

AN INVESTIGATION OF DIET APPS FOR ENHANCING PEOPLE'S HEALTH AND WELLBEING.

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Abstract

Since inactivity and unhealthy eating are amongst the biggest health problems of our era, weight monitoring applications are becoming favoured options. However, in order to ensure people's health and wellbeing, not only their physical state but also mental and social states should be supported by these applications. Recently, studies indicate the power of mobile applications in promoting health and wellbeing but there are still a limited number of studies about how these apps can be improved with the aim of better supporting wellbeing. For this reason, in this study, mobile diet apps were examined in the context of design for wellbeing. Three mobile diet apps were used by 15 participants who had an interest in healthy eating or weight losing for one week. Three phased study was conducted to learn about the users' before and after weight control preferences and the strengths and weaknesses of the diet control apps. Consequently, suggestions were presented for improvement of weight control body monitoring apps with the aim of enhancing people's wellbeing.

Keywords: Design for X (DfX), wellbeing, diet apps

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1 INTRODUCTION

Design for wellbeing yearns to make people happy and to create positive feelings. Design can help forming and promoting positive experiences or transforming existing experiences into more pleasurable ones; it can make people aware of their abilities; direct users to act or think in a better way; and can lead to happiness (Desmet and Hassenzahl, 2012). Very recently, Desmet and Pohlmeier (2013) introduced the term “positive design”, as design activities aiming to help people to reach a pleasurable and satisfying life and more importantly to flourish within it. Thus, together with pleasure, positive design also aims at flourishing personal experiences and for ensuring hedonic and eudaimonic happiness. The former defined as “pleasure or happiness” (Ryan and Deci, 2001), and the latter as “not only pleasure attainment but also seeking perfection for realization of one’s true potential” (Ryff, 1995).

Within studies carried out in design for wellbeing and positive design, mHealth devices are taking attention. Some examples are as follows: SITU Smart Scale (Michael Grothaus Limited, 2014), which can inform users about precise calorie and nutrient contents of food, and export the personal data for sharing with doctors, coaches and nutritionists; Fitbit Flex (Fitbit Inc., 2013), which can track the wearer’s activity and sleep, and motivate the user to become more active; and Cue (Cue Inc., 2014), which can track users’ health at a molecular level by analyzing collected samples of saliva, blood or mucus from noses and place it into a cartridge (after which results are sent to users’ smart phones).

In relation to the proliferation of smart devices, health and wellness apps are also becoming prominent. Of these, diet control apps are under the spotlight because they present a great potential to easily reach those people owning smart phones and who need to pay closer attention to their weight, eating, and exercise levels.

Despite obesity being one of the most preventable causes of death (Chopra and Darntonhill, 2004) it is one of the leading actors in illnesses that can lead to fatalities, such as cardiovascular diseases, hypertension, diabetes, some types of cancer, and muscular-skeletal system diseases. In consideration of the close correlation between obesity and several illnesses, the World Health Organization (WHO) states the urgency of weight loss intervention in anyone’s reach (Morak et al., 2008). Thus, many organizations have collaborated with the WHO to develop strategies and to put them into action including changing of dietary habits, adopting adequate and balanced diets, and increasing activity levels of individuals (Ministry of Health of Turkey, 2010).

Nevertheless, a healthy lifestyle can be achieved not only by demanding on the healthcare facilities offered to the public, but also individuals themselves need to be inclined to behaviour changes to positively contribute to their health. In parallel to this, in recent years, a variety of mobile apps has been developed targeting patients especially with chronic diseases, with an aim to encourage self-caring and hence healthier lifestyles (Holzinger et al., 2010). These apps have the potential to assist users to monitor themselves and to maintain motivation to achieve health benefits in the longer term. The usage of the apps through smart devices relies on those devices’ integrated sensors, which can actively monitor and inform users about, for example, their step counts, daily exercise level, daily calorie intake, and quality of sleep. Some examples of such apps include Moves, MyFitnessPal, and Sleep Cycle.

