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Happy Bits: Interactive Technologies Helping Young Adults With Low Self-Esteem

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ABSTRACT

How can we design digital artefacts to help young adults with low self-esteem feel happier? To gain new insights into young adult's self-esteem problems and how we might help support them with interactive technologies, we conducted a mixed method user-centred study. We used a 6-week cultural probe study with 11 young adults, including a focus group, to understand current practices in managing self-esteem with everyday technologies. We then co-designed interactive digital artefacts for helping improve self-esteem, to deploy as technology probes with 6 young adults for four weeks.

Our contribution is two-fold. Firstly, we present the Self-Esteem Technology Support (SETS) framework for informing design of interactive technologies supporting young adults in managing low self-esteem. Secondly, we propose that interactive technologies designed to help young people feel happier need to be flexible, adaptable, private, available, personalisable, and have an engaging form factor to inspire feelings of fondness toward having the device as part of their daily routines.

Author Keywords

Self-Esteem; Interaction Design; Digital Engagement; Cultural Probes; Technology Probes; Design Workshop.

ACM Classification Keywords

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

INTRODUCTION

This study explores how interactive technologies can be designed to help young adults with low self-esteem feel happier and work towards improving their feelings of self-worth. Improving low self-esteem is important because it can have a dramatic effect on a person's physical and psychological health [6,9]. Severe low self-esteem can make simple everyday tasks, e.g. getting out of bed, seem too difficult. If low self-esteem goes untreated, it can lead to development of conditions such as suicidal thoughts, eating disorders, substance abuse and depression [11,20,32,41]. Young adults, in particular, experience a decrease in personal self-esteem during the transition from childhood to adulthood [32]. While transitional changes are slow, young people can experience short-term fluctuations in their immediate feelings of self-worth [37]. Treatment of severe self-esteem problems requires seeking professional help, however the stigma attached to low self-esteem deters young people from doing this [7]. Interactive technologies can offer ways to provide health support more flexibly through tailored individual solutions used in a private context and their familiar environment [31,44], making it more attractive to young adults than counselling.

Current HCI research addressing self-esteem is limited to technology investigations on how it can be used to deliver Cognitive Behavioural Therapy (CBT) [12,34,40], how using social media affects self-esteem [15,16], and how self-esteem affects people's videogame play behaviours [4, 39]. However, there is an increasing interest in designing interactive technologies that assist in healthcare, both in terms of physical and mental health. Health-related research includes explorations on how technology can be designed to assist people suffering from depression [31], anxiety [30], and schizophrenia [42]. HCI has a role to play in ensuring that these technologies meet the real, very personal and private needs of users, in a situation where requirements are hard to uncover with conventional methods.

To understand how to design interactive technologies to effectively support young adults in the management and improvement of low self-esteem, we used a user-centred investigation and design approach. This involved a six-week cultural probe study [14] and interviews with 11 participants to understand their current practices in using everyday personal technologies to help them manage and improve their low self-esteem. This was followed by a design workshop that led to the creation of two interactive digital prototypes designed specifically to make people feel better about themselves. These were deployed as technology probes [23] in six participants' homes for four weeks to explore if and how these prototypes supported our young people in managing their self-esteem problems and helped them to feel happier about themselves.

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BACKGROUND

The opportunities that interactive digital technologies offer in the health domain include easier ways to collect, create and access data about patients, which can then be used by health care professionals as well as patients to improve their health and general quality of life [26]. Interactive technologies can be used to enhance patient engagement in health-related interventions because they offer flexibility to provide health information and support at any time and in any place that suits patient's needs [33] The many uses of technology for providing benefits in health care and supporting health behaviour change, have inspired us to explore its potential in supporting young adults with low self-esteem. We decided to focus on low self-esteem based on evidence of the extent to which it can negatively affect young people and their everyday wellbeing.

Self-esteem is a complex issue and there are several definitions and opinions to consider when conducting a study like this. Although self-esteem has been studied within psychology [38] for many years, there are different understandings of it, based on different research findings. Self-esteem level (ranging from high to low) has long been a strong concept for conceptualizing self-esteem but has been shown to provide an incomplete picture of self-esteem if used alone. In more recent studies, researchers have defined additional aspects of self-esteem, including *implicit self-esteem* [5], *contingent self-esteem* [8], and *stability of self-esteem* [24]. Self-esteem level represents a person's typical feelings of self-worth. This aspect of self-esteem can change but usually happens slowly over an extended period of time [37]. However, there are short-term fluctuations in self-esteem, which can be both negative and positive, and are most prevalent in young adults [24]. It is the degree to which people experience these fluctuations in their immediate feelings of self-worth that provides the greatest opportunities for interactive technologies to intervene, because they can provide immediate support, when and where needed.

