PEGASO Project - Teenage Perspectives of an Integrated Technology Platform for the Promotion of a Healthy Lifestyle

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Abstract. This paper presents the findings from a participatory technology development workshop with teenagers. Sixteen teenagers were recruited in the East Midlands region of England to participate in the evaluation and development of the PEGASO multi-technology system. This system is being developed to promote awareness and motivation for healthier behaviours in teenagers. The teenagers critically analysed early prototypes of mobile apps, a serious game and wearable sensors with regards to their usability, acceptability, intuitiveness and desirability for teenage users. The results reported here will be utilized in the next design iteration of the PEGASO platform.

Keywords. User-Centred Design, Teenagers, Health, Technology.

1. Introduction

PEGASO is a multi-technology system being developed to promote healthy behaviours in teenagers. The system relies on the integration of a suite of mobile apps, serious game, social network and wearable sensors to engage and motivate young people in awareness of and behaviours associated with health and wellbeing. The EU project takes a user-centred design (UCD) approach involving four countries and their teenage participants. At this stage in the project teenage user perspectives were required to review design work done to date and to direct the next phase of development. For this purpose a one day workshop was designed to elicit data for the technical teams working on the system components which would accommodate the needs of teenagers. This study reports the findings from the workshop, by teenage participants in England only. This paper describes teenage user requirements of the system and the challenges associated with developing multi-technology platforms for this discerning and informed user group.

1.1 Teenage health

There is an increasing prevalence of overweight and obese children within the general population with current statistics stating that 31% of young men and 37% of young women are overweight or obese (Hagell *et al.* 2013). These statistics are a cause for concern because as well as the short term impact on quality of life there is evidence that unmet health care need in adolescence can be a predictor of poor adult health (Hargreaves *et al.* 2015). This then has long term economic implications for healthcare services around the world. Trends associated with weight problems in adolescence include poor diet and teenagers not undertaking the recommended levels of physical activity (Hagell *et al.* 2013), this can then lead to other health complications including poor sleep, mental health problems and long term chronic conditions such as type II diabetes or metabolic syndrome. The PEGASO project aims to address issues of teenage health through the development of a technology system which fits the specific needs of

this user population and through understanding their needs and lifestyle patterns looks to promote improved awareness, motivation and decision making associated with health behaviours. This understanding will be achieved through the engagement of young people throughout the technology development process to ensure that the final output is attractive to the intended market. It is well established that adolescence can be a time of increased health risk, resulting from peer and societal pressure, personal vulnerability, or lack of information (Fuller & Hawkins 2013). The PEGASO project aims to mobilise these contributing factors and use them as tools, whereby social networking, peer support and communication via a discrete and personalised ICT can be developed to work in favour of positive health attitudes and motivation in adolescents.

1.2 PEGASO technology for health promotion and motivation

Mobile technologies offer an interesting framework for new modes of healthcare service provision. Previous research has demonstrated how mobile interventions based in real time and the real world (ecological momentary interventions, EMI's), are accepted by users and can lead to improvements in health behaviours (Heron & Smyth 2010). Previous studies have highlighted that for these interventions to be successful in their deployment the technology solutions need to be "based on a detailed understanding of users, their needs and complex interactions with health professionals, health system and their wider environment" (Ilioudi *et al*. 2010). This evidence supports the approach taken and remit of PEGASO in trying to engage teenage users with the concept of health and wellbeing and of it being a pervasive notion in their everyday personal and social lifestyle. The PEGASO system will utilize the social cues of a computing product; physical, psychological, language, social dynamics and social roles, (Fogg 2002) to engage the teenage user with cues that are appropriate to them personally and as a cohort. The teenage requirements of these cues will be established via an iterative UCD process and designed into the individual components; serious game, mobile apps, wearable sensors, messaging service and social network. This process aims to maximize engagement with the young user population so that there might be a positive impact on their awareness and motivation with regards to their health.

2. Methods

Sixteen participants were recruited for the technology workshop, aged 12-16 years old with a split of 6 male/ 10 female. The workshop was developed using a mix of methods to ensure that the capabilities and competencies of different teenagers was accommodated. This was an important characteristic of the study, as during the teenage years individuals can vary greatly in their communication skills and confidence due to the development which occurs from child to adult (Lang *et al.* 2014). Ethical approval for this study was sought from the local University Ethics Committee and included not only obtaining informed consent from parents but also informed assent from teenage participants aged under 16 years. This was considered an important part of the protocol to promote 'buy in' from the teenagers by involving them and not just their parents, in the research process. Participants were recruited via a snowballing method whereby the study was advertised through personal contacts and online through a 'Parents Social Media Group' specific to the Nottingham City Area. This however did introduce some bias within the sample population as teenagers volunteering to take part were likely to have a personal interest in technology. One teenager was home schooled and all others attended main stream comprehensives in the locale of Nottingham City or Nottinghamshire County. As the participants were recruited through different channels, some attended with a friend or sibling, however the group as a whole did not know each other. All participants owned their own smartphone. Table 1. displays the timetable of

the workshop and describes the activities undertaken with the teenagers to evaluate the technology prototypes they were presented with. The participants were given short breaks every 40 min-1 hour and a long lunch break as the timetable for the workshop was relatively demanding.

