

The Application of Validating and Dialectical Coaching Strategies in a Personalised Virtual Coach for Obese Emotional Eaters

Rationale for a Personalised Coaching System

Aranka Dol¹, Christina Bode², Hugo Velthuisen¹, Lisette van Gemert-Pijnen², Tatjana van Strien^{3,4}

¹Institute for Communication, Media & IT, Hanzehogeschool UAS, Groningen

²Department of Psychology, Health and Technology, University of Twente, Enschede

³Behavioural Science Institute, Radboud University, Nijmegen

⁴Department of Health Sciences and the EMGO Institute for Health and Care Research, VU University, Amsterdam
e-mail: ¹{a.dol, h.velthuisen}@pl.hanze.nl, ²{c.bode, j.vangemert-pijnen}@utwente.nl, ³t.vanstrien@psych.ru.nl

Abstract—There is a growing number of eHealth interventions aiming at enhancing lifestyle to address obesity. However, the existing interventions do not take the emotional aspects of obesity into account. Forty percent of the overweight population is an emotional eater. Emotional eaters gain weight because of poor emotion regulation, not just due to bad eating habits. We aim at developing a personalised virtual coach ‘Denk je zèlf!’ providing support for self-regulation of emotions for obese emotional eaters. This paper presents a research study protocol on validating persuasive coaching strategies in emotion regulation, based on Dialectical Behaviour Therapy, ultimately targeting behaviour change. Our goal is to design a personalised eCoaching framework, allowing us to optimally translate successful behaviour change mechanisms and techniques, such as dialectical strategies, into personalised persuasive coaching strategies.

Keywords—obesity; emotional eaters (emotional eating behaviour); Dialectical Behaviour Therapy; validation strategies; dialectical strategies; eHealth; mHealth; persuasive technology; virtual coach; personalised coaching.

I. INTRODUCTION

Obesity has become a major societal problem worldwide [1]-[3]. The main reason for severe overweight is an excessive intake of energy, in relation with the individual needs of a human body. Obesity is associated with poor eating habits and/or a sedentary lifestyle. A significant part of the obese population (40%) overeats due to negative emotions [4]. They suffer from food cravings and give in to food binges in response to high negative feelings or stress. There is little attention to the personal needs of emotional eaters when it comes to existing health interventions [5]-[7]. Current face-to-face treatments have insufficient recognition to affect regulation.

There is a need for self-management support and personalised coaching for emotional eaters to train themselves in recognising and self-regulating their emotions [8][9].

This paper is structured as follows: In Section II, we discuss the theoretical underpinnings of dialectical behaviour therapy and persuasive coaching strategies. Next, in Section III, we elaborate on the design rationale of a personalised

virtual coach. And in Section IV we present the design of the research protocol. We finish this paper in Section V with a discussion on the expected contributions of this research study, conclusion, and future work.

II. BACKGROUND

Virtual coaching systems form a broad and vivid research area [10]-[13]. Since chatbot Eliza was invented by Joseph Weizenbaum [14], many new studies have emerged. Over the last years, virtual coaches have been developed for behaviour change support, healthy lifestyle, and physical activity support [15]-[19]. Existing virtual coach applications lack systematic evaluation of coaching strategies and usually function as (tele)monitoring systems, limited to giving general feedback to the user on achieved goals and accomplished (online) assignments [20].

This paper presents the research protocol and design rationale for a personalised coaching system and the evaluation of persuasive coaching strategies for emotional eaters based on the Dialectical Behavior Therapy and Persuasive Technology.

This research study is a continuation of a previous study on the design and development of *emotion-enriched* personas [9]. The objective of developing a personalised virtual coach for obese emotional eaters is to raise their awareness about emotions, to enhance a positive change of attitude towards accepting the negative emotions they experience, and to accomplish a balance in body weight.

