

# Remember to smile – design of a mobile affective technology to help promote individual happiness through smiling

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## ABSTRACT

Wellbeing plays a central role in quality of life and encompasses aspects pertaining to mental and social wellbeing, as well as physical wellbeing and the absence of disease. Building upon the natural human understanding that smiling is an expression of happiness, studies have shown that the process of smiling in a genuine manner can help to improve an individual's happiness. To date, approaches that measure happiness have relied upon subjective self-assessment using one of a wide range of questionnaires. However, more recently, Affective Technology has emerged that provides the potential to move towards a more objective assessment of happiness. This paper describes a proposed study aimed at evaluating a bespoke smartphone-based affective technology that attempts to promote happiness through smiling, by reminding participants to smile on a regular basis.

## Author Keywords

Affective Computing; Happiness; Human Computer Interaction; Mental Wellbeing; Mobile Health; Mobile Technology; Positive Computing; Positive Psychology; Reminding; Smiling.

## ACM Classification Keywords

H.1.2 User/Machine Systems, H.5.2 User Interfaces, I.2.10 Vision and Scene

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Understanding, I.4.9 Applications, J.3 Life and Medical Sciences, J.4 Social and Behavioral Sciences.

## INTRODUCTION

Internationally, governments have long recognised the importance of maintaining and promoting wellbeing and quality of life of among their citizens towards: increasing economic benefits, improving productivity and reducing demands on health care. More recently, this awareness has broadened to include additional dimensions of wellbeing such as mental and social wellbeing [7]. This is, in part, prompted and supported by the World Health Organization's longstanding inclusion of mental and social wellbeing as key indicators of health, physical wellbeing and the absence of disease [20].

At an individual level, we all share a fundamental desire to be happy, although perhaps while not always fully understanding the wellbeing benefits that this can bring. Within this natural understanding of the value of happiness, smiling has always been viewed as an easily identifiable indicator of an individual's happiness. Accordingly, there exists a long established scientific understanding of the reciprocal relationship between the two, with smiling being understood to help improve an individual's happiness through facial feedback mechanisms [15, 11]. An initial reaction to the understanding that smiling can improve happiness could simply be to encourage people to smile more. However, a more complex relationship exists between smiling and happiness. Genuine and forced smiles are processed through different pathways within our brains [18], and faking a smile can lead to

emotional dissonance, with links to depression [9]. As such, care must be taken to encourage genuine smiles when attempting to improve happiness. Given the growing popular interest in happiness and rising public awareness of the potential benefits for emotional wellbeing, there have been a number of lifestyle initiatives aimed at promoting more positive attitudes, such as *Action for Happiness* [1]. There has also been an increase in the use of technology to promote awareness of happiness or even attempt to improve individual happiness, a notable example being *GPS for the Soul* [6]. Moreover, it has been shown that the use of smartphone applications to deliver interventions aimed at promoting happiness can be effective [10].

The overarching goal of the research outlined in this paper is to explore the potential role of affective technology in attempting to improve the happiness of individuals within society through the medium of a dedicated positive technology [4]. In an effort towards this goal, the following hypothesis has been posed, "*Individual happiness levels can be improved following regular use of a smartphone application that has been designed to encourage genuine smiling on a regular basis.*"

#### **BACKGROUND**

To date, approaches to measuring and quantifying happiness, at a societal and individual level, have been predominantly subjective in nature, paper-based, and differing in format due to their specific definition of happiness [13]. More recently, technology advances in the field of Affective Computing have demonstrated the potential for a more objective method of measuring emotion [14,12,16]. Underlying the ability of such technology to classify emotion through facial expression is the well understood and established Facial Action Coding System (FACS) [5]. These technologies typically support such underlying approaches with facial feature tracking, skin detection, data analytics and machine learning techniques in order to help improve robustness and accuracy. The use of much of this resulting technology has initially been focused on analysing and enhancing the effectiveness of advertising, through the measurement of

