SmartGardenWatering: Experiences of using a garden watering simulation

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ABSTRACT
SmartGardenWatering is an innovative software tool that advises gardeners on watering schedules and watering use. In this paper we investigate how expert and novice gardeners respond to advice from this piece of computer software. Do they readily accept it and adapt their activities accordingly, or do they override it with their own local knowledge? We describe the project to develop the simulation, including the design of the user interface, and a study of 20 gardeners using the tool. The focus of the study was to identify factors in the design of the software that influence how well it might intervene in ongoing gardening practice. The findings focus on what brings confidence or a lack of trust in the underlying horticultural model and its application to a particular garden. Finally, we consider how these findings might inform ongoing development of the software.

INTRODUCTION
A new generation of digital technologies are appearing with the intention of influencing domestic consumption of resources (Pierce et al 2008). In this paper we describe an investigation of a software tool intended to help people to manage domestic garden water consumption in Melbourne. The tool was developed through a collaboration between interaction designers (including some of the present authors) and horticultural scientists, funded by the Smart Water Fund (2009). It takes the form of a simulation environment in which a gardener first defines the various dimensions of his or her garden: size, soil type, mulch type, plants, and so on, as will be explained below. Based on these data, a profile of water demand over a year cycle is visualised as a graph, and the tool recommends a watering schedule (frequency and duration of watering) that matches delivery to demand. In addition, a visualisation of water tank levels is provided, and the tool allows the user to explore the size of a water tank needed to support the recommended schedule. Importantly, our design thinking was not only to provide these practical calculations, but also to allow users to explore and discover the effects of the various garden factors on water consumption. Underlying the practical tool, then, was a longer-term educational intent around water conservation in domestic gardens.

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A key question explored in the study reported here is what are the conditions under which a simulation tool of this sort, intended for domestic use, can engage users and potentially change their practices? We addressed this by studying the watering practices of 20 gardeners and investigating their use of the tool. The intention was to identify some key design challenges behind this kind of technology when applied to a domestic activity. Although straightforward in principle, this question raised deeper issues about the nature of interactive tools and their relationship with to-be-supported practices; in this case, gardening watering and embedded approaches to environmental conservation and sustainability. Complicating these issues are various different interpretive frames through which the project and its aims were viewed. From the perspective of horticultural science, most central was an equation and data, derived from empirical testing, that related specified garden factors to a volume of water needed to keep the specified plants alive; and the role of the interface that was to make the use of this equation and data available to the public. For the traditional usability designer (e.g., Molich & Nielsen, 1990) of course, the interface should go beyond this to ensure that an identified and profiled user could comprehend the various factors, and could manipulate them correctly. While from the field of cognitive engineering (e.g., Vicente, 1999) comes the view that what is critical is how well the gardener can map the represented world in the simulation to the real world of the garden, and how the simulation might afford appropriate action.

Bringing these perspectives together (science, interaction design, cognitive engineering) was much of the collaborative work of the project. As it turns out, the three views accommodate each other fairly well. The result is a kind of control-engineering paradigm in which the gardener is figured to be like an operator in a power station or other complex plant. The implied vision is that of a garden, fully established with reticulated water supply and timing devices for each outlet, and a gardener sitting behind the screen of a computer, adjusting variables to bring the complex system within some desirable envelope of sufficiency yet sustainability. However, there is a fourth perspective that is also relevant but which does not fit so well. This is the social scientist's view of gardening as a form of practice (Reckwitz, 2002; Shove et al., 2007; Warde, 2005) made accountable locally, and with the ways the craft of gardening and its associated knowledge is an emergent outcome of a distributed and ongoing dynamic in which objects are embedded and form a part of gardening as an activity. In this perspective, problems might be expected when changing gardening tools for interactive tools, and transporting the gardener from the garden to a make-shift control room.

All four of these perspectives were held by the design team from its onset. Thus the design, development and use of the tool became an experiment in exploring not only questions under each perspective but also possible accommodations between them. To these ends, the evaluation reported here consists of interviewing gardeners in their gardens as they talked through their approach to water use, and also investigated their reception and use of the interactive tool. The research questions reflect a spectrum of concerns across the different perspectives. At one end, we were interested in whether the scientific model (the equations and data) was being made available to a wider public. In the middle were questions about how well this application of simulation-style software could be comprehended and used. And at the other end of the spectrum, there were questions about the potential differences between the engineering approach implicit in the tool's design versus the situated practices of gardening and garden watering. This last question raised a larger issue. Many schools of thought in technology design favour working within existing or ongoing practices (e.g., Berg, 1998; Redström, 2006) where product design is not so much about an individual product, or about an end user, but about "the complex of material artefacts and practices of which isolated artefacts are a part" (Shove et al., 2007, 134). Yet a challenge in the area of domestic conservation is to change current practices towards greater sustainability. To support or not support current gardening practices may be simultaneously a good thing and a bad thing. The tool became a site to examine this contradiction.