A. Dialectical Behavior Therapy

Dialectical Behavior Therapy (DBT) focuses on getting more control over one’s own emotions by reinforcing skills in mindfulness, emotion regulation, and stress tolerance [8]. Emotion regulation is about recognising and acknowledging emotions and accepting the fact that they come and go. The behaviour change strategies within DBT are based on validation and dialectical strategies [21]. Validation is about acknowledging one’s experiences or feelings, without judgment. Validation strategies suggest responding in an empathic way, by hearing another person’s point of view and accepting them (and their emotions) without judging.

Dialectical strategies help to find truth (synthesis) in opposing viewpoints and encourage a change of the users' attitude and behaviour. Opposites create incongruence between belief and behaviour since the stimuli or the given information contradict each other. Dialectical strategies focus on confronting the user with a practical focus on changing problem behaviour; the key is in finding a balance between acceptance of intense feelings and emotions and the need for change by adapting feelings and emotions using emotion regulation and interpersonal effectiveness.

Emotional eaters deal with an invalidating daily life environment. With a well-balanced mix of being validated in their perception of negative emotions and a confrontation (dialectical) focussing on changing problem behaviour, DBT offers powerful mechanisms of change [23]. Our eCoaching model translates these mechanisms into persuasive features and compelling dialogues.

B. Persuasive Technology

Persuasive Technology (PT) is a significant predictor of adherence and offers strategies to reinforce the validation – and dialectical strategies' influence on attitudes and behaviours [23]. We believe that PT can assist emotional eaters in attitude change and acceptance of their own emotions. It is essential to identify the intended outcome or change of the intervention, before determining the design principles and coaching strategies that would positively contribute to the persuasiveness in any way. We selected the Persuasive Systems Design (PSD) model [24] for translating behaviour change techniques from DBT into persuasive coaching strategies [25] since PSD focuses on persuasion context and easily implementable compelling design features. We assume that the integration of the dialectical behaviour change strategies and persuasive functions (PSD model) will enhance the personalisation of the virtual coach for emotional eaters and improve the effectiveness of the intervention.

III. DESIGN RATIONALE FOR A PERSONALISED VIRTUAL COACH

The virtual coach 'Develop a wise mind and counsel yourself!' (a translation of the Dutch title: 'Denk je zèlf!') in Figure 1 is an interactive and self-learning persuasive system that coaches attitude and/or long-term behaviour change by providing real-time personalised support [9] and by supplying personal feedback based on persuasive coaching strategies, originated from validation and dialectical strategies of DBT and persuasive features of the Persuasive System Design model [24]. It provides the user with practical exercises to enhance skills in mindfulness, emotion regulation and stress tolerance.

A. Components Virtual Coach

The virtual coach application consists of three different components:

1. the personalised Virtual Coach,
2. the emo.analyser,
3. a set of skills practices in mindfulness, emotion regulation and stress tolerance.

