

Introduction to the LifeGuide: software facilitating the development of interactive behaviour change internet interventions

Lucy Yardley¹, Adrian Osmond², Jonathon Hare², Gary Wills², Mark Weal², Dave de Roure² and Susan Michie³

Abstract. We are developing a set of software resources named 'the LifeGuide' that will enable researchers to collaboratively create, evaluate and modify two central dimensions of behavioural interventions: a) providing tailored advice; b) supporting sustained behaviour.

1 INTRODUCTION: CONTEXT FOR THE LIFEGUIDE

Behavioural interventions - packages of advice and support for behaviour change - are arguably the most important methodology and technology employed by social scientists for understanding and changing behaviour. The applied value of behavioural interventions is that they can promote and support behaviour that benefits the individual and society. Their scientific value is that behavioural interventions provide the strongest test of theories that seek to identify the causes of behaviour [1]. Whereas observational studies can only note that certain factors (e.g. beliefs, attitudes, skills) are associated with desired behaviour changes, behavioural interventions can experimentally test whether changing these factors causes a change in behaviour. Behavioural interventions can be used for a wide range of very different behaviours; for example, to change risky or antisocial behaviour, improve productivity and reduce accidents in the workplace, enhance learning activities, or promote environmentally important behaviour change, such as reducing energy use.

Despite their crucial importance, to date progress has been disappointingly slow in developing effective behavioural interventions [1, 2]. There has also been a lack of cumulative theoretical development about what components of interventions work, in which combinations and for whom [3, 4]. These problems are partly due to the high costs of large trials of interventions with long-term follow-up, which has resulted in a dearth of studies that are adequately powered to address these key theoretical questions.

Internet-based behavioural interventions are set to play a crucial role in the delivery and evaluation of behavioural interventions in the near future, for reasons detailed below. The techniques of e-Science provide a tremendous opportunity to support both the delivery of these interventions and the

associated research, while internet-based behavioural interventions demand innovation in e-Science in order to develop the operational and research capability for real-time interactive engagement with a large number of users.

2 THE ADVANTAGES OF INTERNET-BASED BEHAVIOURAL INTERVENTIONS

Behavioural interventions have traditionally been delivered principally face-to-face, and this continues to be the overwhelmingly dominant method of delivery. A major problem with this mode of delivery is that it is extremely resource intensive, severely limiting the scope for cost-effective interventions; clearly, it is not feasible to provide every individual with 24 hour access to personal advice and support for managing all aspects of their lives.

In contrast, internet-based behavioural interventions can be made available to most of the population for little more than the cost of development [5, 6]. Whereas the quantity and timing of information, advice and support that can be delivered face-to-face is very restricted, internet-based behavioural interventions can be accessible at all times and provide extensive and intensive advice and support. Currently delivered principally over the web, internet-based behavioural interventions will increasingly be flexibly accessible through mobile phones, interactive digital TV etc.

There are two key dimensions of behavioural interventions. The 'motivational' dimension involves providing relevant information, advice, education and decisional aids in order to promote knowledge, beliefs, attitudes and intentions consistent with the desired behaviour. However, a 'volitional' dimension is often also vital in order to help people translate good intentions into behaviour [7-9]. Consequently, effective behavioural interventions also provide a variety of techniques to support and sustain behaviour change, such as aids to goal-setting, planning and self-monitoring, skill and confidence-building, cues and reminders, and systems of incentive and social support [10-13]. Since face-to-face delivery is not cost-effective for many behavioural interventions, printed materials (e.g. booklets and manuals) are often used to disseminate motivational behavioural interventions more widely. However, the information and advice provided in printed materials cannot easily be 'tailored' or customised to the particular situation of the individual, and may therefore be dismissed as irrelevant [14]. Moreover, even when booklets are effective in changing knowledge and beliefs, they cannot provide the volitional dimension of ongoing interactive support for behaviour change, such as prompts, feedback and encouragement.

