

Denk je zèlf! Developing a Personalised Virtual Coach for Emotional Eaters using Personas

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Abstract — Obesity is a fast growing societal threat, causing chronic conditions, physical and psychological health problems, as well as absenteeism and large healthcare costs. Despite numerous attempts to promote physical activity and healthy diet, existing interventions do not focus on often occurring emotional causes of obesity. There is a need for self-management support of this vulnerable target group: emotional eaters. This paper presents the results of the design case study focusing on a holistic development of a personalised virtual mHealth coach that provides self-management training ‘Denk je zèlf!’ (Dutch for ‘Develop a wise mind and counsel yourself’). Target group are young adults with emotional eating disorder and obesity. The contextual inquiry study was conducted to get insights into the needs and experiences of the target users, including interviews and questionnaires with emotional eaters, obesity treatment patients and healthcare practitioners. Personas and user stories were derived from these results and translated into a new ‘Denk je zèlf!’ virtual coach, based on Dialectical Behaviour Therapy and experience sampling measures to capture user experience and emotional state. This paper makes two main contributions: (a) combining holistic design with behaviour therapy in one virtual mHealth coaching application for emotional eaters; (b) applying Personas to guide the design. Preliminary results suggest that an online self-management training might be useful for the target group. Future research will be aimed at iterative evaluation and further development of the dialectical dialogues for the virtual coach and content for the education and instruction modules.

Keywords-obesity; emotional eating; Dialectical Behaviour Therapy; personalised care; virtual coach.

I. INTRODUCTION

The fast growth of obesity is a threat for humanity. *Obesity* is defined as an abnormal or excessive fat accumulation that may impair health and is classified as such with a Body Mass Index (BMI) of 30 kg/m² or higher [1]. Obese patients often suffer from physical, metabolic, or psychological comorbidities, such as cardiovascular conditions, diabetes II, depression, etc. [2]. The number of years spent in relative unhealthiness (suffering from illnesses, disabilities) has impact on societal costs due to incapacity for work, absenteeism and large costs for healthcare [3]-[5]. Nearly 50% of the Dutch population suffer from being overweight or obese [2].

Obesity is associated with low socioeconomic background, unhealthy family lifestyle, bad eating habits and lack of physical activity. Increasing physical activity and reducing

food intake (dieting) are considered cornerstones in the prevention and treatment of obesity. Though many of existing interventions are successful and make patients losing weight in the short run, long term randomised studies demonstrate that diets are not the answer [6]. Existing interventions (the Big Two – eat less, exercise more, such as Weight Watchers [7], My Diet coach [8] and Lose it! [9] (online weight loss programs) do not offer the ultimate solution in the long run, since people are not able to maintain their bodyweight over a longer period of time.

A. Emotional eaters and obesity

Recent studies show that a certain group (40%) of the obese population overeat due to negative emotions [10]. Emotional eating (EE) is an atypical stress reaction. A normal reaction to stress and negative emotions would be loss of appetite. Emotional eaters show this atypical behaviour because they confuse negative emotions with hunger. They have a narrow view on what happens in their body (poor interoceptive awareness) and they are having difficulties identifying and describing emotions and feelings (high alexithymia). Emotional eaters are having problems with emotion regulation - the ability to keep one’s emotional system in a healthy condition [11].

Diets and behaviour therapies do not help people with high degrees of emotional eating as they do not treat the emotions resulting in the problem of emotional eating. Most treatment programs for obesity do not focus on emotion regulation [12][13].

B. Emotional eaters and eHealth

The majority of emotional eaters have a long history of dieting, followed by the inevitable overeating and starting dieting again. They gain weight because of poor emotion regulation, not just due to bad eating habits and/or due to an insufficient level of physical activity [14]. For numerous times, they have tried to loose weight and when the emotional eating behaviour kicked in again, they gained more weight than when they started their previous dieting episode. This is an example of the so-called ‘yo-yo effect’ in health behaviour [15][16]. It is highly imaginable that this is ground for an accumulation of disappointments and a growing disbelief one will ever succeed.