Diet apps can be regarded as tools for raising people’s consciousness about their eating practices, and for directing them to healthier lifestyles. Indeed, studies show that the use of diet apps was well accepted by the public. Their positive effects on weight loss, physical activity level, BMI (Body Mass Index), waist circumference, fat and sugar intake, and eating behaviours have been acknowledged (Stephens and Allen, 2013). However, there are still a limited number of studies about how these apps can be improved with the aim of better suiting users’ needs, and hence better supporting their wellbeing. The work reported in this paper picks up on this gap, to research and make suggestions for improving diet apps by understanding the effects of those apps (regarding features and characteristics) on people’s thoughts, moods and feelings – in other words, on people’s wellbeing.

2 FIELDWORK: EXPLORATION OF MOBILE DIET APPS

To explore how mobile diet apps can be further developed to better support people’s weight control preferences and enhance overall wellbeing, a three-phased period of fieldwork with selected participants (see 2.2) was carried out. Phase 1 (Pre-Interview) aimed to gain insights about participants’ existing moods as well as their preferences for weight control prior to Phase 2. Phase 2

(Usage) involved participants using a diet control app for a minimum duration of a week. Phase 3 (Post-Interview) aimed to understand participants' feelings having completed Phase 2, as well as their general assessment of the app.

It was considered important to explore the possible effects of mobile diet apps on users' wellbeing through 'before' and 'after' enquiries, as commonly used in literature to assess possible effect(s) of a certain variable (e.g. Hjelm, 2004). However, obtaining a measure of wellbeing can be very challenging, because of its multi-faceted nature. Nevertheless, researchers have been developing numerous methods for measuring 'felt experiences' such as intimacy, happiness, and pleasure (Thieme et al., 2012). Current methods utilize subjective rating scales, most of which enforce a restricted time period i.e. during people's use of an app from start to end (McNaney et al., 2012). One of the most commonly used scales for measuring 'mood states' is PANAS (Positive and Negative Affect Schedule). It blends mood and emotion related terms under the general term "affect" (McDowell, 2006). Watson (1999) defines 'affect' by categorizing it into "Positive Affect" (PA), which consists of *enthusiasm, alertness, activity and engagement*; and "Negative Affect" (NA), which consists of *distress, anger, guilt, fear and nervousness*. PANAS can also be used to compare before and after differences for a field study. For that reason, at the start of Phase 1 and the end of Phase 3 sessions, the PANAS scale was administered to participants. They were asked to read each of scale items and then to indicate on a 5-point Likert Scale to extend to which they felt the named item (where 5='extremely' and 1='slightly' or 'not at all').

2.1 Selection of mobile apps

The apps were selected from amongst those available through Google Play and the Apple App Store, considering the smart phone market share of Android (45%) and iOS (33%). First, the top twenty apps downloadable free of charge on both online stores were listed, then those not supporting English language were eliminated.

As the study was conducted in Turkey, an additional list showing the top 10 diet apps in Turkey was gathered. The apps common in both lists and compatible with both Android and iOS platforms were shortlisted for detailed examination. Given their most distinctive features, three apps were chosen for the field study: MyFitnessPal (by MyFitnessPal Inc.), Noom Coach (by Noom Inc.), and Calorie Count (by About Inc.). One of the prominent characteristics of MyFitnessPal is the food database that comprehends meals from Turkish cuisine with authentic names. The prominent difference of Noom Coach is a GPS-based workout tracker with integrated map, a pedometer, and a customisable music list that can accompany users during physical exercise. The links to discussion forums, its dedicated community, Facebook and Twitter constitute Calorie Count's prominent distinctive characteristics. Screenshots from each selected app can be seen in Figure 1.