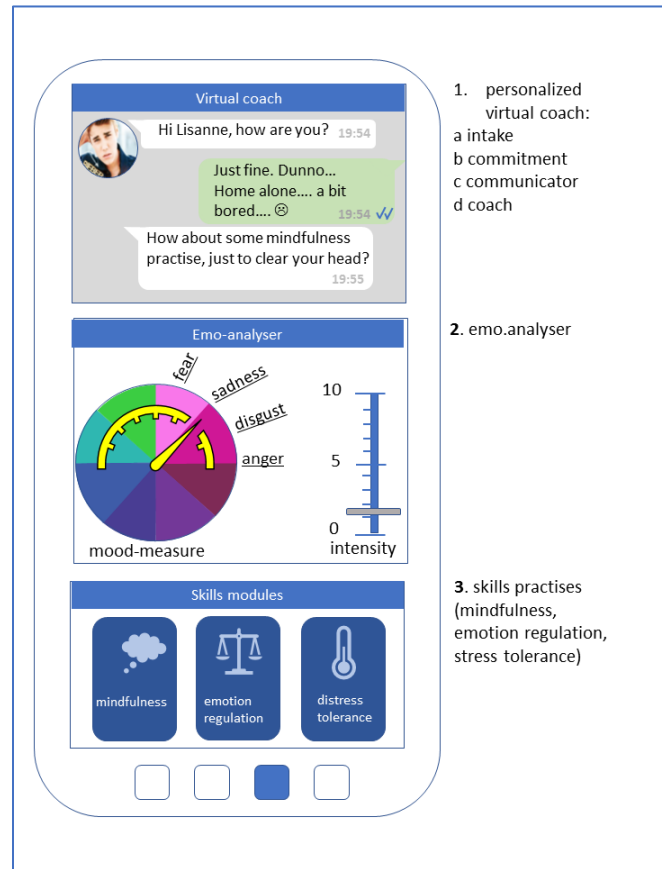


Fig. 1. Schematic overview Denk je Zelf! application

1. Personalised Virtual Coach

The virtual coach is the main part of the application. The virtual coach holds a central position in the application. It acts as a mentor or tutor throughout the application by four functions:

a. intake; b. commitment; c. communicator; and d. coach. It is always on hand for questions. After downloading and installing the application on the smartphone, the virtual coach will be nested in the Contacts list and will become a friend eventually. It communicates as the user prefers, via the private chat timeline delivered with the application, or in WhatsApp, Facebook Messenger, Slack or Telegram.

a. intake

New users have to download the application from the App Store. After installation of the application, the user is guided by the virtual coach to go to the intake module. It invites the user to register and to set a personal profile (the intake module) with information about demographics data, such as (nick) name, age, gender, weight, length, place of residence. The virtual coach wants to get to know the user to be able to provide the utmost service and personalised feedback. She will be asked to fill in questionnaires about her eating behaviour: "Are you an emotional eater?" [26] and about her personality traits: "What kind of person are you?" [27]. The virtual coach also offers features to customise the application

with favourite colour schemes, and to select a preferred picture to personify the virtual coach.

b. commitment

After leading the user through the intake procedure, the virtual coach helps the user to set personal goals and solemnly declare to quit emotional eating behaviour and to learn how to be prepared for the possibility of failure when things don't turn out to be useful at once.

c. communicator

The virtual coach welcomes users at login and acts as a point of contact. It supplies information about the application and redirects users to the other components. It provides the user feedback on the outcomes of the emo.analyser.

d. coach

The virtual coach provides feedback and coaching based on the information users put down in the emo.analyser.

2. Emo.analyser

The emo.analyser is a built-in tool to help the user to register what happened today that made them experience cravings or binges. The goal of the emo.analyser is to create awareness by examining the factors that lead to problematic eating behaviour and the consequences that follow on that behaviour. The user gets to the emo.analyser by (a). on her initiative, because she is experiencing cravings or is thinking of binging; (b). as a result of a conversation with the Virtual Coach, triggered by emotion - or eating behaviour related words, or (c). the user logged in after a reminder to visit the

app and the answer to one question about her current emotional status. In a progressive scheme the user will be questioned about her eating behaviour over the past 24 hours. See Figure 2. The first step of six is to point out the problem behaviour (1). Problem behaviour varies from mindless eating to binge eating. The next step is to determine the prompting event (2) that triggered the problem behaviour. Prompting events emerge in the user's surroundings. The user specifies what made her vulnerable (3) to perform that specific behaviour. This event could have an internal or external reason, such as physical illness or being home all alone, or being invited to a birthday party. The problem behaviour and the prompting event are linked (4) by a series of thoughts, actions, bodily sensations and cognition. Once these are all identified, users are to describe the consequences (5) of their problem behaviour. This way of behaving varies from staying away from a birthday party, to feeling numb, or being depressed. The last step in the chain is to figure out how to repair (6) and reduce vulnerability for example by getting more sleep, or by not buying snack food.

