical Model of health behavior change (TTM) [26] that involves progress through six stages of change: precontemplation (not intending to change soon); contemplation (change is being considered but not definitely planned); preparation (behavior change is imminent); action (behavior change is occurring); maintenance (behavior change has been consolidated); and termination (change not achieved). The Inter99 study conducted in Denmark [22], offering high intensity smoking cessation groups, showed that sustained abstinence was possible in early motivational stages through these groups. De Vries et al. [6] found that smokers in the pre-contemplation stage benefit from information about the pros of quitting, and smokers in the contemplation stage benefit from self-efficacy-enhancing information. Research shows that the quitting stage that a smoker is in can be used to tailor health education messages [2].

There are very few studies in HCI literature regarding use of technology in changing people's behavior in a smoking cessation context. Graham et al [13] developed QuitCoach, a web-based system providing quitting advice to users based on the ideas of TTM stages of change. Strecher et al. [32] looking at web-based smoking cessation programs found that higher-depth tailoring is important. This confirmed earlier findings that electronically tailored materials can combine many of the interactive, diagnostic elements of a clinical encounter but with a much greater reach into the general population [31]. Krebs et al. [15] conducted a meta-analysis of computer-tailored systems concluding that they have the potential to improve health behaviors, and dynamic tailoring was even more effective. Zhang et al [36] studied posts on a popular smoking cessation web page, QuitNet Facebook discovering that short posts about motivations and experiences in quitting were the most popular type, and that smokers at the TTM maintenance stage were the most involved in responding.

Most relevant to our research is the work by Ploderer et al. [23] [24], examining the relationship between TTM stage of change and need for social support. They showed that the type of support needed is related to the quitting stage of people, by analyzing messages posted on a public smoking cessation Facebook support group page [23]. In related work, the Distract Me app [24] gives users different kinds of distractions and tips to use when experiencing cravings. This research shows that distractions and tips complement each other, in that, although distractions attracted people to

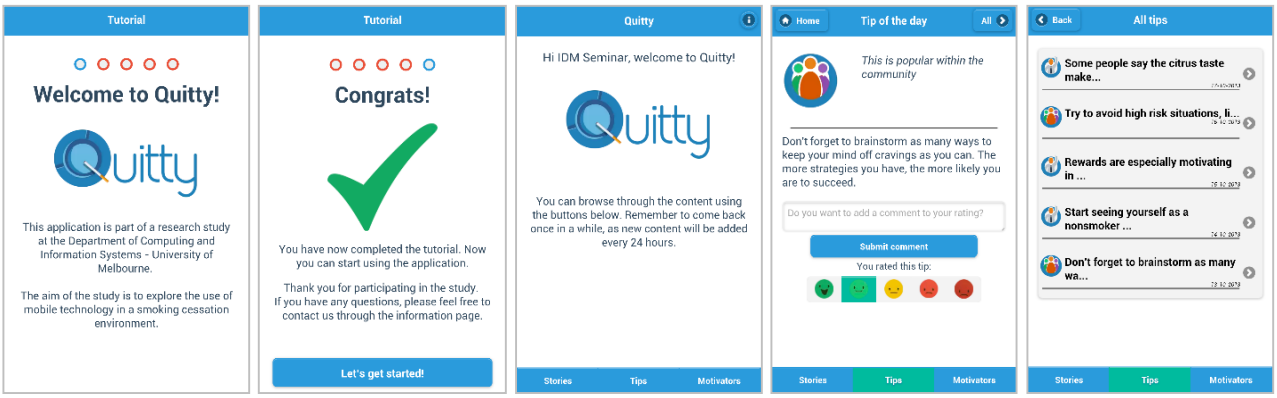

Figure 2: From the left: *Quitty* pages – a) first time start, b) tutorial, c) general start, d) tip of the day and e) all tips.

use the app, tips kept them engaged for longer periods of time helping them cope with cravings and strengthening their commitment to stay quit [24]. Personal stories were also popular suggesting that they may have value as a specific content type and separate feature in an app.

