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# **IBBRE : A VRE to support cross-disciplinary and cross-institutional collaboration in internet-based behavioural research.**

## **Final Report**

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## **Table of Contents**

Acknowledgements .....	2
Executive Summary .....	3
Background .....	4
Aims and Objectives .....	5
Methodology .....	5
Implementation.....	5
Outputs and Results.....	6
Outcomes .....	8
Conclusions.....	8
Implications .....	8

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## Executive Summary

Behavioural interventions (BIs) – packages of advice and support for behaviour change – are arguably the most important methodology and technology employed by behavioural scientists for understanding and changing behaviour. Internet-Based BIs (IBBIs) are beginning to play a crucial role in the delivery of BIs, as they can be completed anytime and anywhere. IBBIs can be made available over the web to most of the population for little more than the cost of development. Interactive IBBIs can provide information and advice specifically ‘tailored’ to address the particular situation, concerns, beliefs, and preferences of the individual, by adapting their path through the information space.

The aims of the project were to develop a VRE to enable behavioural scientists creating IBBIs to collaborate in sharing and reviewing components of internet-delivered interventions, and to analyse if the VRE could be flexibly used to support collaborations within and outside the university.

The overall approach was that of co-design, between researchers from the psychology and computer science. The aims of the project were agreed at the start of the project, but the details were shaped by interaction with our research community; given the technological and cost limitations, we aimed to provide the researchers with the tool they required to use IBBIs effectively. The co-design and co-deployment approach ensured user engagement throughout the development and deployment. A test-driven iterative/agile approach to development was undertaken to ensure that regular delivery of a system was achieved.

Over 400 international researchers are registered on the VRE. They are using this to discuss their interventions; some of the interventions involve international partners, mainly from Europe but some from further afield. The interventions they have created vary in size from a few hundred participants to tens of thousands of participants.

The greatest impact has been on behavioural science communities as there is now a VRE aimed specifically at behavioural scientists, which will facilitate the discussion and development of the IBBi research area. More indirectly, other beneficiaries include the general population, who will also benefit as these interventions become better understood and good practice is shared amongst the behavioural scientists in developing IBBIs, and more effective interventions are developed. For instance, a number of different inventions are being developed to aid smoking cessation and weight loss which, with smoking, obesity and other weight-related health problems being key health issues, can have a direct impact on improving the nation’s health.

Also, those undertaking MSc and PhDs in the field of behavioural science will benefit from having the tools to peer review each other’s work and seeing good quality interventions first hand, instead of just reading about them. This VRE could become instrumental in training future generations of behavioural scientists.

The VRE code and technical documentation is available to other HEIs in the UK, so that it can be used either directly or as an example of how to build a VRE. See <http://www.ibbre.ecs.soton.ac.uk/>

The project aims were achieved, and possibly exceeded, with over 400 researchers using the VRE and developing interventions that have the potential to benefit thousands of people. Co-design and co-deployment was very effective in achieving the project aims. It takes time and effort but the results are worth it.

## Background

Behavioural interventions (BIs) – packages of advice and support for behaviour change – are arguably the most important methodology and technology employed by behavioural scientists for understanding and changing behaviour. Each BI acts as an experiment that tests whether the components of the intervention do influence attitudes and behaviour as predicted by theory. BIs are also powerful applied tools for changing behaviour in desired ways; 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 behaviour changes include reducing energy use, supporting health-related behaviour change for unhealthy behaviours, aiding self-management of healthy behaviours (e.g. hand-washing), and enhancing learning activities for busy health professionals.

BIs have traditionally been delivered principally face-to-face, and this continues to be the 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. Internet-Based BIs (IBBIs) are therefore beginning to play a crucial role in the delivery of BIs. IBBIs can be made available over the web to most of the population for little more than the cost of development. Interactive IBBIs can provide information and advice specifically ‘tailored’ to address the particular situation, concerns, beliefs, and preferences of the individual, by adapting their path through the information space. Interactive IBBIs 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.