The emo.analyser collects the above-mentioned data and provides feedback, shown in a graphic presentation, on the discovered behaviour patterns. By doing the exercise over and over, the user gains a better understanding of patterns in how she responds to emotional occurrences, the impact on her eating behaviour, and the consequences for her emotional well-being. Based on the context (e.g., the weather, log data on location, calendar) and data about the personality and emotional state of the user, the virtual coach application enables tailoring of real-time feedback to the individual user (A). The Virtual Coach provides the user with validating and

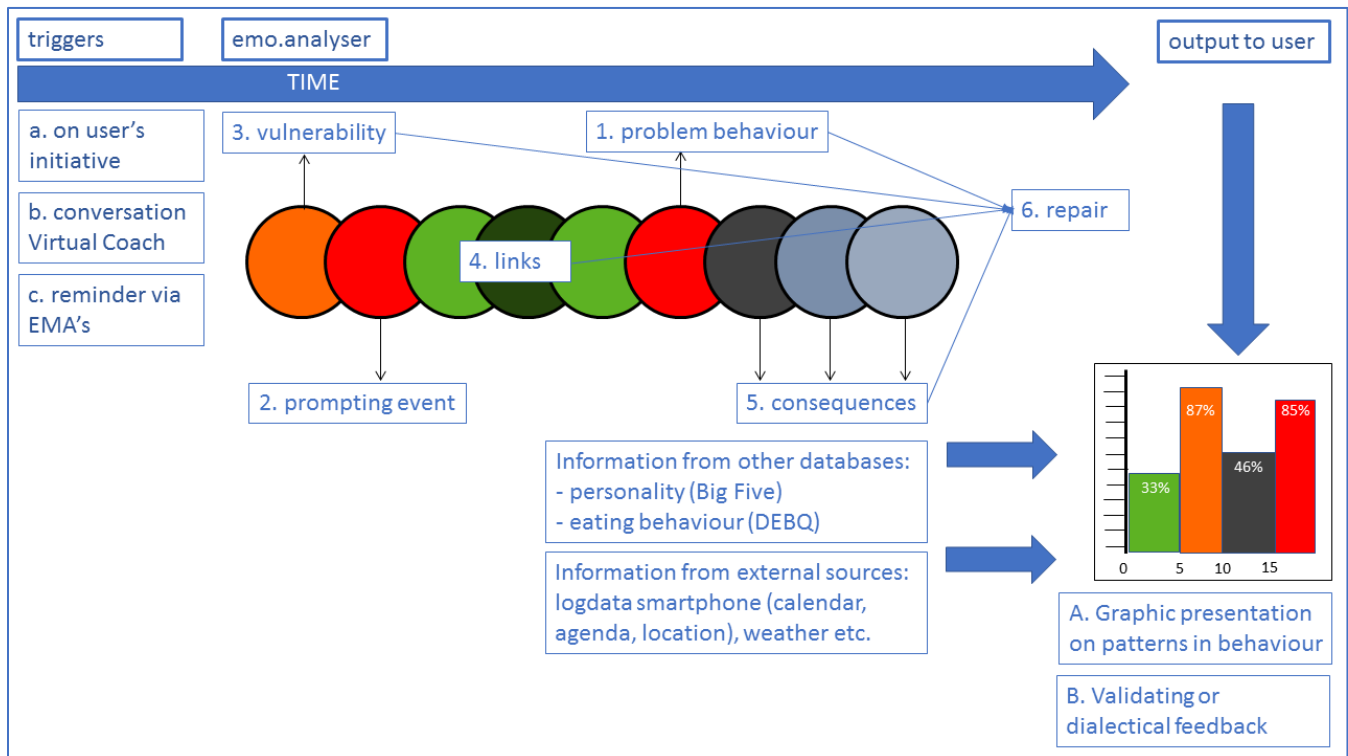


Figure 2. emo.analyser

dialectical coaching strategies (B). These strategies ratify the emotions that the user experiences, but could also put them on edge by providing statements that oppose each other. By expressing opposite sides that both hold true, a sense of imbalance might be achieved which brings about a renewed attitude towards her behaviour eventually [28]. It helps the user to monitor her emotional and behavioural patterns. Personalised coaching is articulated by providing validating or dialectical comments based on the patterns.