DESIGN OF THE QUITTY APP

The *Quitty* mobile app was designed to explore different ways of supporting users in their quitting attempt with information to give them better knowledge on how to quit and change their current thinking and/or behavior. In our design we incorporated findings from the literature reviewed, by implementing motivators, personal stories and short tips, for different stages of change. We were guided in our design by Fogg's [11] principles for persuading people into behavior change using technology. We wanted to study people's use of these different content types in a mobile app to better understand their value and impact in the context of smoking cessation. We also wanted to get users' responses to tailored information. We presented the three content types from two different sources, expert and community, to see whether this had an impact on how the content was perceived and response to peer input. Each of the six different content type/source combinations were examined in respect to how effective it was in persuading people to change or reflect on their smoking habits. Our information was reliable and trustworthy, as we used real content supplied by [1]Quit Victoria, both factual information and stories written by smokers, ex-smokers and experts, ensuring it was real content affecting users.

Quitty provides first time users with a guided walkthrough of the app on their first login (fig 2a,b). The home screen of *Quitty* has three menu items: Stories, Tips and Motivators (fig 2c). Each day a user would receive three pieces of new content, one of each of these types. All past content could be retrieved and reviewed at any time (fig 2e).

[1] Quit Victoria is a government sponsored organization, http://www.quit.org.au

Stories Menu

The 'Stories' menu provides a selection of real-life, first-hand experiences of quitting, written by smokers and ex-smokers. A variety of stories are provided, aimed at different stages of quitting. A sample story from the system is: *"I have given up smoking after 17 years. It has now been a month since my last cigarette. I'm determined to do it. I have a packet of cigarettes sitting next to a photo my children. Everyday I have asked myself, 'who do I love more?' and everyday I give myself the same answer. I want to be alive to meet my grandchildren."*

Stories are included due to their success in health behavioral change in other domains. Hinyard [14] found stories a comfortable, familiar and non-confrontational way for people to receive information. Storytelling, according to Dimond et al. [8], is how people learn and exercise agency, shape identity and motivate others to act.

Tips Menu

The 'Tips' menu provides helpful advice and guidelines on how to quit and/or maintain non-smoking habits. These short tips were written by experts from Quit Victoria taking into account different stages/situations that smokers experience when trying to Quit. A sample tip is: *"Try to avoid high risk situations, like bars or parties, for the first week or so. This can help make the early days easier."*

Tips are included because research shows the effectiveness of tips in supporting people to better health. Tsang [33] says they are useful but it is important to deliver them carefully, in the right way and at the right time. Tips are widely used by major quitting cessation organizations and websites such as Quit Victoria. Langford et al. [16] found informational support or tips are useful in achieving behavioral change.

Motivators Menu

The 'Motivators' menu provides different reminders to users as to why they are/should be quitting. Motivators were written by experts from Quit Victoria and cover different reasons to quit such as health, social, and statistical facts. A sample Motivator is: *"The first few days are the most*

challenging, but remember, the cravings will become less frequent the longer you stay quit."

Motivators as included because reminding people what they can gain or lose as a result of quitting, or not, has a significant impact on behavior [19]. Mann et al. [17] show that gain and loss messages communicate both positive and negative consequences persuasively in a healthcare context.

Two Recommendation Sources

Each of the content types was labeled as recommended by either an expert or the community, by an icon (fig 3) placed in the top right hand corner of the page (fig 1d). This label was *randomly* assigned, and did not represent the actual source of the content. This was done to investigate if the source of information affected information value.

Figure 3: Icons for Expert and Community recommendations.

Expert Recommendation

The expert icon indicates a recommendation from an expert within Quit Victoria. This was done to test Fogg's [11] assertion that the use of expertise is an effective way to persuade people to a specific behavior, to see if users regarded it as trustworthy and therefore more persuasive.

Community Recommendation

The community icon indicates content from the online community of Quit Victoria. We included this because Caldini's principle of social proof says that people decide what is right based on what other people think is correct [4]. A behavior is observed to be correct in a specific situation by the degree that we see other people doing it as well.

The Rating System

To gather immediate responses to content during the three-week study period, the system uses of a 5-point rating scale. This rating scale has five 'smiley's' (fig 1d) which allow users to respond to a simple question about the content, for example, "How helpful was this tip?" or "What did you think of this story?" with a rating from extremely happy to very unhappy. Users also have the option to add comments so we can better understanding the rationale behind ratings.

Incoming SMS Messages

During the three-week study period, participants received a text message each day on their mobile device, notifying them that new content had been added to their app. Each message had different wording to maintain interest and avoid monotony. These were included because in other healthcare domains, SMS-messages have been shown to have enormous potential to trigger users to a proposed behavior [10]. These messages were personalized.