engagement and emotional response [17]. However, there is potential to use this technology within a dedicated Positive Computing approach in support of mental wellbeing. That is, to produce "*a technology that is purpose built and dedicated to fostering wellbeing and/or human potential in some way*" [4]. While there has been growth in the use of smartphone applications to support activities aimed at improving happiness, notably journaling, meditation and mindfulness, these generally still rely on subjective reflection prompted by the technology rather than the use of Affective Computing in a more meaningful way. Approaches that try to make use of more objective Affective Computing techniques, such as HappinessCounter [19], are much less common, as are technologies that take a dedicated Positive Computing approach, such as that proposed in this study.

#### **METHODOLOGY**

The proposed study aims to evaluate the efficacy of a smartphone-based affective technology for improving participant happiness through genuine smiling on a regular basis.

##### **Experimental design**

This initial study will employ a quasi-experimental one group pretest-posttest design to facilitate early evaluation of the hypothesis and of the corresponding experimental setup; specifically, the data collected and smartphone application's functionality and user journey. However, we have taken steps to improve the protocol's internal validity through the collection of additional data proximate to each intervention. Given this approach, it should be possible to establish if there is any potential causal link that merits testing with a larger, more controlled, experiment. The study will involve a group of 45 healthy adults, recruited from a population of university staff and students, who will use the smartphone application four times per day over the course of a 30 day period.

##### **Pre-test design**

At the outset of the study, a self-reported happiness level will be recorded using the Subjective Happiness Scale [13]. This will form the baseline happiness assessment against which

the participant’s post-study happiness levels will be assessed. Demographic data, specifically gender and age group, will also be collected in order to help facilitate subsequent participant modelling.

**Main study design**

During the study, participants will be reminded to access the application on their personal smartphones, to reflect on a stimulus that may encourage them to smile and to allow themselves to smile for approximately 30 seconds. It is this smile that will be analysed using the Affective Computing component of the smartphone application. Personalised reminders will be issued in order to encourage participants to engage with the application on a regular basis. Additional data relating to contextual circumstances that are proximate to each session will also be collected in order to gain further insight into contextual circumstances that might have impacted on the nature of the participant’s smile and engagement with the application. Participants will also complete a single-item happiness scale [2] during each session, to help model ongoing changes in reported happiness levels.

**Post-test design**

At the conclusion of the study period participants will once again complete the Subjective Happiness Scale. This post-test assessment will be compared to the baseline measurement, taken at the outset of the study, in order to determine

any significant change in reported happiness levels that may be as a result of having engaged in the experiment. Additionally, participants will complete a post-study usability assessment of the smartphone application using the System Usability Scale [3]. This will help to determine if any usability factors may have effected the results. Moreover, it will help to inform the design of future iterations of the smartphone application.

**STUDY DELIVERY**

The study to be delivered through the soHappy affective technology, which manages all aspects of pre-test, intervention and post-test experiment delivery and data recording, as illustrated in Figure 1. Reminders will be issued as push notifications to promote participant engagement in the study. Participants will be able to personalise the time of the reminders, if desired, to help to promote adherence. The Video Masker component partially obscures the live video feed from the smartphone’s front-facing camera. This was included as it was felt that participants might feel self-conscious smiling at their own image, particularly as application engagement may, at times, take place in a public setting. However, fully obscuring the camera feed was not an option as the participant will need to be able to frame their face within the camera’s field of view in order to facilitate affect analysis. The Affect Analyser makes use of Affectiva’s Affdex