Validation strategies focus on ‘empathic’ approach suggesting to genuinely hear another person’s point of view and accept them (and their emotions) just the way they are, without judging. For example, in a dialogue a (virtual) coach is clarifying the message of the user by ‘*reflection*’: “So what I hear you saying is...” or ‘*direct*’: “To me it makes sense that...”; or ‘*empathising*’ the emotion “I can see you are sad”; or a cognition “Is that true, or you just think it is?”; or in a more ‘*cheerleading*’ way “You are doing well. I am proud of you!”, and radically accept the messenger.

Dialectical means finding the synthesis out of opposites (thesis + antithesis). It is finding a balance between acceptance and change: accepting the occurrence of strong feelings and emotions making use of mindfulness and stress tolerance and adapting feelings and emotions using emotion regulation and interpersonal effectiveness. Dialectical strategies focus on confronting the user with a practical focus on changing problem behaviour. Dialectical strategies consist of several sub-strategies, such as ‘*entering the paradox strategy*’ with “and” versus “but” responses; the use of ‘*natural change*’ with the “That was then, this is now...” response; the ‘*making lemonade out of lemons strategy*’ with the “That’s great!” response; the ‘*devil’s advocate technique*’, with the “Are you sure?” response, or ‘*extending*’ with the “Wow, that’s pretty serious!” response.

To make users completing the emo.analyser questionnaire on a daily basis, the virtual coach sends out a (WhatsApp or SMS) message to the user with the question whether she experienced problems with her eating behaviour, such as cravings or binges, over the past 24 hours. When answering “No” it goes to “exit” for this day.

3. Skills practises

The application contains three modules on skills practises in *mindfulness*, *emotion regulation*, and *distress tolerance*. The module mindfulness provides exercises in observing, describing and participating in reality, enhancing the quality of awareness in a person’s life. The module emotion regulation contains exercises in building self-efficacy and learning to cope with difficult situations. Distress tolerance teaches skills how to survive crises and to accept reality as it is.

B. Functionalities Virtual Coach

The application Denk je zelf! contains four types of tasks: 1. Conversational features; 2. Functional features; and 3. Ecological Momentary Assessments.

1. Conversational

The conversational tasks are carried out by the Virtual Coach. The Virtual Coach (VC) is a text-based both conversational and functional in-app chatbot [29][30]. It has conversations with the user over the built-in timeline, or via WhatsApp or Facebook Messenger. As a contextual help system, it understands text from users to a certain extent, based on natural language processing and recognising wording patterns from an emotions-related lexicon. The VC is always available. It knows the user’s name. It produces appropriate textual feedback and coaching according to the information that users have filled out in the emo.analyser.

2. Functional

The Virtual Coach provides users with useful information about emotional eating behaviour. It redirects users to valuable skills practices. It sends out reminders/invitations to use the emo.analyser. The user controls the whole process of *onboarding*. It starts with some basic options. The user has the ability to opt-out any time. It guides the user through the onboarding process (Fig. 3) – the whole course from first log in (1), via setting the personal profile (2), to arrival at the actual start-up screen (3), in which the user dictates how much time she spends on the intake procedure at that very moment. The more steps involved, the more knowledge about the user is collected.