At Southampton University we had already developed a set of tools (named the ‘LifeGuide’) that allow behavioural scientists to author IBBIs, underpinned by the IMS QTI standard. While these tools have immediate benefits for individual researchers and research groups, they also have the potential to support major productive changes in research practices if they can be embedded within a VRE that allows IBBIs to be shared between researchers within and across institutions. Major obstacles to intervention research have been identified; they include issues around the extreme time-intensity of developing intervention components and the lack of ready availability of components so that other researchers can critically analyse their key characteristics. If IBBIs could be viewed and shared within a VRE this would allow wider research communities to greatly speed up the research cycle of producing intervention components and testing them using large, pooled datasets.

The challenge to the university was how best to support resource sharing, critical analysis, publishing, and peer review of IBBIs within inter-disciplinary research groups and networks. The behavioural scientists wanted to be able to collaborate on the building of IBBIs, discuss IBBIs (peer review), securely make available the results of IBBIs to other behavioural scientists, allow others to use anonymised data in meta-studies, and inform others of what did or did not work.

In this project we intended to build on the lessons learnt from JISC VRE funded projects such as ‘CORE’ (<http://www.core.ecs.soton.ac.uk/>) and ‘myExperiment’ (<http://www.myexperiment.org/>). The Collaborative Orthopaedic Research Environment (CORE) project developed and deployed a set of Web services that enabled researchers to collaboratively design an experiment, collate the data, analyse the data, and disseminate the results. The users were orthopaedic surgeons, undertaking multi-centre clinical trials that needed to be managed and co-ordinated for a geographically dispersed set of researchers. In the current project we intended to make these tools generic to include the needs of behavioural scientists. The collaborative environment ‘myExperiment’ allows scientists to safely publish their workflows, share them with groups, and find the workflows of others. Workflows, other digital objects, and collections – called Packs – can now be swapped, sorted, and searched like photos and videos on the Web. Unlike Facebook or MySpace, myExperiment fully understands the needs of the researcher and makes it easy for the next generation of scientists to contribute to a pool of scientific workflows, build communities, and form relationships. It enables scientists to share, reuse, and repurpose workflows and reduce time-to-experiment, share expertise, and avoid reinvention. It is the ease with which behavioural scientists could share their intervention components that is of interest to this project.

## Aims and Objectives

The aims of the project have not changed. They were:

- This project will employ a VRE to enable behavioural scientists working within a variety of disciplines across the university to collaborate in sharing and reviewing components of internet-delivered interventions.
- We will analyse and describe how the VRE can be flexibly used to support collaborations within and outside the university.
- The impact of this project will be in two main areas: the technology, and the behavioural science communities.

## Methodology

The overall approach was that of co-design, between researchers from Psychology and from Computer Science. We had agreed the aims of the project but the details were shaped by interaction with our research community; given the technological and cost limitations, we aimed to provide the researchers with the tools they required to use IBBIs effectively.

The initial phase involved requirements gathering, undertaken by the researcher from psychology. This consisted of a participant observation study whereby the researcher learnt to use the LifeGuide software first-hand, attended meetings and workshops, and conducted interviews with various users. At the same time the computer scientists built the infrastructure, discussed development issues with the developers of myExperiment, and looked at previous VREs. This was an iterative process whereby progress and results were discussed at weekly meetings with the whole team. The results of these were distilled into a set of personas and scenarios and a system design to satisfy the requirements. The team in psychology recruited researchers to use the VRE, internationally as well as within the university.

The difficulty with co-design is ensuring that the project maintains a development programme that will meet its original aims and still satisfy the research community. The project team benefitted from Prof. Yardley's expertise in IBBIs and so during the co-design meetings, the computer scientist were advised on what features were essential to the success of intervention development and those that were considered as 'nice to have'. This helped the computer scientists to prioritise the work that would give the research community the greatest impact early on in the project lifecycle.

## Implementation

A test-driven iterative/agile approach to development was undertaken to ensure that regular delivery of the system was achieved. The project took a co-design and co-deployment approach, to ensure user engagement throughout development and deployment.

