Digital Interventions on and off Mobile Devices

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ABSTRACT
Digital behavioural interventions provide powerful mechanisms for facilitating behaviour change. Their effectiveness can be evaluated through the use of randomised controlled trials and the comparison of different intervention components and personalisation mechanisms. The LifeGuide system allows researchers to create interventions and run trials without the requirement of specialist programming support but currently these are restricted to web based interventions chiefly accessed through desktop PCs. Increasingly behaviour change interventions can be delivered on mobile platforms, taking advantage of the affordances of Smart-Phones for both delivery of intervention content but also for the capture of context, important for personalisation. This paper reports on the co-design of a mobile intervention and examines the challenges in creating authoring environments that will enable the creation of mobile and hybrid interventions without the need for specialist programming support.

1. INTRODUCTION
Behavioural interventions are mechanisms for delivering behaviour change, used in a wide variety of contexts from smoking cessation to coping with chronic conditions. Increasingly these can be delivered online and clear benefits to this have been articulated [4]. Offline interventions can be more resource intensive, requiring time from therapists and scheduled appointments. Constructing behavioural interventions online also allows them to be tailored to individuals based on their responses to questions and specific contexts [7].

Constructing Digital Interventions (DIs) can be a complex task and initially often involved the close collaboration with Software Engineers and Web designers in order to construct the specific website. These were usually bespoke, suitable for one type of intervention, and often discarded post trial. The LifeGuide system was developed to allow behavioural scientists to construct their own DIs using an authoring tool and run trials via the LifeGuide server [5]. Without the need for specific technical support full randomised controlled trials can be carried out on a wide range of interventions, re-using components between DIs[10]. This has opened up online behavioural intervention research to a wide community of practitioners, many of whom may not have been in a position to carry out this type of research previously. The LifeGuide system currently allows the creation of DI websites that are primarily aimed at desktop viewing. Text and email reminders can be sent, and the webpages are viewable on mobile devices but the authoring tool makes no specific allowances currently in terms of specific screen resource management, interaction capabilities, nor the ability to infer additional context about the participant for personalisation. Mobile devices have been used to look at implementing online behavioural interventions in a range of settings from adults with mental health diagnoses [6] to childhood obesity [9]. There exist many apps for mobile phones in the market place and some studies have been carried out on the ability of mobile apps to empower users in monitoring their own health [3], but to implement effective behavioural interventions, more evidence is needed of efficacy [2].

Also, crucially, these apps and mobile interventions are again bespoke, requiring dedicated technical construction and not embedded within research frameworks. The UBhave project seeks to address this issue by constructing an authoring system that enables the creation of mobile behavioural interventions without the need for specific technical construction, allowing behavioural researchers to carry out rigorous research on a variety of aspects of mobile behavioural interventions in a variety of context. Similar approaches have been taken in areas such as eLearning technologies [8]. As has been reported in respect to specific mobile health apps, there is a need to better understand what aspects of mobile technology hinder or enhance DIs [1].

This paper presents initial co-design work on the creation

of a hybrid behavioural intervention comprising a LifeGuide authored intervention coupled to an Android based mobile app. This co-design process has enabled us to explore the issues that exist in developing DI app authoring systems for non-technical users and our preliminary findings will be discussed.

2. MOBILE INTERVENTIONS

To investigate the challenges of delivering DIs on mobile devices, the EPSRC funded UBhave project is developing tools to allow the authoring of interventions by researchers without the need for direct programming support. To better understand the requirements of such tools we have carried out a co-design exercise to construct a hybrid intervention aimed at helping those wishing to reduce their weight through managed diet and physical activity. This builds on the an existing LifeGuide intervention POWeR (Positive Online Weight Reduction). Over the course of a number of sessions participants set target goals, and plans to reach those goals. The intervention enables them to keep a record of their progress and received tailored motivational feedback based on their progress.

By developing through a co-design process a mobile app to deliver the POWeR intervention we aim to investigate a number of questions including:

- How can DI platforms be delivered over mobile platforms?

- How can we gather or infer additional context of participants that may be useful for tailoring DIs?

- When are good times to interrupt participants with interventions?

- How might we begin to construct authoring tools for the construction of mobile DIs?

An eventual aim of this project will be to develop an extended version of the LifeGuide system allowing Psychology researchers to create their own custom apps to further explore the use of mobile online interventions for a wide range of behaviour change applications.