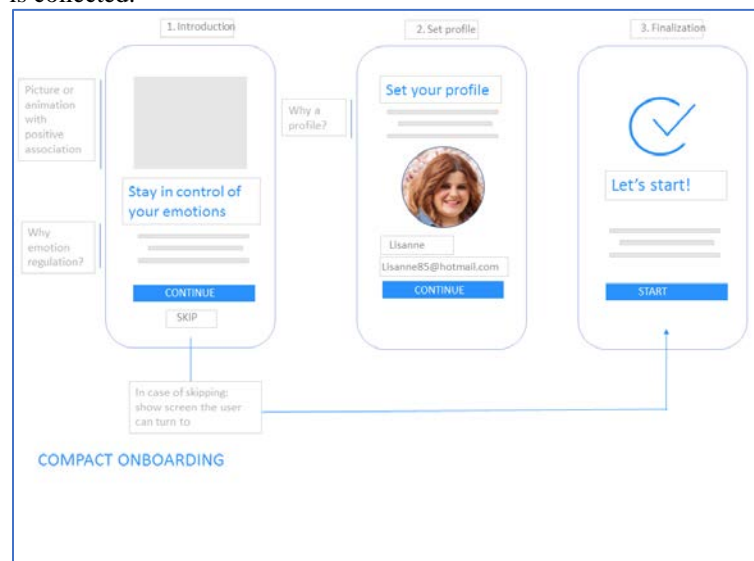


Figure 3. Compact onboarding

The Virtual Coach provides the user with visualisations of the data generated from the questionnaires at intake and from data collected by the emo.analyser. Data is stored in a local folder on the smartphone.

The option-based user interface (Fig. 4) presents the user with an overview of options with the help of which the user can respond. A multi-functional keyboard makes it easier for the user to find essential issues such as favourite skills practices, pages last visited, and fun stuff just by pushing the right button instead of typing words.

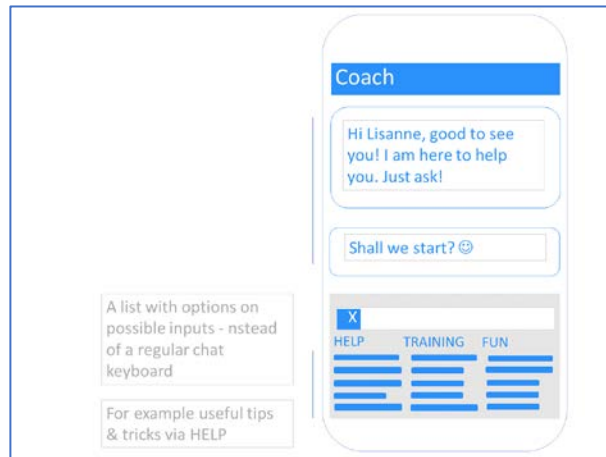


Figure 4. Option-based keyboard

3. Ecological Momentary Assessments (EMA)

Ecological Momentary Assessments are applied to systematically collect data about daily experience and feelings of the users, as well as the context of use, for instance, through a user-friendly smartphone application. Experience sampling is widely used in daily psychiatry practice [30][31], allowing to measure and record encountered feelings and emotions through mHealth applications in real time.

The Virtual Coach sends out a daily message via the built-in timeline, or via WhatsApp or Facebook Messenger inviting the user to log in into the application to answer just one question: "Did you have cravings or binges today, in the last 24 hours?". As soon as she answers that question with a "yes", she will be redirected to the emo.analyser.

IV. APPROACH AND METHODOLOGY

Before starting developing a prototype of the above-mentioned modules and functions, more research is needed to find out how the target group experiences the validating and dialectical coaching strategies. That is why we put up an experimental study design first. For this vignette study - described under V. A. *Vignettes study* - we designed a low-fidelity concept of the virtual coach to evaluate validating and dialectical strategies with target users. This concept version lacks the functionality of the emo.analyser and the conversational functionalities. Next step will be building a working prototype of the emo.analyser. The functional criteria, as drawn up along the lines of the *Behaviour Chain Analysis* [8, pp.57-58,75] from the Dialectical Behaviour Therapy will then be coupled with the outcomes of the vignette study, being the ratified coaching strategies.

A. Vignettes study

In the design of this experimental study, participants are presented with scenarios describing the daily life of a persona [8]. A persona is a fictional representation of the target group of emotional eaters. The persona experiences the very same negative emotions and also encounters food cravings that can lead to binge eating. The realistic scenarios are based on validated personas [9]. The depicted circumstances in the vignettes [33]-[35] will appeal to the emotions and feelings of

the participants in the study. See Figure 5. Three different coaching strategies are presented at random to the participants: 1. validating response, 2. confronting or dialectical response, or 3. a combination of a validating and a dialectical response.