The overall technical approach was to integrate the lessons learnt from other VREs such as myExperiment and CORE; especially their use of communication tools for supporting resource sharing, critical analysis, publishing, and peer review of IBBIs within inter-disciplinary research groups and networks. The framework we built also allowed behavioural scientists to run the interventions within the VRE, allowing them to comment on the content of the intervention. In-house coding standards were adopted to ensure readability, testability, and sustainability of the code.

The School of Psychology employed a research fellow to organize the liaison with the wider research community, document changes in research practice for the procedural case study, and assist with dissemination. The feedback from the community was mainly gathered through workshops run at several conferences. It gave an opportunity to disseminate and demonstrate how to use the tool and also to gain feedback from researchers on what features they wanted to use. In addition, projects and early adopters were encouraged to give feedback on their experience of using the VRE.

The project had weekly meetings, with minutes kept, to disseminate the findings from the community and also to report on progress from the technical development of the VRE. While initially long, these were useful and allowed issues to be discussed and priorities to be set. In addition to these official meetings, smaller meetings between the developers and the psychology researchers discussed issues in detail and design solutions together. Towards the end of the project, meetings began to be

shorter and less frequent. As with any cross-disciplinary work, time is always required for the teams to understand the language and methods of working since these are often different between the disciplines. These meeting resulted in the development of a procedural case study see <http://www.ibbre.ecs.soton.ac.uk/publications/ProceduralCaseStudy.pdf>

The project was evaluated by the Software Sustainability Institute ([SSI](#)), whose feedback has ensured that the project is sustainable and the code reusable by other HEIs and stakeholders.

## Outputs and Results

Over 400 researchers are registered on the VRE and are using the VRE to discuss their interventions. Some involve international partners, mainly from Europe but also from further afield (e.g. Australia, USA). These interventions vary in size from a few hundred participants to 20,000 participants.

The IBBRE (also referred to as the LifeGuide Community website) is available at [www.lifeguideonline.org](http://www.lifeguideonline.org). It allows researchers to upload interventions that were created with the LifeGuide authoring tool. The owner of the intervention can then invite other users to play and comment on the intervention. The comment feature is widely used, and allows comments to be made for each page in an intervention. Other users can add their own comments alongside previous comments. For convenience, all comments for an intervention can be viewed in a summary table, and/or exported to an Excel spreadsheet. A wiki is also available that can be used for recording information about each intervention, though this has not proven to be as widely used as the commenting feature.

For each intervention, useful statistics can be stored and exported. These include data about intervention sessions – which user played the intervention, how long they spent, and how many times each page was viewed. For each session, it is possible to see the exact sequence of page visits, together with all the selections and entries made by the user. Such data is vital to help measure the usefulness of the intervention in changing user behaviour – for example, it may reveal that an intervention page that was thought to convey an important message is not actually viewed very often.

As the number of interventions on the IBBRE increased, it became clear that researchers tended to create several versions of what was fundamentally the same intervention for example, to try out and discuss new intervention layouts. To help keep these versions together, and to avoid having to search long lists of interventions, the website has been recently reorganised into folders of related interventions. Each folder can have a main version of the intervention, plus any number of variations.

Data collected from behavioural scientists highlighted the need for social and technical support throughout IBBRE projects. As more and more researchers outside of Southampton used the software, it also became clear that there was a need for an effective system for communicating key developments with the LifeGuide software. The IBBRE therefore has a researcher-led discussion board to allow asynchronous communication between remote users. An announcement system has also been set up to communicate important software updates. These announcements are automatically e-mailed to users who choose to receive them.

Interviews also indicated requirements for more help materials and examples of how to use LifeGuide functions. A detailed user guide for the software has been created, written from a researcher perspective. This is a living document reflecting all the changes in the development of the system and details of how each new feature can be used. This has moved from a static webpage to a wiki, making it quicker to publish the changes. For educational purposes, demonstration and tutorial interventions are also available on the IBBRE. These are similar in intent, and are viewable by any user. The main difference is that tutorial interventions illustrate LifeGuide language features and relate to sections of the Authoring Tool manual, whereas demonstration interventions can be used for discussions between any users of the website, and are not restricted to the manual.