Technical Design

The system was designed as a web-application in order to avoid dependence on a single mobile platform and operating system. The prototype was developed by using Appery.io (http://appery.io/about-us/) an open-source framework, that offers a cloud-based rapid development environment integrating backend services and API plugins. A database contained information content extracted from Quit Victoria's database and also data logged usage of *Quitty* during the field study. An expert evaluation was conducted before deployment.

RESEARCH DESIGN

The objective of the study was to explore how participants, smokers and ex-smokers, interacted with the different content types and sources of *Quitty,* while thinking about/trying to quit smoking. We wanted to understand which aspects of the app persuaded participants to reflect on or change their smoking behavior.

Before the study, participants completed an online survey to gather demographic information, and information about their smoking habits. They were then given access to the app and asked to use it each day for a total of three weeks. Participants were also encouraged to use the *Quitty* app freely at any other time. When new content was sent each day, a reminder SMS was also sent to remind them to check the system. Their response to that content, ratings or comments, was logged. After the three-week study, a semi-structured interview was conducted with each participant to gain a deeper understanding of his or her experience with *Quitty*.

Participants

Participants were recruited through the University student and staff portal, through Facebook connections of staff and students at the department, and using posters placed around the university campus. They had to be currently or previously smoking and have either a Smartphone or a computer to run *Quitty*. They were also required to have a mobile phone to receive the SMS-messages notifications.

The study involved 11 participants, 8 were male. Their ages ranged from 23 to 47 (average age of 34). All participants had tried to quit smoking, three were trying to stay quit, two were thinking about quitting and six were preparing to quit. The nicotine dependency of participants, as based on the Fagerström test [9] showed that four participants scored 0 (no dependence), two scored 1-2 (very low dependence), two scored 3 (low to moderate dependence), two scored 4 (moderate dependence), one scored 5+ (high dependency).

Data collection

All participants completed the online survey. The first part asked demographic questions about gender, age, occupation, marital status and children. The second part asked about participants' smoking habits, such as, the quitting stage they considered themselves at, how long they had been smoking, in which situations they smoked, when

they were most likely to smoke and their reasons for quitting. The third part asked about their quitting attempts, including the number of times they have tried, how long their longest lasted and what tools/resources they used to help them quit. We were also interested in whether they had used a quitting app or website before. The last question asked the times of day they were unavailable to check for SMS messages, to find a good time to send them.

The study was conducted during spring 2013 in <removed> over a period of seven weeks. All participants had their own personal login, received the same three pieces of content each day, but randomly labeled as recommended by either the community or an expert. They were also asked to give feedback on the content through ratings and comments. Participants could contact researchers directly through email, if they had problems interacting with the system. Every time participants logged into the system their input was saved in a database including tracking their movement in the app. During the study period, remote monitoring meant that technical issues were solved quickly.

After the three-week deployment, a semi-structured interview, approx. 45 minutes long, was conducted with 10 participants (one dropped out before the interviews). The purpose of this interview was to discuss the different types of information they received. During the interview, each participant was shown a table of their daily content and sources, their responses and how they interacted with the system, to prompt their recollections. We asked them about usefulness of the app in supporting quitting smoking, and the different kinds of content and sources and how they were interpreted and used during the study. We were particularly interested in whether the source of the content had any influence on their ratings. We were also interested in their reflections on their smoking habits and whether they changed during the study. We also discussed general impressions of the app and the push messages. Finally, we wanted to know if they used the app as a substitute for smoking. All interviews were recorded and transcribed.

DATA ANALYSIS

The open coding method, from Grounded Theory [30], was used to code the transcripts, with two independent coders for increased reliability. Through the process analysing codes, we were able to get an overview of responses to different aspects of *Quitty* and view this against use data collected during the deployment to confirm our findings.

Affinity diagramming was used to categorised 40 different phenomena, from the coding, into nine different themes: relatability & tailoring; prompt messages; gain/loss content; genuine/fake content; content type; content source; tracking; social; and mobile platform. Even though these themes were elicited from empirical data about smokers, we suggest that they may also be relevant for designing persuasive mobile technology in other domains.