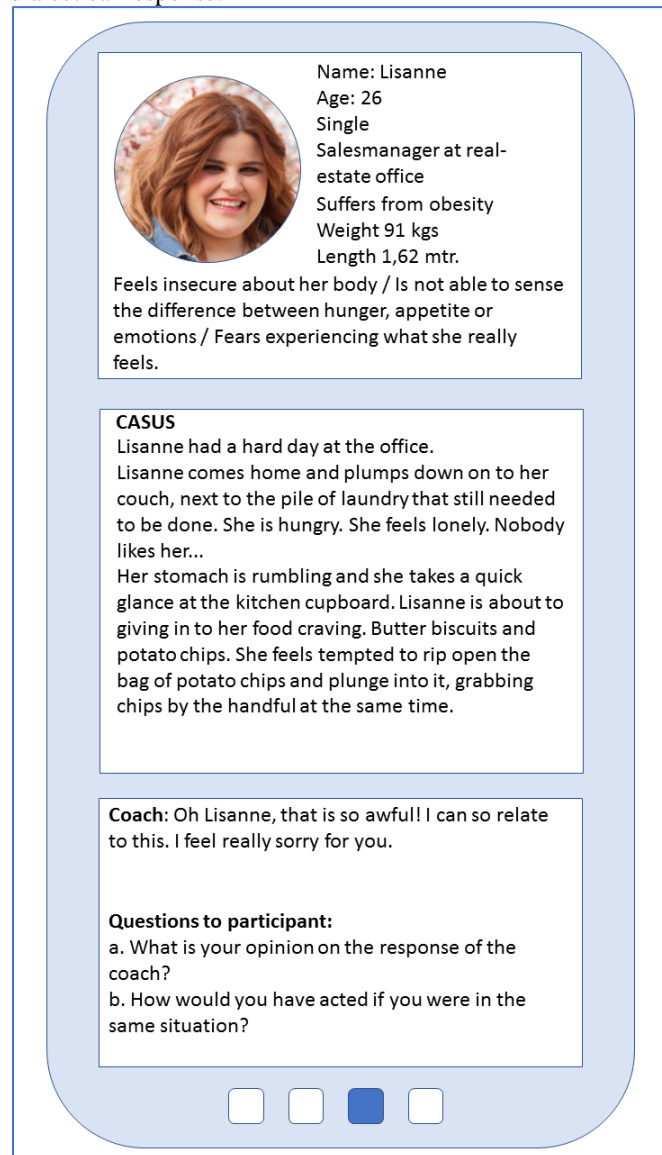


Figure 5. Vignette, example.

B. Research questions

This research study aims at answering the following research questions:

- Which coaching strategies do emotional eaters prefer just at the moment they are experiencing food cravings and are about to give in to bingeing?
- Is there a relationship between the participant's preferences and her personality traits?
- Is there a relationship between the emotional eating behaviour (e.g., intensity, fierceness, what negative

emotion is dominating, time of the day etc.) and the participant's preferences for a coaching strategy?

We will ask the participants to state their opinion on the given scenario. Does it seem realistic to them? Do they relate to the personas? Do they find the given feedback useful? How would they respond to the provided feedback themselves? What kind of coaching style would they prefer?

For the vignette study, we will use Qualtrics - a tool to interrogate experiences and to distribute questionnaires [36].

C. Questionnaires and measures

After answering the questions on the vignettes, participants will be referred to sequential inquiries to get to know them better: "What type of eater are you?" on eating behaviours, "Who are you?" on personality traits and "How do you feel at the moment?" on current emotions:

1. the Dutch Eating Behavior Questionnaire (DEBQ) [26] with 33 questions to determine which eating behaviour out of emotional, external, and restraint eating behaviour is prevalent, using a 5-point Likert scale (1=never; 5=very often),
2. The Quick Big Five Personality Test [27], based on the five-factor model that describes five broad trait dimensions, to identify the personality traits neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness, using a 5-point Likert scale (1=does not apply; 5=applicable). The results of this questionnaire will give us more clues about what personality traits will be suitable for the application.
3. The Positive and Negative Affect Scales (PANAS) [37], containing 20 feelings and emotions the participants experience at this particular moment, using a 5-point Likert scale (1=very slightly or not at all; 5=extremely).