Evidence indicates that eHealth therapy can be just as effective as the face-to-face treatments. Evidence-based therapeutic procedures could be delivered online [17]. eHealth interventions allow for an effective therapeutic

relationship. In addition, this special target group needs personalised anonymous support that is always available. Not only emotional eaters need the moral support, a personalised self-management intervention could also clear away obstacles that hold emotional eaters from face-to-face contact with a therapist.

Obese emotional eaters form a very vulnerable group of people. To avoid further setbacks, they need support they can rely on, one that is trustworthy and auspicious, but realistic, in compliance with their needs. Such support needs to be accessible and comfortable so that one feels safe and secure. There is a need for supportive training programs for this specific target group of emotional eaters. This paper presents the design case study aiming at the development of a virtual mHealth coach application for self-management of young emotional eaters with obesity.

The rest of the paper is structured as follows. In section II, related work is discussed on (online) eHealth interventions for emotional eaters and obesity. After that, in section III the approach and methods are presented for developing Personas and applying them to guide the design process. In section IV, the results are presented including the Personas and the first prototype of a virtual coach. Finally, conclusion and discussion are presented in section V.

II. RELATED WORK

A. Dialectical Behaviour Therapy

Dialectical Behaviour Therapy (DBT) is relatively new in treating emotional eating behaviour. DBT was originally designed to help people that are suffering from Borderline Disorder [18]. The therapy focuses on the process of ‘reduction of ineffective action tendencies linked with dysregulated emotions’ [19]. Recent research on deployment of Dialectical Behaviour Therapy (DBT) shows positive results in weight loss management and weight maintenance in obese emotional eaters [20]-[23]. DBT might be successful in patients where insufficient effect was achieved with Cognitive Behavioural Therapy (CBT) [12] [24][25].

B. The dialectical focus

One of the most powerful ‘mechanisms of change’ or mediators in DBT is the dialectical focus. Since an invalidating environment plays an important role in the life of emotional eaters, it is important that they are treated with a well-balanced mix of being validated in their perception of negative emotions and being confronted with a practical focus on changing problem behaviour. “Based in the biosocial theory, DBT has a unique approach to targeting behavioural dysfunction that is not typically seen among other cognitive-behavioural treatments; one key difference is the emphasis placed on emotions and emotion dysregulation.” [19].

C. DBT and eHealth

There is a broad variety of (blended) eHealth self-management treatments available but the majority of them is focused on weight loss and behaviour change. The

discussion on the effectiveness of such interventions inches along [26]-[32]. Little knowledge in the field of eHealth treatment using Dialectical Behaviour Therapy or even emotion regulation is acquired so far, let alone emotion regulation focused on emotional eating behaviour.

Results of one quasi-experimental study on the effectiveness of the mobile “DBT Coach”, that focused only on one particular skill in DBT (Opposite Action), showed that emotion intensity decreased within each coaching session in participants with Borderline Personality Disorder [33][34]. The target group uses the DBT Coach when it is needed most for them – after getting engaged in dysfunctional behaviour. One publication discusses the lack of user-friendliness of a DBT self-management mHealth application [35].

A small number of self-management mHealth apps can be found at the Play Store (Android) and at the App Store (iOS, Apple). However, they lack scientific grounding, user involvement in the design process, psychological aspects and personalization.

III. APPROACH AND METHODS

The objective of this research is to develop a personalised self-management intervention based on Dialectical Behaviour Therapy for young emotional eaters with obesity. Development is guided by the CeHRes roadmap (Center for eHealth Research, at the University Twente) – a holistic eHealth framework for developing eHealth interventions based on a participatory design process and persuasive design approach to maximize the impact of the intervention [36]. This study focused on the contextual inquiry and early design phases.

First, the contextual inquiry phase was carried out. In order to get familiar with what kind of support emotional eaters really need, it is important to understand the target group [36]. Even though interventions can be evaluated as positive according to effectiveness, as long as the target group will not be captivated by its design and functionalities, they are not going to use it.