3. THE POWER APP

Taking the existing POWeR intervention as a starting point, a series of co-design meetings were used to design and construct a complementary mobile app to support the intervention. A hybrid approach has been adopted with some aspects addressed through a desktop web based interface and other aspects ported to the mobile app. Some tasks such as the setting of goals, it was felt might be more comfortably done on a larger device or PC and generally occurred infrequently, often just at the start of using the intervention. Other tasks were designed to be carried out on the mobile device, for example food diaries. This allows an immediacy to entry perhaps more suitable if out and about. The resulting functionality supported by the app included the viewing of goals and plans, updating of progress in achieving those goals, the recording of food and activity diaries, and the reading of supporting material such as appropriate food lists and specific guidance.

To implement the hybrid approach, a web service has been developed for the LifeGuide server to allow the app to directly access and post data to the intervention server. This is necessary to allow the integration of the existing web based intervention and the mobile app. For example, it allows user to set their goals on a PC using the existing LifeGuide web interface and then check their goals and update their progress on the mobile device. An architectural overview of the UBhave system is shown in figure 1.

On the app itself, users can set reminders on their phone for their goal updates which utilise notifications to take the users directly to the app each day. Users are free to view their goals, and supporting material, as well as make updates and diary entries on their progress. A set of evaluation questionnaires are included with the app, which participants will be encouraged to fill out to aid in evaluation of the intervention. Some screen shots of the application can be seen in figure 2.

4. LESSONS LEARNT

Through the co-design process a number of key issues have been identified which we believe to be crucial in the construction of mobile and hybrid mobile interventions. Many existing online interventions are structured around sessions, incorporating traditional therapeutic approaches. The ubiquity of access to mobile devices may encourage more interrupt driven or regular access and as such alternative paradigms need to be considered in the underlying structuring of the data. Additional affordances allow for new notification mechanisms in addition to the existing LifeGuide SMS and email notifications and mechanisms for constructing and triggering these need more attention. A final example is that of mobile sensing. Modern smartphones contain a battery of sensors that provide contextual information that could potentially be used for tailoring of interventions or for inferring additional information, for example when a good time to interrupt someone is. Modelling this sensor information and presenting it in a form that makes it usable for authors when constructing the logic of interventions is a key consideration of ongoing development.

5. CONCLUSIONS AND FUTURE WORK

Current n-of-1 studies are looking at the utility and efficacy of the hybrid approach. Output from these studies will allow us to better understand how mobile apps can integrate with behavioural interventions and establish more detailed requirements for generic app construction software. Our initial bespoke POWeR app has enabled us to construct a supporting server architecture and our co-design experiences have provided the initial designs for an app authoring tool that will enable behavioural researchers to construct mobile and hybrid interventions with the same ease as they can currently construct desktop interventions using the LifeGuide system.
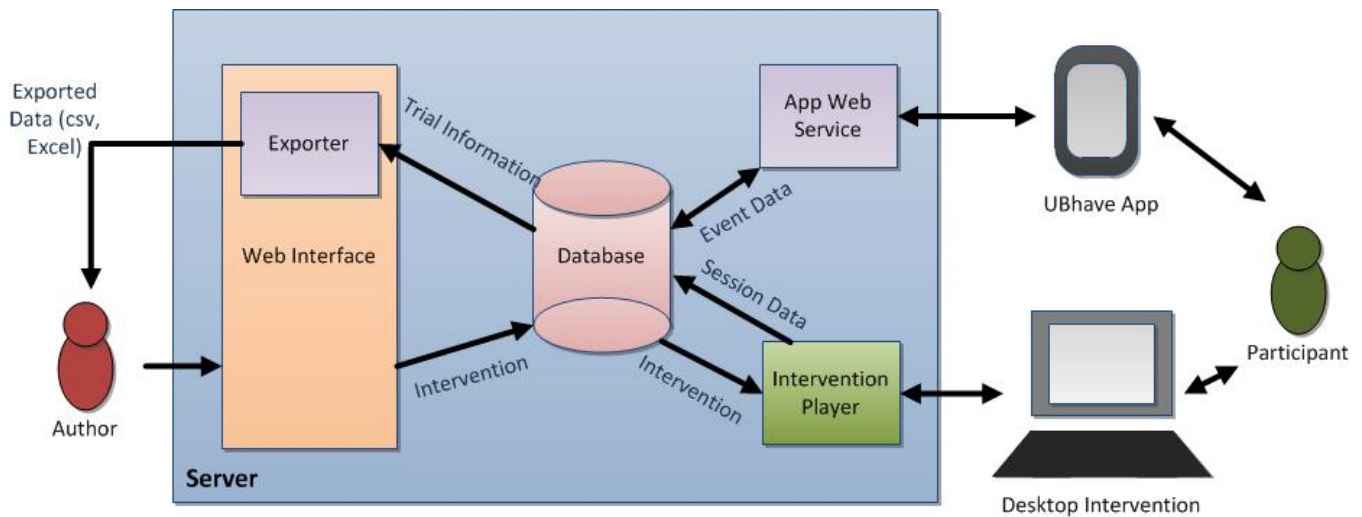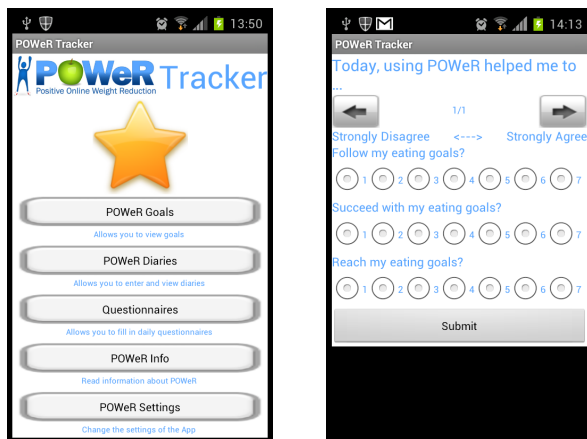
Acknowledgments