People have both global self-esteem and domain specific self-esteem. Global self-esteem refers to a person's overall view of the self, whereas domain specific self-esteem refers to one's self view in a specific domain, for example academic ability or personal appearance [25]. However, the two are not directly dependent on each other. For example, the self-view in the academic domain might be low after failing an exam, but one's global self-esteem will not necessarily decrease [38]. Both global and domain specific self-esteem are important, but for different reasons. Global self-esteem is not dependent on competencies alone. It is suggested that it has just as much to do with self-acceptance and self-respect as it has to do with competence. Conversely, domain specific self-esteem relies directly on being competent in a specific domain. A high global self-esteem will not necessarily tell anything about a person's competencies and a high self-esteem within, for example, the academic domain may not necessarily indicate a high global self-esteem. Global self-esteem is associated with psychological well-being whereas domain specific self-esteem is better as a predictor of a person's performance within a specific domain [38]. Global self-esteem is more likely to be affected by things like positive family relations and/or number of friends. Both global and domain-specific self-esteem can be affected by things like: race, age, intact family, mother's education, father's education, family socio-economic status, mother's occupational status, father's occupational status and number of siblings. In this study, our primary focus is on domain specific self-esteem and how interactive technologies can provide opportunities to improve a person's positive view about their areas of competence. It is also envisaged that engaging in positive activities that help strengthen personal relationships over time result in improved global self-esteem.

SELF-ESTEEM AND HCI

Cognitive behavioral therapy (CBT) is one of the treatments within psychology that has proven to be successful in treating low self-esteem [13]. Research by Eysenbach et al. [12] examined the potential of mobile phone technologies to broaden the access to cognitive behavioral therapy techniques and provide in-the-moment support. Other studies using interactive CBT programs, designed to help people with anxiety and depression, found that they significantly improved participants self-esteem [34,40]. There are also CBT-based applications available on app stores, such as the gamified training app *Goodblocks* [17].

Social media can have a positive effect on self-esteem if the person is focused on strong social relations while browsing [43]. Gonzalez [15] studied the impact of meaningful social interactions on improved self-esteem through digital media interactions. They found that text-based communication, such as SMS, Email and Facebook exchanges, was more beneficial for self-esteem than face-to-face or phone communication as computer mediated communication reduces social pressures and puts greater emphasis on message content. A second study [16] explored the effects of using Facebook on people's self-esteem, through studying the phenomenon of selective self-presentations in mediated spaces [10]. Findings suggested that the information people chose to share with others had a positive influence on their self-esteem, especially when they were able to edit content on their Facebook profile. Selected self-representation is also supported in publicly available apps, such as *Happier* [19], a social community app that allows users to write, record and share their positive thoughts on their profile.

MANAGING SELF-ESTEEM

Self-esteem is high during early childhood, but then decreases when reaching adolescence. Upon reaching adulthood, one´s self-esteem increases and one experiences becoming more positive about oneself [25,32]. For this reason, we have chosen to study young adults, aged 16-24, as this represents a vital stage in their development of self-esteem, when they are most likely to harbour negative feelings about themselves, and most likely to require help in managing low self-esteem. We considered working with

health professional specialists, but as suggested by Bannon [2], the needs of specialists can sometimes override those of users. Rather, we involved young adults as participants, to focus on their needs, in the process of understanding self-esteem management [29].

Conducting research within the area of technology design for self-esteem requires a sensitive approach. This research was designed to always regard participants' well-being over gathering data [43]. Methods were chosen to take this into account and help facilitate communication and interaction between researchers and participants. An empirical study was designed using cultural probes [14], semi structured interviews, and a focus group to understand current practices. A design workshop used the Creative Platform to create technology probes [23] that were deployed in participants homes. These methods are designed to work in sensitive and private situations.

Participants

Participants were recruited through the snowball sampling [28] and a Facebook page created to inform people about the focus of the study and the need for participants. Participants self-identified as having low self-esteem, with three having clinical assessment and diagnosis.

ID	Gender	Age	CP	FG	DW	TP
P1	F	18	X			
P2	M	18	X	X		
P3	M	23	X	X		
P4	F	21	X			
P5	M	22	X	X	X	X
P6	F	22	X	X	X	X
P7	F	23	X	X		
P8	M	23	X	X		
P9	F	16	X*			
P10	F	23	X	X		
P11	M	19	X	X	X	X
P12	F	21			X	X
P13	F	22			X	X
P14	M	24			X	X
P15	M	22			X	
P16	M	19			X	

Table 1. Participant Details and Study Participation (* indicates limited participation, X indicates participation in different phases of the study: CP-Cultural Probe, FG- Focus Group, DW- Design Workshop, TP – Technology Probe)

At the start of this research, we recruited 11 young adults, six females and five males, between the ages of 16 and 23, to be part of a cultural probes study (CP in Table 1). They came from different educational backgrounds and regions of Denmark. Of these, eight participated in a focus group (FG in Table 1). Three of these, with five additional recruits, 2 females and 3 males, participated in a design workshop (DW in Table 1). Of these, six participated in a technology probes study (TP in Table 1). In accordance with the Declaration of Helsinki, the participants were informed at the start of each new activity of how the information obtained would be used and what it would be used for, making sure that participants would be able to make informed decisions and withdraw from the study, whenever they wanted to [45].

Cultural Probes

To understand how our participants were managing their low self-esteem, including their use of everyday technologies in doing this, we used cultural probes, semi-structured interviews, and a focus group.

The cultural probe pack was deployed with 11 participants, aged between 16 and 23 years, for six weeks. However, the youngest participant, P9, left three weeks into the study because of a sudden move to a different part of the country. We still included her data as this is a qualitative study.