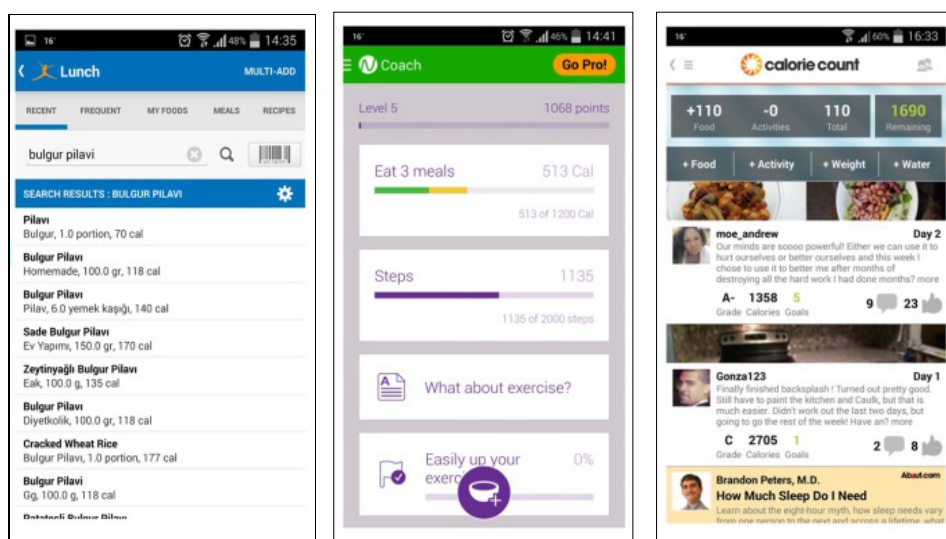


Figure 1: Screenshots from apps selected for the field study (MyFitnessPal, Noom Coach, Calorie Count)

2.2 Participant recruitment

Design for wellbeing is said to be successful in outcomes where users become actively involved, and if the successes of interventions are connected to willingness from users to pursue their own wellbeing and invest personal effort (Desmet and Pohlmeier, 2013). Therefore, having an interest in healthy eating or trying to lose weight at the time of the study was an essential consideration for the selection of the participants. In total, 15 participants having the following additional criteria were sourced for the study: owner of a smart phone and familiar in using mobile-based apps; having a good command of English.

2.3 Phases of the Fieldwork

2.3.1 Phase 1 (Pre-Interview)

In the handbook of Health Behaviour Change, all attempts for weight loss are named “individual-level approaches to dietary change” and contain several key elements to succeed in weight loss and prevent regain (Mc-Cann and Bovbjerg, 1998). These key elements include nutrition education, goal setting, self-monitoring, ongoing program contact and social support. Taking this as a basis, in Phase 1, the participants were asked open-ended questions to understand their existing weight control preferences. The questions are as follows:

1. When trying to lose weight do you follow a special method? (e.g. consulting with a dietician, going on a diet, doing sports/exercises, etc.)
2. Do you set yourself a specific goal? (e.g. I'd like to lose 1 kg in a month / or more general just to lose weight, etc.)
3. Do you measure your body size and weight? How often?
4. Do you pay attention to the nutritional information of what you eat? (e.g. calorie, fat content, etc.)
5. Are you interested in any methods, suggestions, and facts for weight control?
6. Do you prefer having social support when trying to lose weight? (e.g. sharing it with friends, family, etc.)

Following the questions, the PANAS scale was administered, for which participants were asked to think about how they had felt within the last week. One of the three diet apps chosen for the fieldwork was assigned to the participants randomly (i.e. five participants to each of the three apps; 15 participants in total). To introduce the app briefly, participants were presented with a printed card explaining the app and containing five screenshots, a short description, and the main app features.

2.3.2 Phase 2 (Usage)

In Phase 2, participants were expected to use their assigned app for a minimum period of one week. During this period, participants were prompted by SMS messages two to three times a week. This was to remind participants about their commitment to the app (should they not already be using it) and also to invite feedback in case of any usage problems.

2.3.3 Phase 3 (Post-Interview)

On completion of Phase 2, participants were asked to complete the PANAS scale for the second time, this time considering the week that they had used the app. The participants were then re-interviewed. Initially, the same questions (except the first question) from Phase 1 were asked, to find out whether there had been any changes in participants' weight control preferences having used the app. Then, the participants were asked to state how frequently they used the app, whether they thought the app had helped them achieve/get closer to their goals, and how; and whether they had intention to continue to use an app for diet tracking.

Following this, the participants were presented with a table comprising a comprehensive list of features for the app that they had used. The table was used to find out which features participants had made use of or noticed/not-noticed. Also, specific features that they liked/disliked were questioned.