Table 1. Workshop Methods

Introduction	Watch PEGASO promotional video Icebreaker to introduce participants and introduce project, aims of the day Invite questions from participants
Questionnaire	Technology use Questionnaire Obtain baseline data about teenage use of technology
Garment and Wearable Sensor Evaluation	Present non-working prototypes of the garments and bracelets Small group discussions about teenage preferences of suggested designs. Individuals fill in questionnaire about the system sensor components. Design activity for teenagers to design their own garments.
Serious Game Evaluation	Present game as non-working mock up to examine the acceptability, intuitiveness and desirability of - graphics, iconography, storyline, proposed game play and mechanisms for game progression. Semi-structured Focus Group discussion led by workshop facilitator, to enable participants to discuss topics listed above.
PEGASO App Evaluations	Working in small groups, participants were given a smartphone with three PEGASO apps installed. Apps included Health Companion, eDiary, Places Discoverer, Health Square –version1 working prototypes. Set tasks were given to the users to test each app for usability, intuitiveness and acceptability. System Usability Scales questionnaire filled in for each app. Groups discuss the apps and provide feedback on their use outside in addition to the System Usability Scale (SUS) questionnaires (Brooke 1996).

Participants were invited to become members of the 'PEGASO Teen Expert Panel', which would see their continued involvement in the project over a longer period of time.

3. Results

The following sections describe the results elicited from the teenagers about the PEGASO system components they were presented with and their views about the system in relation to teenage user requirements.

3.1 Garments and Wearable Sensors

Participants reported that none currently use or have used a life or fitness tracker sensor. When presented with the prototype garments and sensors as exhibits, teenagers expressed a preference for use and wear of a bracelet/ watch tracker rather than a garment with built in sensors, whilst four of the teenagers stated that they would prefer the combination of both devices. Sensorized garments were considered by all but two of the participants as suitable for use during sporting activity; particularly running, swimming, cycling and going to the gym, whilst bracelet sensors were acceptable for use in daily life and not just undertaking physical activity. Teenagers have an acute awareness of the context of use for these technologies and there appears to be a consensus about what is acceptable 'use in context' for the technologies examined. This is expressed through both individual and group reviews and as such can be considered reliable data going forward in the development process of the PEGASO system.

There was a strong requirement stated from the sample population for the sensors on the garments not to be visible. Teenagers preferred the mock up designs which provided a

discrete, inbuilt pocket within which the sensor could be put during use. Whilst teenagers were enthused throughout the workshop about the prospect of the technology system and its capabilities there was a preference for the wearable items (particularly the garments) to not broadcast their use of technology for fitness monitoring. This preference for less noticeable designs was also reflected in their selection of preferred bracelet design where the majority of participants selected monochrome options. However there was suggestion that whilst they wanted simple, uncomplicated designs teenagers do not want 'boring products' and as such having a choice (either of colour, logo or presentation) would be the more desired option. With regard to the parameters being monitored by these devices, males and females varied in their selections made. Female responses demonstrate that 'Heart Rate', Calories' and 'Activity Recognition' were perceived to be the most important measures to incorporate into the system. 'Energy Expenditure' was the parameter which emerged as most important to the males, with 'Heart Rate', Activity Recognition' and 'Sleep Monitoring' also featuring significantly within the male data set. How teenagers might use this data is as yet unknown and will be explored in the next design iteration.

3.2 Smartphone Apps

The Health Companion app was reviewed positively by the teenagers for its concept and aesthetic. They liked the opportunity for a personalised platform to introduce them to the PEGASO system and to support their use of it over time. There was strong statement of need for the users to be able to modify the look of the app to suit their own preferences. Teenagers liked the variety of content and functionality within the app e.g. mood/ feelings ratings, sleep information, personal progress. However they found the addition of a 'weather' function surplus to requirement and not connected with the other content in the app. Further work is required in relation to the iconography being used within the app as teenagers thought that some of the icons used were not intuitive and did not relate to the content. With regard to information sharing there were mixed views from the teenagers about what personal information should be visible to other PEGASO users. In contrast to current social network use the teenagers were reticent to share their personal image with other users. They expressed a desire for health data to be partially shared; with control of this set by the user but that diet information was not appropriate to be made public. The participants considered that 'badges' (which represent good health behaviours or progress) could automatically be shared to the user's online community. It appears that teenagers believe this mechanism and its visibility would be a tool for motivating them to maintain healthier behaviours.