The probe pack was designed to accommodate different communication preferences, i.e., whether a participant preferred to write, draw or take photographs. We wanted them to reflect on and express how they experienced living with self-esteem problems, how and when they felt affected, and the strategies they used to deal with feeling low. The pack included a diary, a scrapbook, a drawing pad, a pair of scissors, stickers, clipart-pictures, glue, colour pens, a pencil and pen, tape, a smiley-calendar to log their mood each day, sticky notes and a variety of fill-out-the-blanks assignments about their day (see figure 1). A closed Facebook page was created for each participant to write and upload thoughts and images if they preferred this method.

Figure 1. The Cultural Probe Pack

Data Collection and Analysis

Semi-structured interviews were conducted when the pack was delivered with a follow up interview a week later to ensure they understood how to use everything. Interviews were held every second week, ending this study phase with a

total of four individual interviews for each participant. At the first interview, participants were given the Rosenberg self-esteem scale, to measure their self-esteem level [36]. They took the test again at the end, and we can report there was no significant change in self-esteem levels for all participants. This indicates that participating in the study did not have an adverse effect on their self-esteem levels.

Outcomes from the probe packs were used to provide a focus for conversations, and support both researchers and participants during the interviews while talking about self-esteem. Each interview, had different themes, and were guided by participant responses in the probe materials. Completing probe pack tasks also gave participants the time and space, before and after interviews, to reflect on their feelings of self-worth and how they were managing it. After collecting the probe packs, we held a focus group with eight of the participants to explore their experiences and insights from using the probes in a group setting, as group conversations on sensitive topics can make it easier to express views not surfaced during individual interviews [27].

Analysis of probe data is complex. The data returned is in different forms, such as prose, drawn images, stickers, photographs, and responses to activities. We used exploratory data analysis with conventional qualitative content analysis [22] to combine probe outcomes with transcripts of the interviews and focus group. The gathered data was clustered and grouped as a cooperative activity, given the experience of the team in talking with and observing participants. The analysis was influenced by the theory of global and domain specific self-esteem [25] as an analytical lens. Through this process, we identified 14 different behaviours impacting a person's domain-specific self-esteem. Some had a positive impact: reflecting on self, recording personal thoughts, seeing different perspectives, sharing thoughts with others, looking at the bigger picture, asking for advice, doing personal improvement, setting goals, giving self-praise, finding a distraction, and doing what feels good. Others had a negative impact: dwelling on bad thoughts, being self-critical, and isolating oneself.

Through affinity diagramming [3] these categories were further refined by revisiting original data to understand the motivations behind these behaviours and identify technologies used to support them. This resulted in six high level strategies that our participants used to managing their self-esteem problems, and the role that personal technologies played in enacting these strategies.

Cultural Probe Outcomes

We present our findings as a framework summarising the use of personal technologies in self-esteem management the Self-Esteem Technology Support (SETS) framework (see Table 2). This understanding can be used to inspire and inform design of interactive technologies to help young adults manage and improve on their feelings of low self-esteem.

Strategies	Technology Support
Reflecting on Self	Keep an electronic diary to record thoughts, review self-image on social media
Sharing Thoughts	Texting/calling others for advice/to share, communicating with social media, blogging
Changing Perspective	Texting/calling others, browsing social media and internet
Improving Yourself	Online learning, setting goals with personal tracking applications
Being Good to Yourself	Recording good personal moments (photos), playing uplifting music or videos
Finding a Distraction	Social media, streaming services, digital games, calling friends

Table 2. SETS framework: Understanding use of personal technologies in self-esteem management

The SETS framework strategies are:

- *Reflecting on Self* involves thinking about and assessing one's self. As P11 said, "I actually think that it is nice to have that time to walk and think a little".
- *Sharing Thoughts* with others makes it possible to get feedback. As P4 said, "It has helped a lot. I did not talk about it before, I just thought about it alone."
- *Changing Perspective* is possible when others share a different view on things. As P11 said, "when I put something out there, what do others see in it, what do they see as being important."
- *Improving Yourself* involves personal development. As P2 said, "It makes me happy, when I learn new things, then I get really happy."
- *Being Good to Yourself* includes doing activities that you really like. As P10 said, "someone advised me to do something that I thought was fun, when I get bored or feel bad, and it actually helped."
- *Finding a Distraction* can help people avoid dwelling on negative thoughts. As P7 said, "it is mostly just to, like, think about something else. Or maybe to stop think about something."

IMPROVING SELF-ESTEEM

To involve future users in the design and use of technology for improving feelings of low self-esteem, we held a design workshop to create two interactive technology prototypes to deploy in participants homes as technology probes. The SETS framework was used during design to inspire and inform.

Design Workshop

Eight young adults, aged between 19 and 24 years of age, participated in the design workshop. Three had participated in the cultural probes study and five were newly recruited, giving a mixture of experience with our study.

The workshop took place in a classroom at a Danish University and lasted 3 hours. The main challenges in this design workshop were that the topic, self-esteem, is a very private matter for most people, and that participants came from different educational backgrounds with a variety of fields of knowledge. To involve our participants in a design process, it was crucial that we were able to help them relax and feel comfortable talking about and working with designs for the very personal topic of self-esteem management. The Creative Platform [18] allowed us to do this. It is a process used for innovation where people meet and bring together diverse knowledge. It can be used for developing new products free from routines, prejudices, expectations or other limitations, where no one should feel judged, and all are stimulated to contribute. The process helps shift focus from the need for direct social interaction to a game-like mode where participants can bring their knowledge into play. Our participants responded well to this focus on game activities and worked happily in teams to produce several design ideas for informing design of the two prototypes.