FINDINGS

Relatability & Tailoring

The study showed that relatability is an important factor in determining the usefulness of content. All participants mentioned that they preferred content they could relate to. If they could not relate to it, they disliked it and disregarded it. Interestingly, all participants agreed on the importance of relatability, but did not agree on its basis. Five out of 10 participants said they could only relate to content focusing on people in the same demographic and quitting stage as themselves. If the age gap was too big or the content described a different quitting stage, they found it irrelevant. Four participants said that the demographics were not the key factor to determine relatability, but it was based on the content itself, how genuine it was and how well it engaged and involved them, *"While a lot of them didn't relate to me directly in anyway, because I don't have children or I don't have this… it felt genuine enough that I could access it. It felt that there was enough in it that I felt I could make an emotional connection, it wasn't preachy, it wasn't this… it was just an experience that someone was sharing."*

Nine participants mentioned tailored information as something they would like to see more of. Two important aspects of tailoring were identified as demographics and quitting stage. Six participants mentioned quitting stage as having a significant influence on their perception of the content, *"Some of them I found frustrating to read, because, hearing other people having succeeded, when you are still struggling is difficult."*

Prompt Messages

Once a day participants received an SMS-message from the *Quitty* team reminding them to check the app, to read and rate the content. These messages were sent at different times each day and about half of the messages were personalized to include participant name. Eight expressed that they liked the text messages. Only 2 did not like them because they found them annoying, especially at inconvenient times. However, 9 participants found the messages useful saying it made them use the application more, *"These were good reminders. So If I did not check it that day so it was like 'oh yeah that's what I have to do'. Because you do forget especially if you are busy or you are tired."*

One participant mentioned that he found the text messages even more motivating and encouraging when he discovered that they were from a real person and not computer-generated, *"They were good […] It was nice that it was an actual person sending the message. I only realized when I wrote back to it and someone responded. After that, knowing that there were someone there, I found the messages encouraging and positive and friendly and that was my main motivation for checking the app, was getting that text message."*

Participants often logged into the app after receiving the text message because it reminded them that the application existed and of what they were trying to accomplish, *"No, generally if I would receive a text message and I was having a cigarette or I just had a cigarette it would make me feel a little bit guilty."*

Some participants also mentioned that it was a good thing that the messages did not arrive at the same time each day. For example, one participant told us about creating strategies to avoid them, if he knew the exact time it would arrive each day. Participants expressed the importance of messages being interesting and even funny in order to keep them engaged. If they were repetitive, they would start ignoring them. One participant mentioned that an interesting SMS might include a teaser about the daily content. Another important aspect, that almost all participants mentioned, was that it would be useful if the SMS messages included a link to the app, making it easier and quicker to access, making them use *Quitty* more.

Gain/Loss content

Participants were generally fonder of content that had a gain-framed message rather than a loss-framed message. An example of this would be a message saying how much their lungs will improve by quitting rather than having a message telling them how much their lungs would deteriorate from continued smoking, *"I think it was a week or something, the effects on the body and I thought that was a very good way to kind of 'wow I didn't realize it was only that long before you see positive effects'... rather than ones that were ...talking about damage."* According to participants, they would be more likely to ignore negative content, as they feel they see enough of this already and have become immune to it.

Genuine/Fake content

Five of participants stressed the importance of genuine and realistic content. Three participants thought the content seemed fake, that it was made up, due to the impersonal nature and structure of some of the stories, *"Some of the stories I found to be, almost to the degree that they read as if they were just made up. 'Today I am going to quit, I've decided I am going to quit today'."* This is interesting as all content in the app was supplied by Quit Victoria and not made up for the purpose of this study. One participant pointed out that when a story does not cover how hard it is to stop smoking, it does not seem real.

Content Type

The study indicated that the users were most fond of receiving tips (6 out of 10), while 2 preferred stories and 2 preferred motivators. Those who liked tips liked motivators better than stories. Conversely, participants fond of stories did not find tips or motivators as useful. Generally participants thought the different content types supported each other well. This was supported by the ratings given in the app where each of the content types had an almost equal score. Six participants said that the app did not provide them with enough content, both in terms of the amount released each day and lack of depth in the information to keep them interested in using it on a daily basis.