The employment of user profiles and Personas as a tool to inform design is still rare in social sciences [36]. We followed the LeRouge classification model [37] and Van Velsen’s additions to it [38] as a guideline to develop two Personas to guide the design of a virtual mHealth coaching intervention. Personas contain information on their Internet skills and smart phone use, demographic facts and healthcare specifics such as current practices in managing own healthcare, support network, information seeking attitude etc.

To gather input for user profiles and Personas, questionnaires were circulated via social media and the network of contacts. The target group to be reached for was “young adults, 18-44 years of age” and self-declared emotional eaters. Examples of questionnaire questions: “*For what purposes do you use your smartphone?* (social media, news gathering, mail, gaming)”, “*At what specific moment in time would you like to/are you in need to get in contact with a help system?*”, “*What kind of support do you expect from a*

smartphone application?” We approached healthcare practitioners for expert interviews. In the next sections, we present the results of this design case study, including Personas, user stories, architecture and design of the new ‘Denk je zèlf!’ virtual coach.

IV. RESULTS

A. Questionnaires and interviews

In total, 321 responses were collected with the questionnaires and thirteen interviews with healthcare practitioners (dietitians, physical therapists and psychologists) were conducted. The interviews were transcribed and coded. We used a free coding style not to lose the richness of the data. In addition, six obesity therapy patients were interviewed to get insight into the daily needs and experiences of the emotional eaters.

Data extraction from the questionnaires was processed according to the method of LeRouge [37] for creating user profiles and Personas - (a) personal and demographic information; (b) technical capabilities and limitations; (c) needs and desires concerning support and care. Data derived from the interviews with experts and patients learned about eating styles and the problems emotional eaters run into.

B. Personas and user stories

Two Personas were derived from the questionnaires data: *Lisanne* (25 years) and *Anita* (46 years). Figure 1 shows their personal profiles. Lisanne is a highly educated young woman. She is an obese emotional eater. Her eating behaviour is caused by a negative self image. Eating gives her a feeling of comfort as long as the eating lasts. Afterwards she feels guilty and depressed. Anita is a 46 years old mother of two. She is worrying about the family’s financial situation and overeats in stressful situations. Anita left school at an early age. She is from a low socio-economic background.

What we learned by creating the Personas is that we got a better understanding about the specific needs of the target group. We obtained a better comprehension of the moments and situations that cause emotional eating behaviour and the kind of interference that might be helpful to them. While in the design process you can ask questions such as: “*What would Lisanne think of this? Would she like it? Would she consider this as useful?*”

To illustrate how Lisanne will benefit from the application we created a scenario (Figure 2) in which she is about to give in to emotional eating. Use-case scenarios [39][40] were derived from Personas, interviews and questionnaire results by describing the user goals, motivations, actions and reactions while using the new virtual mHealth coaching application.

C. eHealth Intervention Architecture

The first prototype of the smartphone application ‘Denk je zèlf!’ personalised virtual coach is developed within the pre-design phase.


Personal profiles emotional eaters	
Lisanne, 25 years, highly educated	Anita, 46 years, limited education
	
“I wish that I was more confident about myself”	“When I am stressed out I start snatching the cookie tin”
Background	
Lives alone, single / High school graduate / Suffers from obesity / Co-morbidity unknown / l. 1.62 mtr., w. 91 kgs.	Lives with husband and two sons / low SES / Suffers from obesity / Co-morbidity unknown / l. 1.65 mtr., w. 85 kgs.
Attributes	
Feels insecure about her body / Is not able to sense the difference between hunger, appetite or emotion / Fears to experience what she really feels.	Is worried about putting on more weight / Suffers from stress and finds comfort in food / Has a sweet tooth / Hates to be patronized (authorities).
User needs	
Education on eating behaviour / Self-confidence / Help to set realistic goals / Support from peers.	Stop gaining more weight / Education on healthy food / Getting support from her family / Stop harassing thoughts.