Participants were welcomed and introduced to the task of designing interactive technology for managing self-esteem. Icebreaker games were played at the beginning, and two videos of creative interactive technologies were shown to inspire them. They were then given sticky notes and asked to write ideas on how technologies might help people manage self-esteem problems. Participants were divided into two groups and asked to each present three ideas to the group. We then gave them the SETS framework, to help them integrate the six strategies and technology supports found in the cultural probes study into their designs. We then stepped the groups through several games that helped them to build on ideas and encourage creative thinking. The final activity was to create physical mock-ups of their favourite ideas, using various materials such as fabrics, colours, glue, scissors, clay, and straws, and present and explain them.

Design Workshop Outcomes

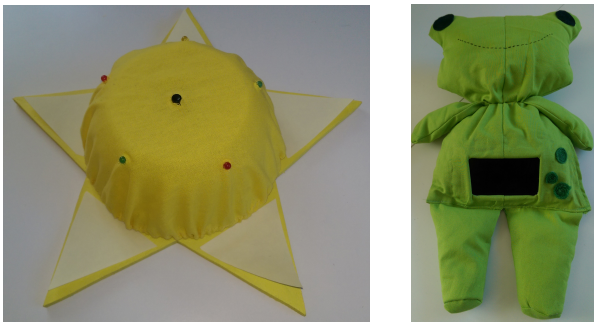
Outcomes from the workshop included 20 sketched ideas. Examples of the sketched ideas included: a 'hugging bot' to make you feel good by simulating a hug; a 'bicycle guide machine' intended to distract you from your worries by having the user set a goal when going for a bicycle ride; a box with small tasks to distract users from their problems; a box that automatically plays motivating music when you feel bad; and a jar containing nice, uplifting comments that couples could write to each other. Common to these ideas was encouraging activities to help the user feel good, providing distractions, and giving positive or motivating comments.

The sketched ideas were then refined into eight physical mock-ups, which were: 1. a bottle that always provides cold beer for relaxing together with friends; 2. a slot machine with happy notes from friends, family, to read when feeling bad; 3. a green creature (figure 2) that plays music and says positive things; 4. a bot to bring you a beer when you feel sad; 5. a massage blanket that gives your shoulders a massage; 6. a music box with a big button for playing motivational music when pushed; 7. a hugging panda to say motivational things when hugged; and 8. a happy analysis robot that could analyse and respond to your current feelings.

Figure 2. Physical Mock-up from Design Workshop

Technology Probes

Technology probes have become increasingly popular when working with users to design and understand the potential for new technologies in different situations [1,21,35]. They combine the social science goal of collecting information about use and the users of the technology in a real-world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and designers to think of new kinds of technologies to support needs and desires. Their simple, flexible and adaptable design and data logging capabilities enable researchers to study complex personal and private environments where access to information about user needs and attitudes can be hard to gain with more conventional HCI methods [23]. Since those affected by self-esteem problems can find it difficult to talk about their problems, this method helped our participants record and articulate their needs and attitudes towards technologies for managing self-esteem problems in their own environments, at times that were meaningful to them.



(a) (b)

Figure 3: The Technology Probes deployed in Participants' Homes, a) Sun of Fortune, b) Happy Frog.

Two prototypes were created to act as technology probes: Sun of Fortune (Figure 3a) and Happy Frog (Figure 3b). Their design was informed by the SETS framework, design outcomes from the workshop, presentations by participants during the workshop, and how coherent they were with the qualities of a technology probe. That is, they need to provide

opportunities for collecting data about their use as well as inspire the users and researchers to refine, redesign and think of new design ideas.

Sun of Fortune

The Sun of Fortune requires users to write activities on sticky notes located on its five sunrays. Participants were asked to choose activities that make them feel good or distract them from negative thoughts. When feeling low, they could press the Sun's central button, causing the five coloured LEDs to light up randomly, like a Wheel of Fortune, before selected one to remain lit, indicating the chosen sunray. This effectively selects an activity that they should do. The sunrays sticky notes afford easy removal, archiving, writing and quick and easy adding of new activities.

The Sun of Fortune is made using a plastic bowl to hold the electronics: a BBC Micro:bit, an edge connector, a battery pack and 5 LEDs. The bowl is covered with a soft yellow fabric and mounted on a wooden plywood panel the shape of a sun, with sticky notes, cut to fit the triangular form of the sun's rays.

The Sun provides an opportunity for users to activate all of the strategies in the SETS framework, based on the actual activities specified on the sunrays. In particular, *Being Good to Yourself* and *Finding a Distraction* can include activities such as "Listen to Your Favourite Song", "Watch the Shrek Movie", "Play Angry Birds" or "Call a Friend". Activities could also include "Take a Quiet Walk" to give time for *Reflecting on Self*, or "Practice Your Guitar Playing" to work on *Improving Yourself*. Additionally, in the very act of creating the sunray notes, users can reflect upon what makes them feel good and what could potentially distract them from negative thoughts.

The Sun finds its inspiration in several ideas and prototypes from the design workshop that encouraged users to do things that felt good, thereby creating a distraction from bad thoughts. Instead of offering one specific activity, e.g. drinking beer with friends, as the sketched ideas and mock-ups did, this design is more flexible and personalisable. It enables users to specify a set of activities that they would like to do, or that they think would be helpful to them.