Finally, the participants were asked to (i) indicate how they felt (and how frequently they felt so) during the usage of the app (see Table 1); and (ii) provide a general assessment about the apps (see Table 2) against two provided 5-point Likert scales. In constructing the post-interview, Pace's (2004) guidelines for *optimal experience* were used as a guide, including: exploiting curiosity; being conscious of time urgency; matching challenges to the skills of users; focusing attention with relevant,

interesting content; avoiding distracting interface elements; and enhancing discovery with surprise. Csíkszentmihályi's (1990) features of *optimal experience* were also used, consisting of challenges, skills, deep concentration, clear rules, unambiguous feedback, loss of self-consciousness, control of actions and environment, and positive effect and intrinsic motivation.

Table 1 Frequency of moods and feelings felt during usage of the app

<i>Did the app made you feel...</i>	Never	Rarely	Sometimes	Often	Always
	0	1	2	3	4
Curious					
Challenged					
Skilful					
Focused					
Surprised					
Social					
Satisfied					
In control					
Self-confident					
Creative					
Motivated					
Engaged					

Table 2 General assessment of the app

	Never	Rarely	Sometimes	Often	Always
	0	1	2	3	4
Were you content with the interface elements?					
Were you content about the awards / offerings?					
Did it provide you with clear feedback?					
Was it easy to find the features that you want to use?					
Was it easy to complete the tasks that it requires?					
Do you think that it was easy to use?					

3 RESULTS AND ANALYSIS

A combination of qualitative and quantitative methods was used to analyse the information gathered from Phases 1-3. As a general approach, answers to the interview questions were thematically analysed. Voice recordings during interviews were transcribed into a written form and assessed by segmentation, categorisation and theme-based relinking. The PANAS scale, administered to the participants in Phases 1 and 3, is claimed to provide independent measures of positive affect (PA) and negative affect (NA) (Clark and Watson, 1991). In the scale presented to the participants, positive and negative emotions were presented mixed. During the analysis, in order to compare the before-and-after results, positive [i.e. interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, active] and negative [i.e. distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, afraid] affects were separated. Then, a Student's t-test was performed to see whether changes in values of PA and NA from Phase 1 to Phase 3 were significant. Mean PANAS scale values of five participants' answers (i.e. grouped by app usage) were calculated and the data were analysed according to the tables created considering these mean values (Figures 2 and 3).

3.1 Phase 1

Answers to interview questions showed that all participants had their own way of controlling their weight. The majority of the participants (13/15) preferred either doing sports or going on a certain type of diet. Despite body monitoring being proposed as an essential part of weight control (Baker and Kirschenbaum, 1993), it was barely indicated by participants. Just over half the participants (9/15)

stated a long-reaching or nonspecific aim such as ‘losing weight in general’ or ‘fitting into old clothes’. Again, the majority of the participants (14/15) stated that they paid attention to food nutrient information, and most (13/15) read about methods, suggestions and facts concerning weight control or healthy eating. Lastly, most of the participants (13/15) mentioned that they preferred to feel the support of their family, friends, peers, etc. whilst trying to lose weight.

3.2 Phase 3

For the analyses of PANAS, significant before and after mean values of PA and NA were investigated using a t-test. Mean (M), Confidence Interval (CI) Standard Deviation (SD), Standard Error of Mean (SEM) and p-values were calculated (see Table 3). The results were PA (p=0.37) and NA (p=0.16). By conventional criteria neither of these differences are considered statistically significant. Nevertheless, the increase in post-study mean values of PA and decrease in post-study mean values of NA showed that the apps might have contributed positive effects on some participants’ PA and NA. A study involving a greater number of participants may more clearly show the statistical differences between users’ before/after PA and NA values.

Table 3 Summary of T-test calculations

	Mean (M)	Confidence Interval (CI)	Standard Deviation (SD)	Standard Error of Mean (SEM)	p-value	RESULT
Before PA	2,9533	-0.4848 to -0.1914	0,3719	0,1176	0.3742	No statistically significant effect found
After PA	3,0990		0,3474	0,1098		
Before NA	2,0066	-0.1461 to -0.7861	0,5832	0,1844	0.1616	No statistically significant effect found
After NA	1,6866		0,3900	0,1233		

Analysis of the answers from the interviews led to the following results on weight control methods and preferences compared with answers from Phase 1.