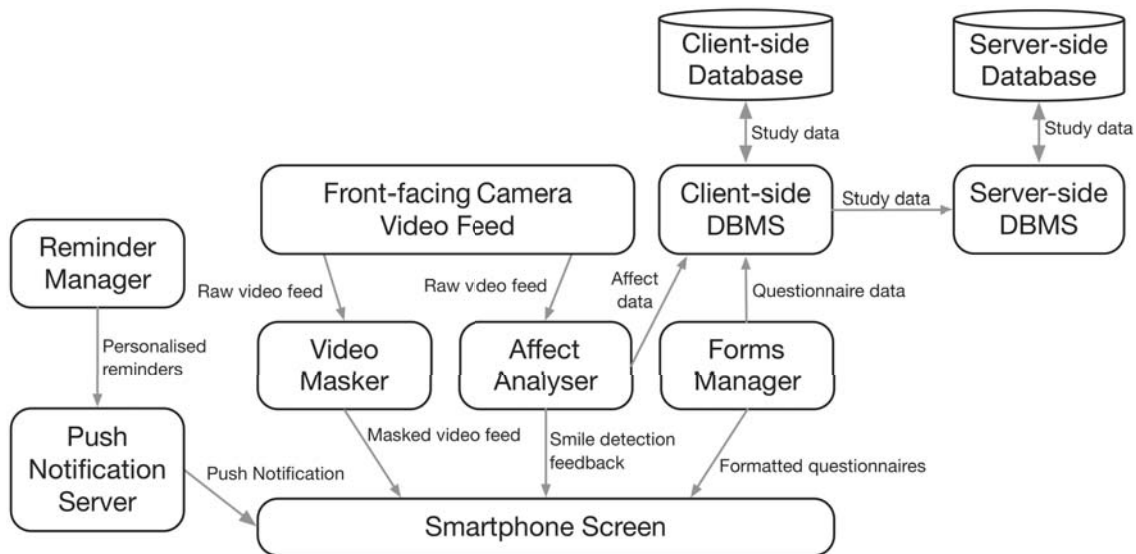


Figure 1: soHappy affective technology system architecture.

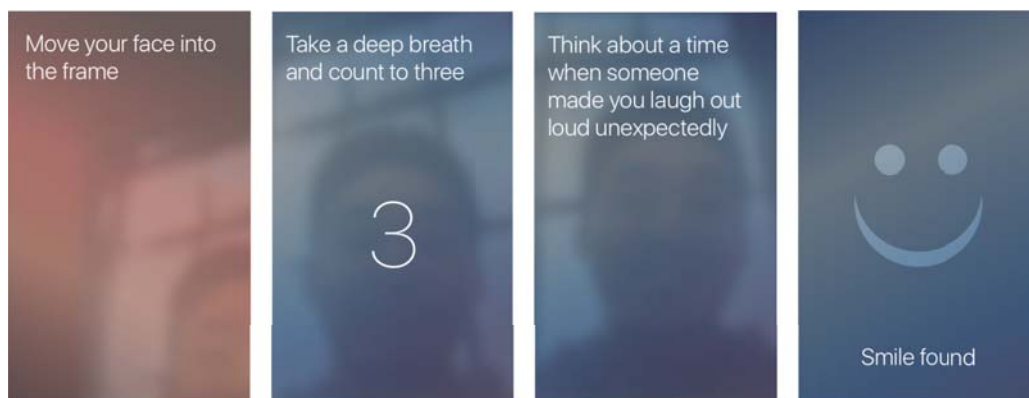
affective computing software development kit [14] to analyse the video feed and determine the probability of a given expression and emotion being present, as well as recording the corresponding set of facial landmarks. In addition, the Affect Analyser also provides feedback to the participant on how successful the smile detection process is progressing during smile acquisition. The Forms Manager delivers the pre-test, post-test and engagement session questionnaire-style question and response items. The application maintains a Client-side database of all data recorded during each session, along with a Client-side Database Management System (DBMS) that manages data transfer to the main server-sided database on completion of each engagement session. A Server-side DBMS will interact with the Client-side DBMS to undertake the transfer of study session data, as well as facilitating researcher access to the study data for post-study analysis purposes.