¹ School of Psychology, Univ. of Southampton, SO17 1BJ, UK.
Email: L.Yardley@soton.ac.uk

² Electronics and Computer Science, Univ of Southampton, SO17 1BJ UK. Email: {acoljsh2|gbw|mjw|dder}@ecs.soton.ac.uk

³ Department of Psychology, Univ College London, WC1E 7HB, UK.
Email: S.Michie@ucl.ac.uk

Interactive internet-based behavioural interventions can provide information and advice specifically 'tailored' to address the particular situation, concerns, beliefs and preferences of the individual, and may therefore be more persuasive than generic printed information [14, 15]. Interactive internet-based behavioural interventions can also provide a rich, stimulating, engaging and actively supportive environment, with audiovisual illustrations, reminders, personalised feedback regarding progress and concerns, and opportunities for peer-to-peer support and comparison [16, 17]. Supporting long-term maintenance of desirable behaviour changes is a major problem that has not yet been solved [18]. Internet-based behavioural interventions may for the first time offer a cost-effective means of providing long-term support.

Currently, the potential of internet interventions is restricted by the lack of software that will allow researchers to easily create all aspects of an interactive intervention, without the need to programme the software infrastructure for each intervention individually. This limits the number of interventions that can be developed and evaluated, thereby limiting the accumulation of knowledge about intervention effectiveness, and the relative effectiveness of intervention components and causal mechanisms. The initial development costs are typically greater for internet interventions than for traditionally delivered interventions, and once programmed they cannot easily be modified, acting as a barrier to innovation and enhancement of interventions. Lack of access to resources for programming interventions also restricts the numbers of researchers that can engage in developing and testing internet interventions, and in particular makes it more difficult for postgraduate students and junior researchers to engage in this type of research. Commercial software packages have been developed recently that allow professional users some scope to enter the content for the particular intervention that they wish to create, but these restrict the researcher to those components pre-selected by the developers, and do not offer the research community the crucial advantages of free access and the ability to innovate methods and integrate findings.

Since the essential components, functions and underlying infrastructure required for internet interventions are common to a vast range of applications, it makes sense to develop an open-access set of shared software resources that researchers can use to easily create and modify different interventions themselves – the LifeGuide.

3 FUTURE OF THE LIFEGUIDE

The LifeGuide is being designed to provide the research community with facilities to collaboratively devise complex interventions, with immediate access to components that have been validated in previous LifeGuide projects, that can then be utilised (modified as necessary) in new applications. The research community will then be able to work together to rapidly recruit participants from geographically dispersed locations, and integrate the data to form very large data-sets that can be used to carry out more powerful analyses than have hitherto been possible, such as mediator and moderator analyses of intervention effects.

As internet interventions become very widely used in many spheres of life, this could in the future provide the basis for national and international 'population laboratories' for the

continuous further refinement of interventions. Ultimately, a semantically enriched and adaptive LifeGuide system should be able to continuously and semi-autonomously model and refine interventions, based on the preferences and outcomes of lay users. We also plan to ensure that LifeGuide interventions can interface with existing medical systems (e.g. patient records), and with remote monitoring devices (e.g. monitoring blood glucose levels, physical activity, heart functioning etc.), and can be delivered via a range of digital media (e.g. mobile phone, television).

4 THE LIFEGUIDE: WORK IN PROGRESS

We are using a co-design approach to ensure that the LifeGuide offers the flexibility needed to deliver a very wide range of interventions with different formats and ingredients, and is sufficiently user-friendly that novice researchers can readily use it to develop interventions, with the aid of the basic online training package, manual and help we are developing. An international network of researchers has been recruited through our workshops and demonstrations; these researchers are collaborating with us in evaluating and developing the LifeGuide by applying it to a range of very different health problems. The interventions include: an 'internet dr' intervention to provide people suffering from common conditions (e.g. colds and 'flu, irritable bowel syndrome) with tailored advice that enables them to cope with their symptoms; an e-learning website for health trainers to teach them how to help clients adopt healthy behaviour; and an intervention to promote and support hygienic behaviour to reduce the spread of infection, especially during pandemic flu. We are currently carrying out qualitative and quantitative pilots of these interventions, prior to conducting substantive tests of them.

The LifeGuide software has two main parts, the authoring tool and the LifeGuide server software.

The authoring tool has been developed using Eclipse RCP (Rich Client Platform) technology and allows intervention authors to construct individual pages, in terms of content and presentation, and link them together using the intervention logic. Logic can be based on current user selections, or data from past sessions. The intervention pages created by the authoring tool can be saved, loaded and edited locally as the author constructs their intervention. The intervention files are held in an xml format promoting extensibility and interoperability. Figure 1 illustrates the user-interface of the authoring tool in page-editing mode, and shows the level of graphic design achievable with the tool.