Setting a specific goal. Just over half of the participants’ aims (8/15) were observed to have evolved from an ambiguous phrasing to a more specific and short-term target. The daily calorie intake calculated for each participant appeared as a determining factor in specifying aims for weight control.

Measuring body size and weight. The frequency of monitoring weight was slightly raised (from never to once a week) although the frequency of measuring body size did not change. None of the participants measured their body because they found it unnecessary or difficult.

Attention to nutrition information. Although most participants (14/15) stated their interest in nutrition information of foods in Phase 1, in reality around half (7/15) paid no attention to either calorie values or nutrition information provided by the apps.

Interest in methods, suggestions and facts. In Phase 1, a majority of participants (13/15) stated that they were interested in methods, suggestions and facts related to weight control and healthy eating. In fact, such information provided by the apps was not taken into consideration by many of the participants (9/15). Some complained about time limitations or a lack of quality information provision.

Social support. The social connectivity tools provided by the apps (e.g. Facebook) were not used by any of the participants, mostly because they did not want to share personal information.

The following results relate to general evaluations of the apps.

Frequency of the app usage. Despite the most effective approach to weight loss being to log food consumption (within 15 minutes of the event) or to record before eating (to trigger changes in food choices), none of the apps required participants to use food logging features before eating.

Achieving goals. All participants stated that the apps somewhat had an effect on reaching their goals for weight control, but they all had some difficulties during the food logging process, such as not being able to find the appropriate food. This decreased the benefit of the apps.

Intention for further usage of the app. MyFitnessPal persuaded participants to use a diet tracking app in the future because they believed in the advantage of the app. However, participants using Noom Coach and Calorie Count thought that these apps were not adequate for supporting a weight control process.

When the participants commented on the comprehensive list of features offered by the app that they had used, their most and least liked features were revealed as follows.

Most liked and used features. As expected, the most liked features were generally the most used features. The most used features were common across the three apps and concerned food logging, i.e. nutrient details, daily calorie calculation, and diary.

Least liked and used features. On the other hand, reminders of the apps for goal-setting, different tasks and challenges for ongoing program contact, and social network connections were the least liked and used features.

According to the results of feelings and moods within “optimal experience”, each feeling was expected to be felt at least moderately but the participants almost never felt social, challenged, surprised or creative. Figure 2 illustrates the participants’ feelings and mood frequencies according to the apps (based on the mean value across five participants). All of the apps fall short in affecting the social, challenged, surprised and creative feelings of the participants. They did however succeed in making participants feel moderately to quite-a-bit motivated and in control. Nevertheless, it is possible to single out MyFitnessPal because of its higher frequency levels for each feeling or mood.