The Happy Frog

The Happy Frog was designed for participants to lift up when they felt low, triggering it to speak aloud an encouraging or motivating comment. A comment was chosen by the system at random when the frog was activated (lifted). There were three predefined comments, which were: "You are nice"; "You are a good person"; and "You look good today". Additional comments could be created by participants through a personal web page. Immediately after a comment was spoken by the Frog, users were prompted by three emojis – happy 🙂, neutral 😐, and sad ☹, appearing on the smartphone screen. They could quickly and easily touch one to give feedback on how the spoken comment made them feel.

The Happy Frog is sewn in green cotton canvas and filled with rice and cotton fibre. The eyes and the dark green spots are made from yarn, and the mouth is drawn with a black marker. In the Happy Frog's stomach, a sewn pocket holds a smartphone which has software installed to make the Happy Frog register when it is lifted. The Frog has an internet connected Samsung Galaxy S3 mini smartphone.

The Happy Frog provides the opportunity to *Reflect on Self*, as it gives positive compliments and motivating thoughts to add to the user's internal dialogue. It also gives them the opportunity of *Sharing Thoughts* and *Changing Perspective* based on comments they have generated for themselves, or with the help of others. In creating comments at a time when they feel good, they have reflected on what they might need to hear when they feel low, and positive thoughts they think will help. The random delivery of comments adds the quality of serendipity to the positive influence these comments can have. The ability to respond to how the comment makes them feel also encourages *Reflecting on Self*.

The design of the Happy Frog was inspired by the sketches and mock-ups from the workshop that had a figure with a face. The frog form factor was inspired by both the green creature physical mock-up (figure 2) and the huggable panda. The functionality of the Happy Frog was inspired by those ideas and mock-ups that were designed to give the user compliments or motivating comments.

Data Collection and Analysis

We conducted a four-week technology probe deployment with six participants, aged between 19 and 24, to study how young people react to a device helping them manage their self-esteem problems. Three participants had been with the study since the beginning and three joined at the design workshop stage. Participants had two weeks with each probe, three starting with the Sun, and three starting with the Frog. We wanted to investigate participants' use of the technology probes, especially in terms of the kind of content they added, their appropriation of them, where they used and placed them in the house, their daily use patterns, their overall reaction to having them in their lives, their impressions on how helpful they were, and any design ideas about interactive technologies that they stimulated.

During deployment, participants were asked to keep a diary of their experiences, to keep all used sunray sticky notes from the Sun of Fortune and take photos of each probe location. A box of additional sunray sticky notes was provided, and each participant had a personal login for generating comments for their Happy Frog. Interviews were conducted at the start, midway, and at the end of the two-week deployment, for each probe. When collecting the probes at the end of the four-week period, participants were asked to compare their experiences with the two different probes.

The data collected in this phase included: six transcribed interviews from each participant, hand written sunray sticky notes from the Sun of Fortune stacked in order of use

(including those still on the device), data logged by the Sun of Fortune (number of button presses), comments created by users for the Happy Frog to speak, including date and time they were created, and the ratings given to the Frog via the emojis, including date and time of feedback. Each data point was identified with a participant. There was also a set of photographs from each participant documenting each location in the house the probes were placed.

In total, the Sun of Fortune had 72 sticky notes created by participants and the Sun's button was pressed 102 times. All participants, except one, created a new sunray note each time they used one. The Happy Frog was lifted 217 times and given a rating every time. Of the 217 ratings, 168 were neutral, 49 were positive. A total of 38 unique comments were created by participants and were mainly created during the first two days of receiving the Frog. In general, these comments were created between 16.30 and 22.00, while a small number were created between 12.00 and 13.30. Five of the six technology probe study participants reported a preference for the probe they experienced first. All participants reported that at least one of the probes offered a concrete and private way to work with bad feelings.

The data collected was diverse in form and complexity. Data such as numbers and times were graphed against a variety of factors including: number of sunray notes created/button presses by participant/gender (see Figure 4); number of frog comments posted by time of day/day of week/date by participant/gender; smiley rating returned from frog probe by number/time of day/day of week by participant/gender.

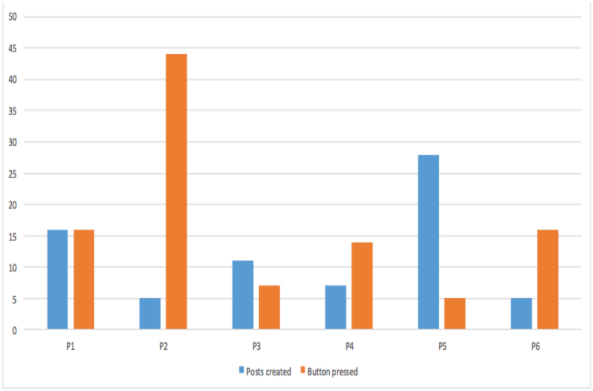


Fig 4: Example Sun of Fortune graph: Number of sunray notes created and button presses per participant

Interview data was analysed using content analysis [22] and codes and categories clustered using affinity diagramming [3]. Textual data such as activities written on sticky notes and frog comments created were analysed by sorting and comparing across participants. Image data showing probe locations were compared visually across participants, and a story written to represent them.