Pre-test and post-test question and response delivery both take the same form and are a simple onscreen presentation of the four items and associated Likert scales that make up Lyubomirsky's Subjective Happiness Scale [13]. This is carried out by participants once at the outset of the study and once again on completion of the study, and is delivered by the smartphone application. It was felt important to keep the presentation of this scale as simple as possible so as not to interfere with the validity of the measure

when moving it to delivery using a smartphone. This is also the case with the delivery of the System Usability Scale, which is delivered following the post-test subjective happiness assessment, and for collection of participant demographic data at the outset of the study. Our attention here is centred on the delivery of the study intervention, as it presents a more complex technology delivery challenge and the novel aspect of the work presented in this paper. Consideration of this work is perhaps best presented as a high-level walkthrough of the user journey that takes place during one of the four daily engagement sessions, which across time go to make up the intervention stage of the study.

#### USER JOURNEY

At each of the four daily reminder times, the smartphone application will issue a reminder to the participant that it is time to engage with the soHappy application. Figure 2 illustrates some of the key screens employed during an engagement session. On launching the soHappy smartphone application, the participant will be prompted to orient the smartphone so that their face is positioned centrally onscreen (Figure 2a). Once the Affect Analyser has detected the presence of a human face within the camera's field of view, a brief countdown is displayed along with a prompt for the participant to take three relaxing breaths (Figure 2b). Following this, a stimulus in the form of a text message is presented onscreen to suggest that the participant should try to recall a



**Figure 2: soHappy smiling activity walkthrough, from left to right: guiding prompting the participant to correctly frame their face, encouraging the participant to relax in preparation for smiling, prompting the participant to recall a happy memory to a genuine smile, providing feedback that a smile has been detected.**

memory that makes them happy (Figure 2c). These suggestions will come from a generic set of stimuli, such as “Remember a time when someone made you laugh out loud unexpectedly”, however it is eventually intended to allow participants to contribute their own prompts in future iterations of the smartphone application. Once a smile is detected by the smartphone’s front-facing camera the screen will provide feedback to the participant that this has been detected (Figure 2d). Once the recommended thirty second smiling period has elapsed the participant will be informed that this is happened, although they can continue to smile for longer if desired. Should the participant not continue smiling, or detection of their smile fails for some reason, they will be offered the opportunity to smile again. However, there is no requirement to do so before moving on to the next stage. During the smiling exercise the Affect Analyser measures and records the likelihood of a smile having occurred along with its duration. Additionally, the participant’s most probable expression and emotion, as determined by the Affect Analyser, are recorded, as well as a set of facial landmarks that relate to FACS Action Units [5], which are sampled every second during smile detection.

Following this attempt to smile naturally, the participant is invited to provide a subjective measure of their happiness using Abdel-Khalek’s single-item happiness scale [2]. This scale first poses the question “*Do you feel happy?*”, before directing the participant to consider three points, designed to encourage the participant to base their response on their overall feelings, rather than their current feelings. This direction promotes responses that relate to eudaemonic wellbeing, rather than hedonistic happiness. Participants are then guided to interact with the screen to rate their overall happiness level on an eleven point scale that ranges from *Minimum (0)* to *Maximum (10)*.

Next, the participant is invited to provide details of a range of contextual circumstances proximate to the ongoing session. First, an indication of the nature of the location that the session took place

within is requested, by asking the participant to select a label for their current location from one of the following: *Home, Work, University, Shopping, Café or Restaurant, Bar or Club, Outdoors Rural, or Outdoors City or Town*. Following this, the amount of social interaction since the application was last used is recorded; this is prompted using the question “*How much social interaction have you had since last using the app?*” and the response recorded using an eleven point scale, which ranges from *None (0)* to *Lots (10)*. This is further explored using the question “*Who was the most recent social interaction with?*” and the set of labelled responses: *Family, Friend, Colleague, Acquaintance, or Stranger*. Once social interaction-related factors have been recorded, physiological factors are explored to establish the participant’s physical activity and fatigue levels. The physical activity measure is prompted using the question “*How physically active have you been since last using the app?*”, again recorded using an eleven point scale, ranging from *Not Active (0)* to *Very Active (10)*. The fatigue measure is prompted using the question “*How tired do you feel at present?*”, and recorded using an eleven point scale ranging from *Not Tired (0)* to *Very Tired (10)*. Subsequently, the participant is thanked for their engagement and can use the app to prompt unrecorded smiling until the next planned engagement session.