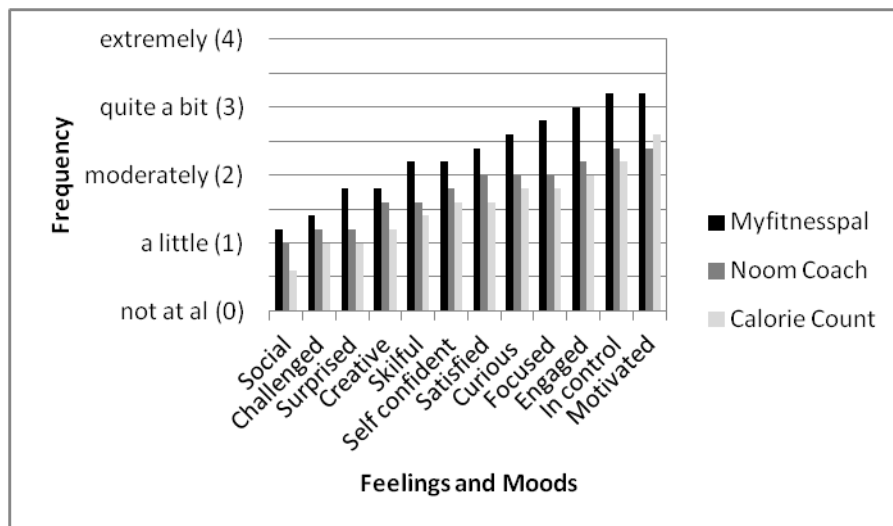


Figure 2: Feeling and mood frequencies analysed by app

According to the results of general assessment of the apps (see Table 2), all the apps made the participants occasionally content with their interface elements, and all of them made the participants rarely content about the awards or offerings provided by them. In relation to this, the highest frequency level was seen in ‘finding features easily’ in MyFitnessPal and the lowest frequency level was seen in ‘contentment’ in Calorie Count. Figure 3 illustrates participants’ assessment of the apps (based on the mean value across five participants).

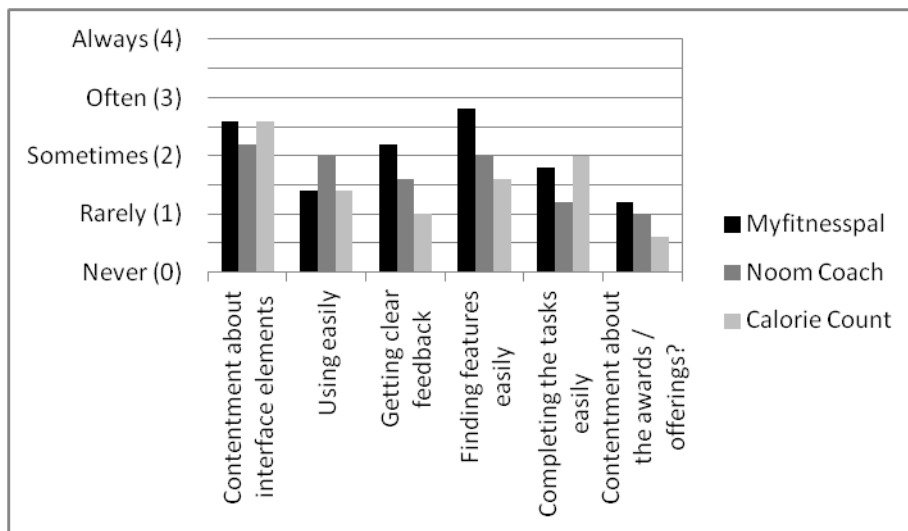


Figure 3: Assessment of the apps according to mean value

4 DISCUSSION

In the field of study of this work, it is known that people need motivation for setting themselves specific goals in relation to losing weight, and that they also need to monitor their weight, food intake and exercise levels. In consideration of the kind of dietary intervention programs (apps) studied in the fieldwork, a level of nutrition knowledge, setting a goal, regular (weight/body) monitoring, and social support during the app usage can be suggested as recommendations for good implementation.

General assessment of the apps showed that all participants experienced certain difficulties during interaction and usage. The apps offer most of the features for helping people to lose weight and enhance their wellbeing, but the presentation of these features should be reconsidered. Current mobile computing technologies provide developers with endless opportunities. Therefore, better design of the app interaction gains importance here. The features of the apps should be presented to users more simply and clearly so that the enhancement of wellbeing that is sought can actually be secured.

Food logging

Food nutrition information is important for weight control. In consideration of the importance of adhering to dietary change programs, it can be said that food databases and emphasizing different features is important for persuading users towards sustained app use. To keep users' attention, as suggested by some participants, the apps can provide more accurate, basic and explanatory information. Food logging was performed in similar ways in each of the three apps. It can be advantageous for the apps to offer additional information about food, to help increase the engagement of users and to increase the frequency of app usage. For example, comparative nutrition information between foods can be presented. Since the primary obstacle to achieving goals centred on food logging, it is suggested that food databases should be better developed. Additionally, the apps can broaden their food database to also assure users of the trustworthiness of the information they provide. It may be a challenging task for developers to include a wide range of cuisines and exact food ingredients and names in the apps. However, trying to find a close enough food match in the database appeared to be a bothersome task for users.

Weight tracking and feedback

Despite all the apps having charts for tracking users' weight easily, most of the participants in the field study did not make use of them. In that respect, the selected apps failed to point out the importance of weight and body size monitoring to achieving health and wellbeing goals. Instead, the apps could have demonstrated how easy it is to log weight and encourage users to regularly provide readings.