During the whole time span of the research study, namely seven days, some Ecological Momentary Assessments [29][30] will be carried out. Participants receive text messages (SMS) on a daily basis, with an invitation to log in to the application and answer to just one question: "Did you have cravings / have a binge today?" In case of a "YES", participants will be redirected to a questionnaire named *emo.analyser*, the trying-plane for the future *emo.analyser* application. In this questionnaire, participants will be asked to fill in what happened right before they gave in to a binge, and which emotions/feelings they were experiencing.

In this chain of events and emotions, they analyse the vulnerabilities that made them open to experiencing specific events, developing strong feelings and emotions over it, and making them giving in to binges. In case of a "NO" participants will be invited to answer some additional questions.

D. Methods

The target group consists of emotional eaters (N=45), women, age 18 years and upwards. Participants are recruited

via a Dutch franchise organisation of dietitian nutritionists, who are specialised in treating emotional eating behaviours.

First, a pilot study will be conducted with 2-3 participants to validate the study protocol and to test the questionnaires. Participants are ensured in the anonymity of their participation. Data collected during this research study will be analysed for research purposes only. The data will be stored anonymously and safely on a local server, using an encrypted secure network connection (https) only the main researchers have access to.

Recruited participants are invited by email to visit the stated link. They will be asked to fill out the demographics data, such as (nick) name, age, gender, weight, length, place of residence.

Participants will be invited to participate in a semi-structured post-interview to discuss their experiences with the presented dialogues and their motivation for picking specific answers. Post-interviews will be audio recorded with permission of participants.

V. DISCUSSION, CONCLUSION AND FUTURE WORK

This paper presents the research study design to evaluate and validate coaching strategies that emotional eaters prefer in a personalised virtual coach, based on their emotional state and context. The potential contribution of this research is divided into two objectives.

First, a multidisciplinary holistic user-centered design approach [38] provides valuable insights into preferred persuasive coaching strategies of the target users for developing a meaningful and persuasive virtual coaching system for self-managing emotions. One of the primary goals of the personalised virtual coach for emotional eaters is to raise their awareness of their own emotions and to enhance a positive change of attitude towards accepting the negative emotions they experience daily. Ultimately, improving emotion regulation is expected to lead to better weight management of emotional eaters.

Second, it will gain more insights into applying the behaviour change techniques from health psychology and persuasive technology for virtual coaching application. Next step is to focus on developing virtual coaching systems that coach the user by analysing real-time behaviour by providing real-time personalised timely feedback based on user profile, events, and context. Coaching-based applications can provide self-management support for patients at times when a therapist is not available, or in the case that the user needs personalised anonymous help that is always within reach, which is the case for emotional eaters who often experience feelings of shame.

After conducting the vignette study we will be able to provide personalised and customised feedback and coaching based on experienced and digested emotions and feelings that users have entrusted to the *emo.analyser*, so the next step will be to construct the first working prototype of the *emo.analyser*. After user evaluation, the functionalities of the *emo.analyser* will be integrated into a choice-based user interface.

To conclude, this study makes two main contributions: (1) gaining more insights in: a) what coaching strategies do

emotional eaters prefer; b) what triggers emotional eaters to (over)eat and at what times of the day the craving usually occur; c) emotional states at the moments of experiencing food cravings and giving in to binges, and (2) we aim at developing a general personalised eCoaching framework, enabling the optimal translation of successful behaviour change techniques, such as dialectical strategies, into persuasive coaching strategies implementable for broader target groups.

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