Tips

Tips were seen as practical, concise and simple. A typical tip was easy for the user to implement. Participants shared that even if a tip does not work for them or it is a tip that they are already aware of, it still helps reinforcing their behavior, *"To change your routine, go for a walk, take your mind off it, do something else. Most of the time you have a cigarette because you're bored as well. So, it's kind of reinforcing behaviors that you already know you should be doing, but to actually see it written there as well it also reiterates it."* One participant indicated that a tip should not only focus on quitting aspects, but also try to suggest ways to get healthy again, *"that is one of the main things that drives you to stop smoking cigarettes, is to get healthy."*

For a tip to be considered useful it has to be realistic and achievable for the user, *"Actually tips would also be about how realistic I found them… You know like someone who is a heavy smoker he wants to quit either he's got to be really mentally prepared for it or you actually need to like, get him ready, you have to get him psyched and mentally ready to bring really, really small changes into his smoking habits."* Another aspect that made a good tip was to make use of original content, *"I think a good tip would be something people are unlikely to have thought of."*

A bad tip was when the user did not get enough detail on how to actively apply it. Some participants said that when a tip was abstract, like "Think of yourself as a non-smoker and the benefits you would gain", it was not helpful. If a tip was not relevant to the user, for example related to their personal quitting stage, it is also considered unhelpful, "*…that fairly common tip 'Just go for a walk or something'. Initially when you quit smoking, that's the last thing you feel like doing, because you don't feel right. Tips like that it's like "no! I am not going to go and do any exercise, this is hard!"*

Stories

Stories gave users an opportunity to relate to the writer of the story, *"I'm listening to someone whose not trying to scare me into something, 'I'm not trying to do this', just telling me her experience, and sharing that with me, and encouraging me to go on my own journey. So, I respond to that positively."* Stories offered hope to people trying to quit smoking. One participant explained that even a small hope that things will get better could have a huge impact, *"I think for me personally if I had read stories about, you know, 'I quit smoking after 20 years and it was horrific and I hated it and I thought I could never live without cigarettes, but eventually it got better and I thought about like every day' a story like that I would have gone 'Yeah, I*

guess there is some sort of hope.'" According to participants, stories differed from the other content types by offering emotional, rather than factual advice.

We found that for a story to be considered useful, it has to grab the reader's attention and offer something different. Many participants talked about stories missing the middle part - the struggle of quitting - which would make it easier to relate to the person in the story and create a feeling of reality. One participant said that reading about the struggle makes a story inspirational, increasing the usefulness and quality of a story.

Motivators

Motivators were considered factual content, both new information and things that participants were already aware of. Participants were fond of motivators that made them reflect on themselves. Throughout the surveys and interviews the biggest motivator within smoking cessation involved money and the savings from quitting.

Most participants stated that for a motivator to be effective it had to be positive. Positive motivators gave people more confidence helping them to focus on possible achievements. Like tips and stories, a motivator has to be relatable in order to be considered useful. Some participants indicated that if a motivator was focused on long-term gains, they had difficulty relating to it, *"15 years seems like a very long time… it's like in 15 years I will be 50 or something. It's too far away, it's not like… it's kind of discouraging to think that I have done that much damage and that is going to take that long to get any kind of benefit."* Participants wanted to know about the immediate effects of quitting smoking through motivators with short-term focus

Content Source

The app was designed to send content to participants from different sources, either an expert or community. When asked if they noticed these sources only 4 participants said that they did. The others either misunderstood this concept or did not notice it. The idea of having different content sources was discussed in the interviews. Five participants said they would prefer having community based recommendations, *"I don't know if being expert requires having experience of reality addiction but it doesn't necessarily imply that they have been though it. Maybe they know the facts and figures, but they haven't lived it. Experts do not know how it is."* Two participants preferred an expert source, while the other 3 didn't mind. However, it was discussed that these recommenders could compliment each other. One participant stated that he had high expectations when something was labeled as being recommended by an expert.

Tracking

Another theme that emerged was tracking. Six participants mentioned that they wanted some type of tracking within the app in order to measure progress of their quitting attempt, *".. I don't necessarily count the days, but then I can perhaps with a tracker go 'Oh it's been nine days and twelve hours! This is great! I feel better now, it felt like it was only two days!'."* Self-monitored progress combined with positive feedback, such as badges or scores based on the users' activities and actions, were seen as desirable, and could help people trying to quit to stay smoke free.