Participants liked the idea of the eDiary app, which facilitates the users daily monitoring of diet in terms of diversity and balance. This was considered a useful way to think about their food intake and there was consensus on the graphical representation of this information, with teenagers preferring a graph format rather than smiley faces; which were considered too childish for their age group. However the teenage testers did not think the app satisfactory in its current Version1 Prototype state, as demonstrated through the discussions and also the SUS questionnaire responses. This early version of the app fell short on several usability aspects associated with swiping and clicking actions, the use of photographs and icons and the appropriateness of the language currently being used within the app. Teenagers reported that if these aspects could be improved then the app, once more developed with additional functionality, content and files, might be useful to them.

The Health Square app provides teenagers with a tool for locating and recommending 'healthy places' to other users, the focus being on places to eat. Teenagers did not place value on this app as it was considered that there are already established apps and websites which offer this kind of service (TripAdvisor, Around Me). This was

exacerbated by the fact that the prototype app was not yet well populated with recommended places in the tester's area and so there was little information for them to view. Technical issues also caused problems with the testers trying to add their own recommendations, an issue which undermined the tasks set. As such the review of this app did not yield useful insight; with the only requirement elicited being that this app would only have influence if teenagers could view choices and recommendations that their friends go to.

The evaluation of the 'Places Discoverer' app which focuses on location and access to sports facilities and places for play and activity elicited similar results. The lack of data within the app for the locality made it less engaging for the teenagers to explore and test. Participants expressed interest in the concept of the app but stated that it needed to accommodate their needs as teenagers, the main example being the financial constraints of this age group, whereby information about expensive gyms would be less useful than free facilities such as tennis courts and parks spaces. It emerged in the discussions that there was a potential disconnect of the intended use of this app, with testers stating that they knew what was available in their local area and that it would be more useful in an unfamiliar area, otherwise it was redundant.

3.3 Serious Game

The teenagers were excited about the prospect of a serious game to support their awareness and motivation for healthy behaviours; however were also vocal in their need for the game to maintain the element of fun and enjoyment as the main driver and motivation to play. The game is based on a dystopia scenario of a zombie apocalypse and some teenagers reported that the storyline was good but the link to healthy living was not apparent. Participants liked the concept of data from the wearable sensors feeding into the game so that real world activity could provide reward within the game. There were limitations around this discussion however, as the low fidelity game mock-up was not able to represent adequately the interactions between it and the sensors. This meant that the participants were keen on the concept but required more detailed information and a working prototype of both technologies to evaluate and express how they might make use of it in their daily lives. Teenage evaluation of the game aesthetic elicited a range of views with stated requirements for improved graphics, less cartoony characters, more differentiation between game play modes for day and night. Confusion was expressed about the value of one of the game mechanics, namely the 'social goal' of players to find a cure for the zombie virus. They did not think that this was an interesting concept within the game and that motivation to engage with this facet of game play might be low in comparison to other parts of game play e.g. exploring the 'world' and fending off zombies.

4. Discussion and Conclusion

This study has elicited a range of views and requirements from teenagers regarding the individual components and overall PEGASO system. They are generally keen to be more aware of their diet and activity but want this information to be easily accessible and without burden. The apps, sensors and games appear to provide an acceptable suite of tools which teenagers are willing to use in their everyday lives to improve their awareness and motivation towards better health behaviours. These findings have important ramifications for the adolescent health community and not just the PEGASO project.

With regard to the individual components and system integration there is still a lot of development to come and the results from this mixed method workshop provide a useful set of data for technology partners. From the data easy decisions can be made where

consensus has been found amongst the teenage testers. Whereas for development decisions, where teenagers have expressed varied and conflicting views, further work is required or the system development will have to incorporate bespoke and personalised solutions to meet the needs of this user group. Further work is required for all aspects of the system and includes but is not limited to the following actions: *Development on the apps to improve functionality and usability, whilst also considering the teenagers feedback about appropriateness of some information to them. *Review of the game mechanisms to engage users with specific aspects of healthy living where current proposals are not considered entertaining enough for the young users. *Demonstration of the value and use of wearable sensors in non-cardio/ high demand physical activities. *Improved portrayal of the interactions between the technology components so that teenagers can appreciate the benefits of the system as a whole and evaluate it in respect to their everyday needs

This development process is ongoing and subsequent iterations will address these issues further and also assess the impact of the EMI's when the platform is used over both short and longer periods of time by teenagers.

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