FINDINGS

Findings show that the ways in which participants worked with their negative thoughts towards feeling happier were highly individual. This was evidenced by which probe they used the most and the different ways they chose to use the two probes. All participants were engaged with both the Sun of Fortune and the Happy Frog. They used both probes regularly and created activities for the Sun and comments for the Frog. In general, each participant had at least one probe that they felt a positive reaction to, and all participants could imagine using these interactive technologies in the future.

Overall, the Happy Frog probe seemed to have a more direct effect on improving the participants' feelings of self-worth. It gave immediate comfort and good feelings through both the comments it spoke and the physical act of hugging the Frog. The Sun of Fortune had a more indirect effect. While participants felt distracted from their negative thoughts when doing the activity, the probe did not make them actively reflect on their feelings of self-worth. In fact, the activities written for the Sun, e.g. "Rehearse Piano" and "Call Mom", were more likely to lead to longer term benefits that encouraged self-improvement or relationship building.

Sun of Fortune

Most participants thought the sun form factor was colourful and happy looking but found it hard to place in their homes. Some participants felt that the probe was too visible in the space of their home, especially if they had visitors, as P6 said, "I don't want to show I have low self-esteem in the living room". However, the visibility of the sun encouraged some people to remember to use it, as P11 said, "I think it had something to do with the fact that it was very visible, you could easily see it, so you thought, now I'm doing this, it is not just thoughts in your head, that's a big step on the way, when saying 'I'm doing this'." Participants used the Sun of Fortune (pressing the button) mainly when coming home from school or work, in the afternoon or evening. The Sun was also only used at home, because participants felt that the size and physical form precluded taking it out.

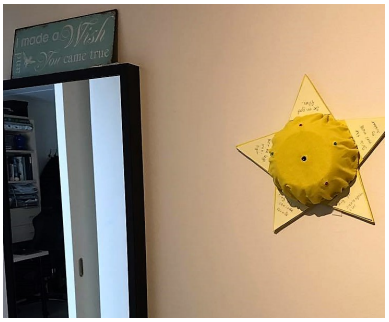


Fig 5: Sun of Fortune on the wall in a participant's home

Despite the fact that the Sun did not require a power outlet, participants seemed to have a hard time finding a place for it. For some, its size was the biggest problem, as P13 explained, "My biggest problem has probably been that it has moved around a lot. I'm having trouble finding a place I can put it." Interestingly, P13 regarded it as a decorative feature (see Figure 5), saying, "I really like it. I want it hanging. It looks really nice, I hung it up by the mirror, I like having it there.".

Participants valued the fact that they could personalise the activities to suit their own interests and preferences. The sunray sticky notes created by participants had five general themes: 1. *doing a physical activity*, e.g., "Go for a run" (P12); 2. *tasks that needed doing*, e.g., "Wash windows" (P6); 3. *self-improvement*, e.g., "Rehearse piano" (P14); 4. *relaxation*, e.g., "Long warm bath and music" (P11); and 5. *making contact with others*, e.g. "Call mom" (P6). As we predicted, making the activity sunray notes for the sun prompted positive self-reflection. As P12 noted, "It gave me a lot to think about, when I used it. What do I really like and what is it that makes me happy when I'm having a hard time." Some used the opportunity to write activities for the Sun as a way to do things with others, but as P12 told us, she wanted the Sun to be hers and felt that it was something that she should do for herself and on her own, "I just think that the Sun was for me alone, and only when I felt bad. I don't know, I just think I felt it was very personal."

The activities created for the sunrays were mostly those that participants enjoyed doing. However, two participants used the sun as a random to-do list. They added activities that were not fun but had to be done, claiming that when these chores were out of the way, that would make them feel happy. This strategy did not always work, as P6 confessed, "I tried pushing once and then it landed on 'Clean the floor', so I thought, 'I'm going to push it until it lands on something that I want it to land on'." Two participants experienced feelings of annoyance with the sun, claiming it got in the way of them deciding what they actually wanted to do with their time. Or when they did use it as a to-do list, they then had to feel guilty if they did not feel like doing the tedious activity chosen by the sun.

Even though participants had control over the activities they could write on the sticky notes, they still had problems with a lack of flexibility in have one specific activity randomly chosen by the system, particularly when it did not fit with their current situation. Participants found it hard to come up with appropriate activities to write on the sunrays, since they had to predict which activities would fit the time they would have available and an activity suitable for the particular time of day they might need to use it. As P11 said, "some of the ideas that make me happy when I do them are not something that I can write on the note...like calling my family…if my family don't have the time". He went on to suggest that the system needed to be more flexible, in terms of the chosen activity. It would also be helpful if the system could adapt to the time a person had available, the time of day and even the weather conditions. This would ensure that the sun could be used more often.

Happy Frog

In general, most participants found the frog design fun and engaging. They made comments like, "I think it is really cute" (P6), and "It's cute. I like the way the mouth looks." (P14). The Happy Frog was only used at home by participants, as P6 said, "it is probably just because it is too big. If it was a bit smaller, then it would maybe be a bit easier to take it with you." Additionally, they said they did not need the company of the frog when they were with other people, as P5 said, "When I'm together with my family, then I have them to talk to if I need to. So, I don't feel like I need a toy."