A blog for IBBRE (<http://blogs.ecs.soton.ac.uk/ibbre/>) has been in operation for several months, mainly detailing issues and lessons learned with the development of the VRE. It has received some useful comments, which have helped in improving the system testing.

In addition a technical (<http://www.ibbre.ecs.soton.ac.uk/publications/IBBRETechnicalCaseStudy.pdf>) and procedural (<http://www.ibbre.ecs.soton.ac.uk/publications/ProceduralCaseStudy.pdf>) case study report has been produced. The procedural case study examines the ways that using IBBREs and the

VRE enhance the researcher's experience. The technical case study provides an overview of how and why certain approaches have been taken.

### **Publications from this work**

*A Virtual Research Environment (VRE) to Support Sharing and Collaboration in Internet Intervention Projects.*

**Williams, S., Yardley, L., Wills, G., Samangoei, S. and Gilbert, L** (2010) A Virtual Research Environment (VRE) to Support Sharing and Collaboration in Internet Intervention Projects. In proceedings Med-e-tel: Global Telemedicine and eHealth Updates: Knowledge Resources. Luxembourg,LU, 518-522.

[\[PDF\]](#)

*Introduction to LifeGuide: Open-source Software for Creating Online Interventions for Health Care, Health Promotion and Training.*

**Williams, S., Yardley, L., Weal, M. and Wills, G** (2010) Introduction to LifeGuide: Open-source Software for Creating Online Interventions for Health Care, Health Promotion and Training. In proceedings Med-e-tel: Global Telemedicine and eHealth Updates: Knowledge Resources. Luxembourg,LU, 187-190.

[\[PDF\]](#)

*LifeGuide: An infrastructure for empowering behavioural intervention research*

**Yang, Y., Osmond, A., Weal, M., Wills, G., de Roure, D., Joseph, J.A., Yardley, L.,** (2009) LifeGuide: An infrastructure for empowering behavioural intervention research. In: UK e-Science All Hands Meeting 2009, December 2009, Oxford, UK.

[\[PDF\]](#)

*Supporting the running and analysis of trials of web-based behavioural interventions: the LifeGuide*

**Yang, Y., Osmond, A., Chen X., Weal, M., Wills, G., de Roure, D., Joseph, J.A., Yardley, L.,** (2009) Supporting the running and analysis of trials of web-based behavioural interventions: the LifeGuide. In: 5th IEEE International Conference on e-Science, 7 -9th, Dec, 2009, Oxford, UK.

[\[PDF\]](#)

*Designing authoring tools for the creation of on-line behavioural interventions*

**Osmond, A., Hare, J., Price, J., Smith, A., Weal, M., Wills, G., Yang, Y., Yardley, L. and De Roure, D.**(2009) Designing authoring tools for the creation of on-line behavioural interventions In: Proceedings 5th International Conference on e-Social Science, Cologne, Germany.

[\[PDF\]](#) also available at <http://eprints.ecs.soton.ac.uk/17577/>

*LifeGuide: A platform for performing web-based behavioural interventions*

**Hare, J., Osmond, A., Yang, Y., Wills, G., Weal, M., De Roure, D., Joseph, J. and Yardley, L.** (2009) LifeGuide: A platform for performing web-based behavioural interventions. In: WebSci'09: Society On-Line, 18-20 March 2009, Athens, Greece.

[\[PDF\]](#) also available at <http://eprints.ecs.soton.ac.uk/17201/>

*Application of the LifeGuide: The development and quantitative analysis of the 'Internet Doctor'*

**Joseph, J.A., Yardley, L., Hare, J., Osmond, A., Yang, Y., Weal, M., Wills, G.** (2009) Application of the LifeGuide: The development and quantitative analysis of the 'Internet Doctor'. In: Proceedings 5th International Conference on e-Social Science, Cologne.