Figure 1. Key Personas Lisanne and Anita

Scenario Lisanne and the e-DBT ‘Denk je zèlf!’ virtual coach
<p>Lisanne comes home after a busy and frantic day at the real estate agent’s office. It has been a turbulent day and it felt like a lot of her colleagues were hot-tempered, judging by their blunt manners. Due to lack of time Lisanne skipped lunch. She satisfied her appetite with unhealthy snacks and cookies.</p> <p>At home she should start cooking her dinner but she is too worn out and totally not inspired. Her stomach is rumbling and she takes a quick glance at the store cupboard. She notices butter biscuits and potato chips. She feels tempted to rip open the bag of potato chips and plunge into it, grabbing chips by the handfull at the same time. Binge eating lies in ambush for attack and she senses a crying need for some kind of support, for someone who could provide her with advice to pull her through this situation.</p> <p>She reaches for her phone and activates the ‘Denk je zèlf!’ app. The virtual coach welcomes her with: Hi Lisanne, how can I help you? Lisanne starts typing:</p> <p>-When I come home from work I start craving for snacks and chocolate... I just can’t resist them...</p> <p>-Hi Lisanne, the greater part of emotional eating occurs at night, due to feelings of loneliness or experiencing stress, but it can also happen because of irregular eating behaviour. Shall we give it a try to investigate this?</p> <p>The virtual coach refers Lisanne to the behaviour chain analysis. Lisanne finds comfort in the reassuring words of the virtual coach and starts with the behaviour chain exercise.</p>

Figure 2. Scenario Lisanne.

The training consists of a series of education and instructions modules on emotional eating behaviour and emotion regulation. A personalised virtual coach will guide the user through four different modules. First an ‘intake procedure’ will take place: the user will be invited to make a commitment never to lose oneself in emotional eating behaviour again, followed by educational modules on mindfulness, emotion regulation and stress tolerance (Figure 4). The training offers exercises based on practical experience in daily life. Modules are replaceable – they can be substituted by modules with content that is focused on users with low socioeconomic status.

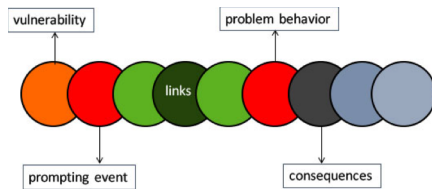


Figure 3. Behaviour chain analysis model by Linehan [17]

Users are invited to fill in their behaviour chain analysis (Figure 3) and emotion diary on a daily basis. Reminders to do so are sent out on fixed moments (by agreement with the user). Both components are considered indispensable in the face-to-face training being daily ‘homework’ for the participants. The behaviour chain analysis is to be performed at the moment a participant has given into cravings and bad eating behaviour or is just about to do so.

The behavioural chain analysis is utilised to analyse problem behaviour and determine prompting events and vulnerability factors. People can also fill in new skillful solutions and ways to prevent prompting events and think of solutions to reduce vulnerability in the future.

D. ‘Denk je zèlf!’ Personalised Virtual Coach

The virtual coach was invented to meet the needs of the user for immediate support. Every time a user is experiencing negative emotions he can connect to the virtual coach and ask questions and start a dialogue. The virtual coach is the very heart of the e-DBT ‘Denk je zèlf!’ training. It supplies the user with so called dialectical dialogues – providing them with answers to their need for change and to their need for acceptance. According to Lynch et al. [19], dialectical theory is defined as: “The thesis (behaviour change) brought forth the antithesis (the need for acceptance), and both acceptance and change-based strategies were integrated into the treatment package (*synthesis*). Dialectical theory provides the theoretical undercurrent needed to balance and synthesise these strategies. Core acceptance-based strategies derive from client-centered approaches and Zen practice and these involve mindfulness skills, validation, and radical acceptance.” [19, pp.463]. The goal of the training is to teach people developing their own wise mind and to learn making decisions that have consequences for the quality of life. By providing dialectical dialogues the virtual coach helps the user practicing this process of decision-making by identifying the possible consequences of choosing either one of them. The output of

the virtual coach is personalised by data derived from the behavioural chain analysis and the emotion diary. The virtual coach is a self-learning system. Ecological momentary assessment (EMA), often called as experience sampling measures (ESM), is applied within virtual mHealth coaching application to assess behavioural aspects [41][42], for instance by assessing subjective momentary states several times a day via a user-experience diary integrated in a virtual mHealth coach application.