#### **EVALUATION METHODS**

Descriptive statistics will be applied to explore the data arising from the study. Initial evaluation of the appropriately normalized data will take the form of Pearson’s Correlation in order to find any significant relationships within each participant’s data points and across the full set of study data. Box plots and scatter graphs will also be utilized to further investigate the underlying relationships discovered and the significance of the associated data points. Additionally, an analysis of variance of results will also be conducted to explore any insights into changes in individual self-reported and automated happiness levels recorded during the study. Furthermore, feature extraction will be performed on the recorded data, with the resulting feature vectors utilized by Machine Learning

techniques, such as Support Vector Machines, Bayesian Networks and Linear Discriminant Analysis, in order to generate a classification model that will be employed to investigate if happiness levels can be predicted though the contextual circumstances measured. The usability of the smartphone application will also be evaluated at the end of the study using the set of responses to the System Usability Scale [3].

#### **DISCUSSION**

This study, and associated technology, have been designed to test the hypothesis that “Individual happiness levels can be improved following regular use of a smartphone application that has been designed to encourage *genuine* smiling on a regular basis.” To this end, establishing if there is a change in participant self-assessed happiness, using Lyubomirsky’s validated Subjective Happiness Scale [13], will be central to the findings. While it is acknowledged that the absence of a control group will weaken internal validity, care has been taken to mitigate this. Specifically, the study protocol has been designed to allow the recording of additional data during periods of engagement, both in relation to subjective happiness and surrounding, environmental, social and physiological, contextual circumstances. These should help facilitate the identification of any confounding factors that might affect internal validity. Perhaps most significant of these measures is the continuous assessment of happiness during the study using two separate mechanisms; one subjectively self-assessed and the other objective assessed using the Affect Analyser.

These additional measures provide additional benefit beyond the sole purpose of helping to assess the validity of the study. Recording data relating to the contextual circumstances at the point of intervention will also allow for work to be performed that explores the potential to model and predict when a participant is most likely to be able to constructively engage in the smiling exercise. This could afford the automatic personalisation of reminders to help to encourage participants to engage in the smiling exercise at the most beneficial times. This is an important

consideration, given the understanding reported earlier in this paper that it is likely to prove more conducive to happiness if participants smile naturally. Moreover, such a model may also allow for the number of instances of engagement to be minimised, while retaining any beneficial effect, by reducing the amount of disruption to daily life caused by delivery of any ongoing intervention based on this work.

Finally, the usability assessment of the smartphone application will help to understand any aspects of the application’s user experience design that could have influenced the data collected, and will help to inform future revisions to the application.

#### **FURTHER WORK**

Clearly, the next step in this work is to deliver the study in order to determine if the hypothesis can be tested using the soHappy affective technology. Notwithstanding this, a number of additional features for this technology have already been planned. At an early stage, the inclusion of a feature to allow participants to contribute their own happiness prompts to the set of stimuli presented could be highly beneficial. This additional personalization could afford a greater degree of meaningfulness to the prompts and will also allow the application to become a form of journaling tool that could further prove conducive to improved happiness. It is also proposed that a *Happiness Dashboard* feature be included, from which participants could view their past activity within the application and perhaps engage in socially sharing of their activity. This would allow for aspects such as social feedback mechanisms and the effects of social integration to be explored within future studies. Finally, the delivery of a larger scale, more controlled study would be important to validating any findings.

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