Social

Nine participants showed interest in having some kind of social functionality in the app. Some wanted the ability to write to the authors of the content in order to ask questions. Others wanted to be able to contact a smoking cessation expert to get personal advice or ask simple questions. One participant mentioned that this functionality would make them more motivated to use the app as a substitute for smoking. Most participants mentioned the importance of being a part of a community while trying to stay quit. This could be either an online community or some way to arrange social activities. Five participants stated an interest in sharing their own experiences with other people online.

Mobile Platform

Nine participants used their mobile phone as their platform to access *Quitty*. They made a total of 98 logins during the three weeks of deployment with an average of personal logins of 0.47 per day. We logged a total of 792 browsing interactions, the highest number for a single participant being 192 and the lowest being 16 interactions. Participants indicated that a mobile device was preferable in a smoking cessation context because it can be easily accessed from anywhere, when you might be having a craving for a cigarette, *"It is like maybe if you are in a bar and you like, you can actually ask, what do I do if I actually see someone smoking and I am craving."* One participant said quitting smoking is a very private thing, so in this way, a mobile device offers a possibility to look at the phone secretly.

Participants used the *Quitty* app in different locations and situations. This includes being at work, at home, when out socialising. They used the app throughout the entire period. However, we discovered major differences in how often they used the system. For example, one participant logged in to the system two or three times per week, while another participant only used it twice during the study period.

DISCUSSION

Our aim with this research was to study different content types within a smoking cessation context using a mobile app to get a better understanding of people's perception of the effectiveness of stories, motivators and tips in helping them to quit smoking, and to discover those aspects of behavior change apps that could assist smokers who are trying to quit. We found that specific qualities of the content can play an important role in helping people to quit smoking, but that quitting is a very personal endeavor, in which each individual has his or her own needs. In this

section we discuss our findings and what we can learn from them to help us create more effective technology for supporting smoking cessation.

One of the strongest findings in the study is the importance of the relatability of the content. When users received content they could not relate to or make direct use of, they disregarded it. This aligns with past findings that tailoring content to people's demographic and personal quitting stage is important. However, we found that the way in which the content is tailored needs to be simple and flexible. As one participant said, *"I think users wouldn't really want to be having to input a lot of stuff each time. If there was just a simple slider though of showing where someone thought they were at, that might change every day, that might give the app an idea of which tips and motivators to show them."* Earlier studies in this and other domains, such as Dijkstra [7] and Paay et al. [21], found tailoring content to be important, but our empirical results add to this with ideas on how that information should be tailored.

During the study we discovered just how important and useful reminding text messages where considered by users in aiding their smoking cessation. They were seen both as a positive reminder and a useful tool to get them to do specific tasks. Both data logging and interviews show that it the SMS messages triggered participants use the app more, aligning with Fogg's theory on the effectiveness of triggering the user to do a specific behavior [11]. Through our empirical study we can add that people respond more positively and feel more encouraged in their efforts to quit smoking if they feel that these messages are sent by an actual person and not system generated.

Generally, users prefer receiving content focusing on the gains of quitting smoking (e.g. the improvement of general health) rather than content focusing on the negative aspects of smoking (e.g. risk of diseases), confirming previous work by Morris [19]. This does not mean that loss framed content is not helpful in order to quit smoking. We found that even though participants disliked loss-framed content, they still paid attention to it in the *Quitty* app. This indicates that loss framed content can have an impact, despite the users opinion of it. Secondly, even though gain-framed content was liked more, this does not mean that it is the right type of content to effectively persuade smokers to stop smoking. We found evidence that different types of messaging worked best at different stages in the quitting process - negative or shock-inducing content is useful to get smokers to realize that they should quit, while positive content has the most impact on smokers in the maintenance stage of quitting.

A finding that came up in the interviews was that of fake content. This was particularly interesting since the origin of the content we used was real people who had, or were trying to quit. We found that for content to be perceived as real, it has to describe the struggle of a smoking cessation and what can be achieved by quitting. Furthermore, if the participant does not see the message as achievable, it can also seem unrealistic and fake. It is therefore important to describe the process of quitting, including the struggle, so that people can relate to it. This aligns with Fogg's [11] theory that credibility of information is an important factor in designing persuasive technology, and Azjen's [1] TBH theory that it is important to help people to perceive that behavior change, in this case quitting smoking, is within their control.