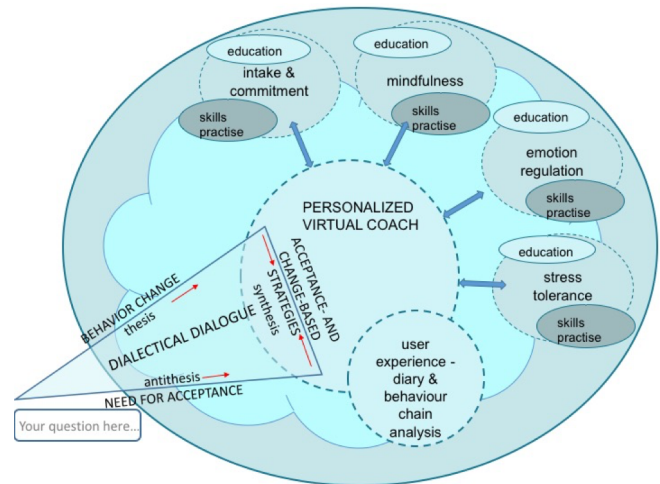


Figure 4. Schematic drawing of ‘Denk je zèlf!’ mHealth intervention

In order to develop the virtual coach, including the two vital parts of the coach - the behaviour chain-analysis and the emotion diary - Personas and use-case scenarios were translated into user stories. Next, user stories are translated into a prototype of the virtual coach. Java-based virtual assistant (developed on the Play framework) makes use of an open-source natural language parser named *Alpino*. This Dutch linguistic language analyser [43] is self-learning and produces ‘tree diagram’ data in XML format. The output is stored in a graph database (NEO4J).

V. DISCUSSION AND CONCLUSION

In the process of developing a self-management intervention for a vulnerable group of obese emotional eaters, it is essential that the design and application meets the needs and expectations of the target users. By questioning the target group and mapping out their needs and wishes, user profiles were defined and two Personas Lisanne and Anita were formulated. Personas provided the needed guidance to define user stories that were translated into a first prototype of the personalized virtual coach ‘Denk je zèlf!’. This new interactive prototype will be iteratively evaluated together with users and healthcare practitioners.

The next step is to conduct a field test with members of the target group on the usability and the content of the virtual coach. The content – dialectical dialogues - is collected from handbooks for therapists and derived from online user groups. The users will be given small assignments such as navigating to the virtual coach and starting a conversation. We ask them

to judge the replies of the coach by their faithfulness and truthfulness. The output will not only benefit the quality of the interaction with the virtual coach but the information will also be used to enrich the characters of the two Personas.

Lisanne and Anita served as a starting point for a concept design (Figure 5) and they will guide further development of the user interface and content of 'Denk je zelf!' modules intake, mindfulness, emotion regulation and stress tolerance.

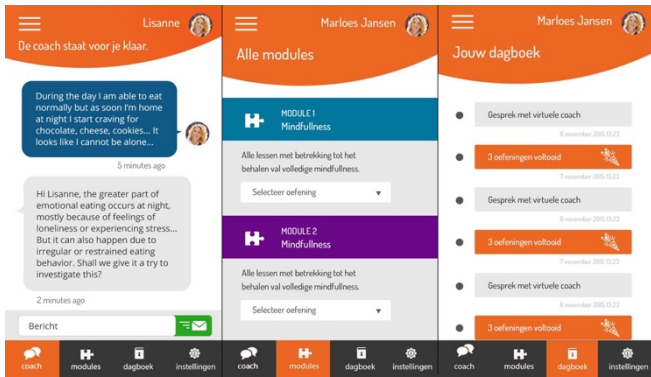


Figure 5. Concept design of the virtual coach

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