[\[PDF\]](#)

*Application of the LifeGuide: A think-aloud study of users' experiences of the 'Internet Doctor'.*

**Morrison, L.G., Joseph, J.A., Andreou, P., and Yardley, L.** (2009) Application of the LifeGuide: A think-aloud study of users' experiences of the 'Internet Doctor'. In: Proceedings 5th International Conference on e-Social Science, Cologne.

[\[PDF\]](#)

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

**Yardley, L., Osmond, A., Hare, J., Wills, G., Weal, M., de Roure, D., Michie, S.**(2009) Introduction to the LifeGuide: software facilitating the development of interactive behaviour change internet interventions. Proceedings of the AISB Convention, Edinburgh.

[\[PDF\]](#)

## Outcomes

Overall, the project has been a great success, and in many ways has exceeded its original aims. The IBBRE project originally set out to enable behavioural scientists working within the university to collaborate in sharing and reviewing components of internet-delivered interventions. This was achieved with the IBBI. Multi-disciplinary and multi-institutional (and some international) research teams can upload and discuss interventions while they are being developed.

The greatest impact has been on the behavioural science communities, in that there is now a VRE specifically aimed at behavioural scientists, which facilitates the discussion and development of research into IBBI. Behavioural scientists can collaboratively develop and share intervention components allowing cost-effective and time-efficient IBBI research. Thus, there is the potential for quicker turnaround of IBBI research leading to the potential to benefit larger numbers of patients and other population groups.

Those undertaking MSc's and PhD's in the field of behavioural science will benefit from having the tools to peer-review each other's work and see good quality interventions first hand, not just read about them. This VRE could become instrumental in training future generations of behavioural scientists.

Facilities available on the VRE (including the commenting system, detailed help materials and demonstrations, data management, and the easy uploading and downloading of interventions) have been received well by the behavioural scientist community. Informal e-mail feedback and more formal evaluations from interviews have demonstrated that behavioural scientists have found the LifeGuide Community Website to provide an easy-to-use and efficient research environment that enhances collaborative sharing and discussion within IBBI projects.

The VRE code and technical documentation is available to other HEIs in the UK, so it can be used either directly or as an example of how to build a VRE.

The co-design and co-deployment methodology was very successfully applied in this project and lessons learned could be used by similar JISC projects in the future.

## Conclusions

The project aims were achieved, and possibly exceeded, with over 400 researchers using the VRE and development interventions that are benefitting thousands of people. Co-design and co-deployment was very effective in achieving the project aims. It takes time and effort but the results are worth it.

## Implications

The VRE and associated tools are good but, as always, need improving. In addition, different disciplines may need to have slightly different tools, although care has been taken to ensure that the VRE is generic in nature. Other projects and developers can build on the IBBRE project by reusing the code or extending it to add new features to satisfy their research user community.

The IBBRE project provides behavioural scientists with an easy-to-use VRE that can help them to improve their digital literacy and governance of their research data. The IBBRE project provides open access to its code and documentation and is an exemplar of what may be achieved for specific research communities.

The main areas of development that can take this work further revolve around expanding and enhancing tools within the VRE. For instance, the export function currently outputs directly into a spreadsheet, but may be usefully extended to output to SPSS or similar statistical analysis tools.

The implications of the IBBRE project for other professionals in the field, are answered in part in the 'Outcomes' section. However, this project could also have an effect in helping researchers manage their data in a controlled manner. Although each intervention is unique, the VRE produces a standard short report which allows basic meta-studies on different types of interventions. Future work could develop a detailed common report to support comprehensive meta-studies across inventions that differ in purpose and underpinning theories. This would enable behavioural scientists to gain a better understanding of behavioural change.

Project Acronym: IBBRE  
Version: 0d  
Contact: Dr Gary Wills  
Date: May 20110

Future research may also want to explore possibilities around the storage and reuse of the scientific data generated from intervention studies.

The IBBRE framework could also be enhanced to run interventions created with other applications that did not use our authoring tool. Currently, the IBBRE VRE works with a specific workflow called an intervention. As the framework is open it may also be possible to plug in other types of workflows allowing other disciplines to use the tools developed in the IBBRE project.