The placement of the Happy Frog within the home was limited by the fact that it needed to be charged often, due to the battery life of the smart phone. Participants placed it near a power point and had it plugged in most of the time. Three participants kept the frog near their bed and used it when they woke up, went to bed or were just relaxing (see Fig. 6). The other three kept it in their living room or kitchen area.

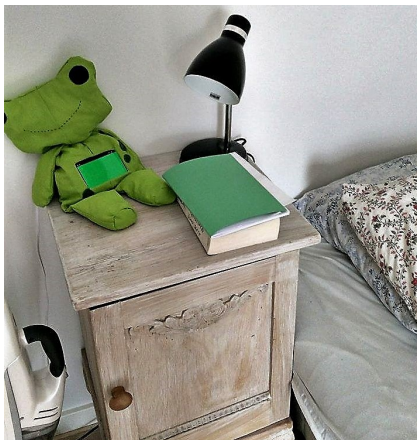


Fig 6: Happy Frog located in a participant's bedroom

Comments created for the Happy Frog by participants had three general themes: 1. *compliments*, e.g. "You are smart and strong" (P14); 2. *motivating comments*, e.g. "If you want to find some quality friends, you have to bypass the bad ones first" (P13); and 3. *happy experiences and jokes*, e.g. "Speaking of horses…" (P11). The Frog was used mostly in the morning, before leaving for school or work, to help create a positive mood, instil confidence and create sense of well-being. As P5 said, "I get in a great mood when I use it in the morning when getting out of bed." Many then used it again when they came home during the afternoon or evening. P14 used it to give him confidence to socialise with others, "It is when you need to be together with other people… Both before and after". P6 deliberately used it for comfort before falling asleep at night, "It is just a nice little reminder in the evening, about everything being good - so you can just go to sleep".

Participant created comments given a positive rating were usually either motivational or reminders of happy experiences. Not surprisingly, writing the comments provided an opportunity for self-reflection, and the ability to record and remember nice experiences. As P11 said, "These are some fun things in my life. I think that has been very nice, and to reflect a little by writing the comments."

Although participants reported that they really appreciated the ability to personalise the comments spoken to them by the Frog, most confessed that they had problems writing

complements to themselves. This resulted in predefined system comments receiving the most positive ratings because they were not self-written. P11 noted, "for example, you want to write 'You are doing great', sitting and writing a compliment like that for yourself, that is really hard, because it seems a bit fake, knowing that in reality you are giving yourself compliments, and I feel really uncomfortable with that." Most participants said they would prefer to have these compliments written by family, friends or their partner. As P13 said, "I got my boyfriend to write some things, so that was a lot of fun. Even though there are some things that are repeated, they are nice quotes." P5 supported this by saying, "It must be someone who knows you, writing these messages. I think that would give a better result, than if it is random strangers."

DISCUSSION

By talking with young people and having them respond using cultural probe materials we uncovered the kinds of strategies that they use to manage their low self-esteem, and how they use personal everyday technologies in private situations to assist them in feeling happier about themselves. We found that they each managed feelings of low self-esteem differently, both with and without personal technologies. With respect to the use of technologies, even though specific apps exist in the public access app stores for improving and managing self-esteem, our participants tended toward self-made solutions combining a range of familiar technologies and platforms. At the same time, they reverted to paper-based diaries, physical exercise and meeting people face-to-face when they felt that worked better for them. The diaries provided in the probe pack were popular, participants enjoyed reflecting on and recording their personal thoughts in these and were open to the idea of using a digital diary if available "in their pockets" via their smartphones.

Ideally, we would measure self-esteem levels using the Rosenberg self-esteem scale [36] at the beginning and end of the technology probe deployment to be able to claim improvement in self-esteem from using the Sun or the Frog. Instead we have reported here on participant's perceptions of what helped them to feel happier for the purposes of design inspiration. What we gained from this study was an understanding of different design aspects of the probes and how they helped our participants to deal with negative thoughts and feelings and feel happier about themselves.

In using the technology probes in their homes to help improve their feelings of low self-esteem, we noticed that our participants worked through their negative thoughts in highly individual ways. This was evidenced by the different times they chose to use them, the different locations they placed them in their homes, the level of attachment they developed for the probe, and the ways they integrated them into their daily routines.

The Sun of Fortune had a less direct effect on participant's negative thoughts, as they reported being only temporarily distracted while doing the activity. They also reported that the sun's activities did not always fit the times they felt bad, so could not always help them feel happier. So, although they found doing an activity a useful way to distract themselves from feeling low, they required greater flexibility and adaptability in the activities suggested by the system to better match their immediate needs.

The Happy Frog more directly helped manage low self-esteem, creating immediate positive and happy feelings about themselves. The complements and happy memories triggered positive thoughts and helped improve self-image, as well as promoting reflection on this. Participants reported that they would feel happy for a short time while soaking up the complement or doing the activity but then the bad feelings would always return. However, even though the effects of both probes were felt to be short lived, both interactive technologies were easily and enthusiastically integrated into their homes and daily lives.