The positive feedback and encouraging statements offered by apps, e.g. 'well done' in circumstances when participants opted for healthy and low-calorie food, was observed to be successful in directing users towards specific aims.

The apps were not fully successful in providing participants with the methods, suggestions and facts they prefer to refer to. Some participants complained that limited time and lack of quality of the provided information were main reasons for lack of engagement. To eliminate these problems, Pace's

(2003) criteria for optimal experience (see 2.3.3) should be met. Therefore, the apps should be well equipped to guide their users; they should present information in a more interesting and engaging way; they should be conscious of time urgency; and they should inspire discovery with surprise.

Privacy

Despite all the apps having customisable privacy settings for sharing data, none were very clear in conveying the activation of privacy settings. On the contrary, the apps should reassure users' privacy, and should encourage them to be more socially connected to support their weight loss and wellbeing. This can be achieved for example, by introductory videos accessed through the social connectivity features.

Feelings and moods within optimal experience

All participants mentioned some problems with the apps during usage. The main and repeated task that participants were involved in was food logging. Difficulties faced during this task may have lowered the positive feelings and moods of the participants. In consideration with the general assessments of the apps, the reason of the negative feelings and moods might also be attributable to unclear app interfaces, and difficulties experienced during interaction (e.g. hard to find certain features).

In all three apps, the least liked and/or least used features should be developed, especially to ease the task of food logging. For example, introductory videos explaining the features of the app could be useful. Similarly, the app could present tips and reminders. Some features will surely benefit from integration of more advanced technologies. For example, despite automated capture of dietary intake, recognition of content and portion size from photographs is still a challenging though potentially high-impact area (Stumbo, 2013).

In addition to the acknowledged positive effects of the diet apps on wellbeing, discussions refer to the potentials of these apps for better supporting people's wellbeing. The results indicated that these apps could be the promising diet monitoring tools of near future due to the increasing rate of obesity and appropriation of mobile applications by people.

5 CONCLUSIONS

The work in this paper focused on developing rationale for improving diet apps designed for enhancing wellbeing. This was achieved by understanding the effects of three selected Android and iOS apps, and comparing their features and characteristics on users' thoughts, moods and emotions.

Based on the comparative results of a PANAS scale administered to participants before-and-after using the apps, it was found that use of apps that support weight loss and/or consumption of healthy food may have a slight positive effect on users' overall wellbeing according to the t-test results (PA ($p=0.37$) and NA ($p=0.16$)).

Following the use of the apps by 15 participants (divided equally across the three apps), the effects of the apps on participants' existing diet control preferences were discussed. It was uncovered that the apps could be developed better in order to positively support mentioned preferences. For example, positive feedback could be provided for achieving specific aims. Informative video demonstrations can be provided for motivating users to body-monitor. A broader database can be employed for increased tracking of nutrition information. Taking into account users' attention to methods, suggestions and facts about healthy eating, privacy options can be provided and users of the apps could be assured about the sharing of their information for more effective social support.

The field study allowed for the identification of app features in relation to their frequency of use, and whether they were noticed. The most and least liked app features, along with recommendations from the participants on the strengths and weaknesses of the existing diet apps were uncovered. The manual food logging, lack of positive feedback, and unappealing social network connections were prominent app weaknesses. Personalised daily aims, nutritional information, and reminders for body monitoring were prominent strengths.

The effects of the diet apps on aspects of optimal experience were also collected, which helped draw out additional suggestions for improving apps. For example: the employment of newly emerging technologies and comparative screens for making food logging easier – this would in turn would help solve problems that cause most of the negative feelings and moods of participants; the integration of existing technologies for more effective usage tips and reminders; the refinement of the apps' interfaces for ease of use; and the employment of increased security precautions and informative demos (e.g. though video clips) for greater uptake of social network features. With the implementation

of these suggestions, it is argued that a higher quality of user experience for the apps can be achieved and goals towards improved health and wellbeing are more likely to be realized. Although current diet control apps present some deficiencies, they have the potential to be further developed for human wellbeing; to help decrease the risk of obesity and contribute to a healthier and happier population.

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