Once the intervention has been constructed, the XML files can be exported from the authoring tool into a single intervention file that can then be uploaded to the LifeGuide server. The LifeGuide server allows researchers to run trials of their authored interventions and collect the trial data in a secure database allowing authorized access at various levels of anonymisation. The server uses technology developed from the ASDEL project (Assessment Delivery Engine for QTiv2)⁴ [19] and XSLT style templates to render the intervention as a series of XHTML pages viewed by the participants of the intervention using standard browser technology. By using Web standards,

⁴ <http://www.asdel.ecs.soton.ac.uk/>

efforts have been made to ensure browser compatibility and the use of XSLT will allow the continued development of delivery to a wider range of mobile and embedded browser platforms.

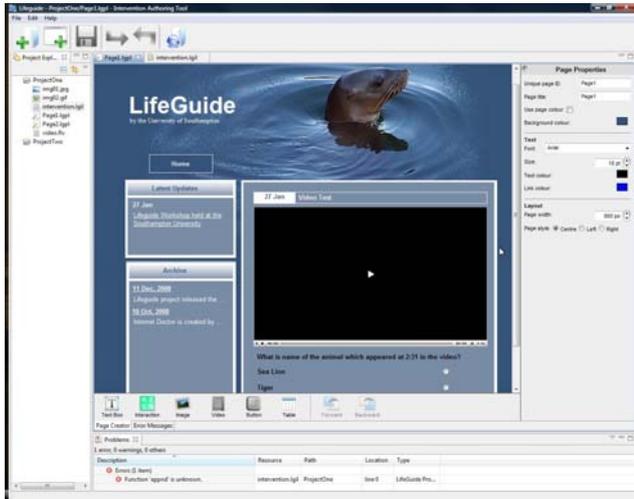


Figure 1: The LifeGuide authoring tool

Using LifeGuide, researchers are able to select and change the question types and response options used to assess lay user status, and the content and format of the tailored advice delivered (which is matched to user responses). The flexible interface gives researchers the ability to select and change multimedia resources linked to the site (e.g. audio/visual resources illustrating symptoms, self-care techniques etc.), adjust the look and feel of the system (e.g. colours, font, skins); and design their own user interface, using templates. LifeGuide will also facilitate collaboration in intervention development (e.g. through discussion boards and links to video-conferencing facilities). LifeGuide collects output data on participant use and outcomes, stores it securely, and provide facilities for collating and outputting anonymised data. Figure 2 illustrates the manager software which gives user details such as how many people used a particular intervention in a given time, the actual order of the pages viewed and where the users were geographically located.

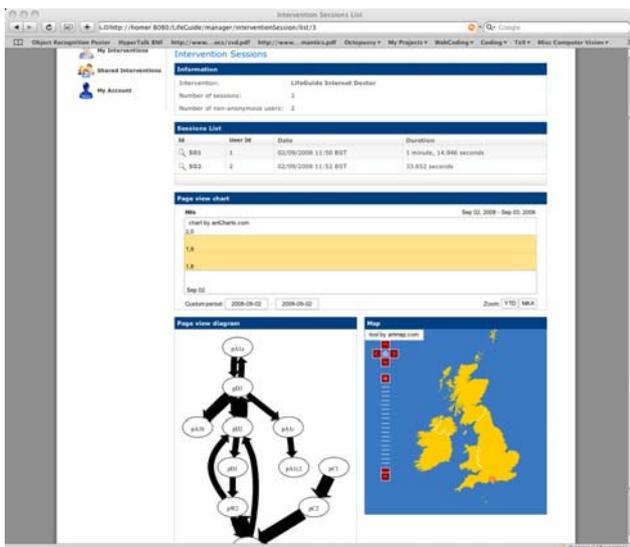


Figure 2. Features of the intervention manager software

Trial data can be output in SPSS and Excel (csv) formats and a wider variety of formats can be supported as and when the need arises.

Coding standards have been adopted to ensure readability and testability. Full account has been taken of issues relating to accessibility of Web-based systems and software to people with disabilities and the outputs of this project will conform to published standards and guidelines (e.g., the WC3 Web Accessibility Initiative level Double-A). We are endeavouring to future-proof the LifeGuide software by using open source software and adopting open standards that are technology independent, facilitating easy updating. We will also ensure that data collected is not 'locked-in' to the system or approaches used, enabling other systems to reuse the data.