Figure 1: The UBhave Architecture.

Figure 2: The POWeR App.

6. REFERENCES

[1] A. Ahtinen, E. Mattila, A. Vaatanen, L. Hynninen, J. Salminen, E. Koskinen, and K. Laine. User experiences of mobile wellness applications in health promotion: User study of wellness diary, mobile coach and selfrelax. In *Pervasive Computing Technologies for Healthcare, 2009. PervasiveHealth 2009. 3rd International Conference on*, pages 1–8. IEEE, 2009.

[2] Emily Breton, Bernard Fuemmeler, and Lorien Abroms. Weight loss — there is an app for that! but does it adhere to evidence-informed practices? *Translational Behavioral Medicine*, 1:523–529, 2011.

[3] KH Connelly, AM Faber, Y. Rogers, KA Siek, and T. Toscos. Mobile applications that empower people to monitor their personal health. *e & i Elektrotechnik und Informationstechnik*, 123(4):124–128, 2006.

[4] F. Griffiths, A. Lindenmeyer, J. Powell, P. Lowe, and M. Thorogood. Why are health care interventions delivered over the internet? a systematic review of the published literature. *Journal of Medical Internet Research*, 8(2), 2006.

[5] Jonathan Hare, Adrian Osmond, Yang Yang, Gary Wills, Mark Weal, David De Roure, Judith Joseph, and Lucy Yardley. Lifeguide: A platform for performing web-based behavioural interventions. In *WebSci'09: Society On-Line*, March 2009. Event Dates: 18-20 March 2009.

[6] Virginia Harrison, Judith Proudfoot, Pang Ping Wee, Gordon Parker, Dusan Hadzi Pavlovic, and Vijaya Manicavasagar. Mobile mental health: Review of the emerging field and proof of concept study. *Journal of Mental Health*, 20(6):509–524, 2011.

[7] M. Kreuter. *Tailoring health messages: Customizing communication with computer technology*. Lawrence Erlbaum, 2000.

[8] M. Virvou and E. Alepis. Mobile educational features in authoring tools for personalised tutoring. *Computers & Education*, 44(1):53–68, 2005.

[9] Susan J. Woolford, Kathryn L.C. Barr, Holly A. Derry, Christina M. Jepson, Sarah J. Clark, Victor J. Strecher, and Kenneth Resnicow. Omg do not say lol: Obese adolescents' perspectives on the content of text messages to enhance weight loss efforts. *Obesity*, 19(12):2382–2387, 2011.

[10] Lucy Yardley, Judith Joseph, Susan Michie, Mark Weal, Gary Wills, and Paul Little. Evaluation of a web-based intervention providing tailored advice for self-management of minor respiratory symptoms: exploratory randomized controlled trial. *Journal of Medical Internet Research*, 12(4):e66, December 2010.