The study made use of three different content types: tips, motivators and stories, which had differing effects on users. Our findings show that the majority of participants were most fond of the tips as they were practical and easy to implement in supporting quitting. Never the less, the tracking, ratings and comments show little difference between the motivating effects of the different content types, which indicates that they support each other well. We also labeled tips, motivators and stories as being recommended by either an expert or the community, to see if this had any impact on how they were perceived. These content sources seemed to have little affect on participants' responses to the content, but this was probably due to the fact that most participants either did not notice the different sources or did not understand what they indicated. However, when asked which source they would prefer, community was most popular because it is perceived as originating from people in the same situation. Experts were seen as people not in the same situation, but were expected to deliver high-quality and trustworthy content. This confirms the principle of social proof as an effective persuasive mechanism [4].

Most participants agreed that personal tracking in the app would make it more effective and interesting for them. Participants suggested that an app that measured their achievements would keep them engaged with the app. especially if it showed a visualization of what they had achieved, and gave them milestones, aligning with the persuasive principle of self-monitoring by Fogg [11].

The social aspect of quitting was a topic that was considered important by participants, the reason being that it can be helpful and motivating to communicate with people in the same situation, helping users feel they are not alone and offering hope for successfully quitting. Participants said that they also wanted to be able to share their own tips and experiences while trying to quit with others. However, Ploderer et al. [24] found that even though users say they would like to contribute personal content online, this may not be the case when given the opportunity. Our participants partly confirmed this issue by sharing with us that quitting is a personal thing and that when quitting they tend to isolate themselves. However, since research has shown [31] that personal encounters and exchanging personal stories are most effective in helping people to quit, we think that social networking and sharing information could be an important aspect of any quitting application.

To make our empirically based insights more accessible to smoking cessation app developers, we propose six guidelines that give practical advice on how to design technology to help people quit smoking.

Guideline 1: *In designing a smoking cessation app, effective relatability and tailoring can best be achieved by providing concise content that dynamically matches the smoker's current quitting stage.*

Guideline 2: *Messages sent to user's to trigger their use of a smoking cessation app are most effective if they appear to come from an actual person, arrive at different times of the day, and change their message over time to retain interest.*

Guideline 3: *In designing a smoking cessation app, a combination of loss framed content in the early quitting stages, and gain framed content in the later quitting stages can achieve maximum impact on helping smokers to quit.*

Guideline 4: *For the content of a smoking cessation app to appear genuine, it should describe the struggle of quitting, and give advice that the participant will perceive as achievable at their particular stage in their effort to quit.*

Guideline 5: *A smoking cessation app that is also able to provide tracking information on a user's smoking habits and achievements towards quitting will keep users more engaged and motivated to continue to use the app.*

Guideline 6: *A smoking cessation app is more likely to be effective in helping people to quit smoking if it incorporates a social aspect, for example, user generated content or social networking with other people in the same situation.*

LIMITATIONS

Although our study was carried out using acknowledged techniques such as online surveys, field studies, prototype deployment, semi-structured interviews and open coding of data, it has some limitations that we wish to mention.

One potential limitation of the study is that participants' motivation might have been affected by the fact that they received $40 vouchers for participating in the study, rather than using the app completely out of free will.

Another potential limitation of the study is that it involved a relatively small number of participants and took a qualitative research approach. We are therefore not able to make claims on statistical significance from our findings.

Finally, as the app was web based, in order to achieve independence from a particular mobile OS, the system had slower loading time than a stand alone App would have. This might have influenced some participants' use and impression of *Quitty*.

CONCLUSION

This paper explored the design of mobile technology to persuade health behavior change in smokers trying to quit. Our findings from an empirical study of a prototype smoking cessation app *Quitty*, involving a three-week field trial with 11 people, elicited nine themes that support new insight into the context of smoking cessation using technology. The study showed that to increase the power of persuasion for the content in a mobile application it should be tailored to the user's situation and quitting stage, provide both positive and negative messages at the right times, provide real information and personal tracking, and incorporate a social aspect, while using personalized SMS-messages to prompt daily use of the system and encourage users to reflect on their smoking habits. Based on participants' use and perceptions of our prototype application, we propose six design guidelines for designing smoking cessation apps, as an aid to quitting smoking.

FUTURE WORK

We plan to redesign *Quitty* in response to the findings and deploy it in a longitudinal study, with more people, to validate and extend our findings.

ACKNOWLEDGMENTS

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