More details of LifeGuide and how to access it can be found at: www.lifeguideonline.org

ACKNOWLEDGEMENTS

LifeGuide is funded by the UK Economic and Social Research Council (ESRC) as part of the National Centre for e-Social Science (NCeSS).

REFERENCES

- [1] S. Michie, A. J. Rothman, and P. Sheeran. Advancing the science of behaviour change. *Psychology and Health*, 22:249-253 (2007).
- [2] A. Warsi, P. Wang, M. P. LaValley, J. Avorn, and D. H. Solomon. Self-management education programs in chronic disease: a systematic review and methodological critique of the literature. *Archives of Internal Medicine*, 164:1641-1649 (2004).
- [3] S. Michie and C. Abraham. Interventions to change health behaviours: evidence-based or evidence-inspired? *Psychology and Health*, 19:29-49 (2004).
- [4] P. M. Nicassio, B. E. Meyerowitz, and R. D. Kerns. The future of health psychology interventions. *Health Psychology*, 23:132-137 (2004).
- [5] P. A. Jennett, H. L. Affleck, D. Hailey, A. Ohinmaa, C. Anderson, R. Thomas, B. Young, D. Lorenzetti, and R. E. Scott. The socio-economic impact of telehealth: a systematic review. *Journal of Telemedicine & Telecare*, 9:311-320 (2003).
- [6] 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:e10 (2006).
- [7] C. J. Armitage and M. Conner. Social cognition models and health behaviour: a structured review. *Psychology and Health*, 15:173-189 (2000).
- [8] F. F. Sniehotta, U. Scholz, and R. Schwarzer. Bridging the intention-behaviour gap: planning, self-efficacy and action control in the adoption and maintenance of physical exercise. *Psychology and Health*, 20:143-160 (2005).
- [9] P. Sheeran. Intention-behaviour relations: a conceptual and empirical review. In: *European Review of Social*

Psychology, 12. W. Stroebe and M. Hewstone. Eds. Chichester: Wiley, pp. 1-36 (2002).

- [10] P. M. Gollwitzer and P. Sheeran. Implementation intentions and goal achievement: a meta-analysis of effects and processes. *Advances in Experimental Social Psychology*, 38:69-119 (2006).
- [11] I. C. A. Hobbis and S. Sutton. Are techniques used in cognitive behaviour therapy applicable to behaviour change interventions based on the theory of planned behaviour? *Journal of Health Psychology*, 10:7-18 (2005).
- [12] P. Karoly. Mechanisms of self-regulation: A systems view. *Annual Review of Psychology*, 44:23-52 (1993).
- [13] A. Prestwich, M. Conner, R. Lawton, W. Bailey, J. Litman, and V. Molyneaux. Individual and collaborative implementation intentions and the promotion of breast self-examination. *Psychology & Health*, 20:743-760 (2005).
- [14] M. Kreuter, D. Farrell, L. Olevitch, and L. Brennan. *Tailoring health messages: customizing communication with computer technology*. London: Erlbaum, (2000).
- [15] H. De Vries and J. Brug. Computer-tailored interventions motivating people to adopt health promoting behaviours: introduction to a new approach. *Patient Education and Counseling*, 36:99-105 (1999).
- [16] B. G. Danaher, S. M. Boles, L. Akers, J. S. Gordon, and H. H. Severson. Defining participant exposure measures in Web-based health behavior change programs. *Journal of Medical Internet Research*, 8:e15 (2006).
- [17] C. Kerr, E. Murray, F. Stevenson, C. Gore, and I. Nazareth. Internet interventions for long-term conditions: patient and caregiver quality criteria. *Journal of Medical Internet Research*, 8:e13 (2006).
- [18] A. J. Rothman. Toward a theory-based analysis of behavioral maintenance. *Health Psychology*, 19:64-69 (2000).
- [19] G. Wills, H. Davis, L. Gilbert, J. Hare, Y. Howard, S. Jeyes, D. Millard, and R. Sherratt. Delivery of QTiv2 Question Types. In: *Procs. Int'l Conference, Loughborough, UK* (2007).