During the technology probe study, participants worked with the personalisable content of the two probes to fit their individual needs. However, the act of creating content for the probes, i.e. sunray notes and frog comments, troubled participants more than we anticipated. The problem with the Happy Frog was having to write compliments to themselves. This made them feel uncomfortable. Instead, they suggested it would be better and more natural to have someone they knew, or felt close to, writing the comments. This was evidenced by the fact that system comments were given positive feedback using the happy emoji while the self-created ones were usually rated as neutral. The exceptions were motivational or happy experience comments, which were also often given the happy emoji. One explanation that surfaced during interviews was that participants were aware that we would be looking at what they wrote. As P5 said, "I considered writing some silly comments, but I thought that you could see them. So, I didn't feel like writing that." Even though we had taken precautions, such as logins to private web pages where they created the comments, some participants still felt wary about writing exactly what they wanted to for fear of others reading them.

With the Sun of Fortune, having the randomly selected activity fit the specific time of use was a problem for most participants. For instance, activities that required getting in touch with other people, or going for a walk were not useful late in the evening, or in poor weather conditions. Participants indicated a need for more flexibility and adaptability of the activities. They made suggestions about having a number of predefined activities that only took a short period of time, or only using the Sun at specific times of the day. However, the Sun was designed with the flexibility that the user could decide against the suggested activity and simply push the button again. Some participants did this. But there was a general desire amongst our participants that the system should choose a "good" activity for them. This relates to the design workshop idea of a "happy analysis robot" that can analyse and respond to your

current feelings, thereby tailoring suggestions of activities to individual needs, current time and environmental constraints.

Overall, participants felt that the Happy Frog was more successful in helping them manage feelings of low self-esteem and helped make them happier, as it only took a short time to use, and easily fit into their everyday routines. It also had the immediate effect of making them smile, feel positive about themselves or feel motivated when they needed it. The Happy Frog helped them cope with fluctuations in their self-esteem stability by providing immediate relief from the negative feelings that happen during a low ebb. Conversely, the Sun of Fortune was seen as a source of inspiration for most participants, as they could write their favourite things to do on the sticky notes. They gave a variety of explanations for the helpfulness of the sun, including: they liked something to take the decision on what to do for them; it motivated them to actually do the activities; and it gave them permission to do something nice for themselves. It allowed participants to give themselves a special treat.

All participants enjoyed the flexibility to write their favourite things to do on the sticky notes. However, some still reported that at times the sun annoyed them because they realised that they were perfectly capable of figuring out what they needed to do when they felt bad. This indicates that although the sun did not always select the "right" activity, it prompted self-reflection about appropriate ways to distract and be good to yourself in times of need. In this way, problems that they had with the Sun not being able to exactly predict appropriate activities to make them happier for the time of day and time available, became unimportant when the user took a more active role in the decision making. The design of the sun enabled them to look at the five activities they had personalised for themselves at an earlier time, and all they had to do, while feeling bad, was choose the one they wanted. Alternatively, rather than relying on the random selection provided by the system, they could press the button until they felt happy with the selection or use the system selection to prompt a decision about which activity they hoped would be chosen. In the absence of a design that could automatically adapt to the user's situation, this flexibility was very important.

Like the Happy Frog, the Sun of Fortune was able to have an effect on combatting the negative feelings invoked by fluctuations in self-esteem stability. However, the sun offers the benefit of a more lasting effect, depending on the kinds of activities specified. For example, self-improvement activities give an opportunity to increase a person's self-esteem by improving their performance in that area and relationship building activities help improving supportive relationships with family and friends.

FURTHER WORK

Our study indicates that using interactive technologies for managing and helping improve low self-esteem is beneficial. However, we acknowledge that our findings are limited by short deployment times for cultural and technology probes. It is also difficult to know if our methods facilitated honest and open sharing of this sensitive topic by participants. We were happy to include both young adults with a clinical diagnosis of low self-esteem and those who were self-diagnosed. Future work in this area would benefit from separating results for these two types of participants and should include longer deployments with a refined design, measuring self-esteem levels using the Rosenberg scale before and after deployment to confirm that the interactive technologies have evidenced improvement in self-esteem.

CONCLUSIONS

This study investigates how interactive technologies are appropriated by young adults to manage and help improve feelings of self-esteem. Low self-esteem is an important issue because it can have a dramatic effect on a person's physical and psychological health and influence how they deal with everyday tasks.

Through a six-week deployment of cultural probes, interviews and a focus group, we identified the role that everyday technologies play in supporting strategies for managing low self-esteem. As a contribution to HCI, we offer the SETS framework for informing interaction design of technologies for helping young adults in managing low self-esteem. This framework provides designers with an understanding of the strategies young adults use to manage self-esteem, and the kinds of interventions that provide effective support.

Using outcomes from a design workshop and applying the SETS framework, we designed two interactive prototypes. These were used as technology probes to collect empirical evidence on young adults' responses to the using digital technologies designed specifically for the managing low self-esteem to help them feel happier. Each technology probe was deployed for two weeks with six young adults to gather responses on how technologies might help them manage and improve feelings of low self-esteem and to collect design ideas from them on how to better design these technologies.

Both probes were successfully appropriated by the young adults and provided enough flexibility for participants to use them in different ways and personalise them to fit individual needs, thus helping us to understanding how and why digital technologies helped young adults manage low self-esteem.

We contribute with the findings that interactive technologies designed to support management of self-esteem should be flexible, adaptable, private, available when and where needed, and have personalisable content and an engaging form factor to motivate use and inspire feelings of fondness toward having the device as part of their daily routines.

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