In the next section of the paper, we first describe the history and shape of the collaboration that produced the tool; this being the source of the different perspectives under discussion. Then we describe the method and the findings of the evaluation study of real gardeners both reflecting on their watering strategies and using the tool. Finally, we offer some preliminary thoughts and conclusions on the questions raised.

ABOUT THE PROJECT

This project has been running for four years and represents a complex interaction between horticulturists, interaction designers and gardeners (users). To help in understanding the issues encountered, we first present the history of the project, the software, and the horticultural ideas on which it is founded.

The history of SmartGardenWatering

This project was initiated by two horticulturalists (Geoff Connellan and Peter May, Department of Resources and Land Management, The University of Melbourne) who obtained funding from the Smart Water Fund (2009) to generate research data on garden water use and convey it in a meaningful way to the public. The aim was to spend two years gathering data relating to plant water use, performance of mulches and watering systems, and to develop a mathematical model to determine a watering schedule for Melbourne gardeners. The third year of the project (2008) involved some of the authors of this paper representing this work in a way accessible by gardeners. This was an interesting challenge. It required us taking a large amount of research data, horticultural expertise and a formative water model, and designing software that would allow non-experts to explore it, manipulate it, and learn from it.

Our design approach began in a traditional manner of working closely with the horticultural experts, defining scenarios and personas, workshopping screen designs and experimenting with nascent approaches with members of the target user group (Pearce et al, 2008). However, during this process, we became very aware of the extent to which the design process was influencing and shaping the way the data were being represented, as well as even the message that was being portrayed. A primary aim was to produce a resource for general application that was fun to use and encouraged exploration in order to support its educational outcomes. Hence the project moved away from one of simply presenting scientific research data to the public, towards one of presenting an environment in which the lay public could confidently explore and experiment to produce a practical outcome (a watering schedule) as well as an educational outcome (to understand better how various factors impact on garden water use). We named the software SmartGardenWatering (SGW).

Some of the authors of this paper received further funding from the Smart Water Fund to extend the project through 2009 to establish an online community of gardeners who could model their gardens and their watering needs, save and share their models, and communicate within an online gardening community. Hence the current project is focused on improving the software, and designing and establishing an online community. We also aim to validate the existing water model through field trials in which water use and garden conditions will be monitored in people's homes.

SmartGardenWatering.org.au – the software

The SmartGardenWatering software is a Flash application that allows Melburnians to model their garden and obtain a schedule for watering throughout the year, as well as advice on the performance of rainwater tanks. The user begins by entering the postcode of their home, after which they are informed of the average rainfall and soil type for that area. They then define one or more 'zones'. A zone is an area of the garden that is served by one watering system (e.g. a vegetable patch watered using a dripper, shrubs watered with a soaker hose, etc.).

Next, they are taken to the main screen of the program that allows them to enter information about each garden zone using four 'concertina' tabs on the screen: 'plants', 'conditions', 'watering' and 'schedule' (Figure 1). These are described in turn below.

Figure 1: Main screen showing plant choice and demand graph.

Plants

Users describe what plants are contained in each zone by making a choice from a 'quick selection' set of predetermined plant groups, such as lawns, vegetables, fruit trees, shrubs, etc. Alternatively, they may elect to use a more detailed database of 1500 plants (taken from the Burnley Plant Directory (Burnley, 2009). This also allows specific plants to be selected, or the user may choose to search based on flower colour, water demand or origin. Whichever way the user decides to populate their zone, as soon as a plant type is selected, they immediately see an animated line appear on the graph at the bottom of the screen (Figure 1). This represents the water demand of their garden throughout the year. From here on, this line updates in an animated fashion as changes are made to any settings in the program.

Conditions

The second concertina presents choices related to the physical conditions within that particular zone of the garden: area of the zone, an option to change soil type, density of planting, microclimate conditions, slope and the type of mulch applied. Again, changes here cause an immediate response in the demand graph.

Watering

The 'watering' concertina presents a choice of watering devices (drip hoses, above or below mulch, soaker hoses, sprays, etc.). On making a selection, blue bars appear on the graph showing the calculated schedule for each month of the year (these can been seen at the left and right ends of the graph in Figure 1; one of them is highlighted with a rollover). It will be noticed that the bars sit just below the demand line displayed on the graph. The shaded band above and below the line indicates a region moving from *just surviving* to *lush garden growth* and the program aims to produce a schedule that errs on the conservative side of this region. If the user wishes, they may modify the schedule in the next concertina.

Schedule

The final concertina allows manual adjustment of the watering schedule (Figure 2). This may be required if the user wishes to have a particularly lush garden, or maybe notices an alert that warns of a violation of current watering restrictions. Such violations can often be resolved by decreasing the *frequency* of watering and increasing the *duration* (depth) of watering.

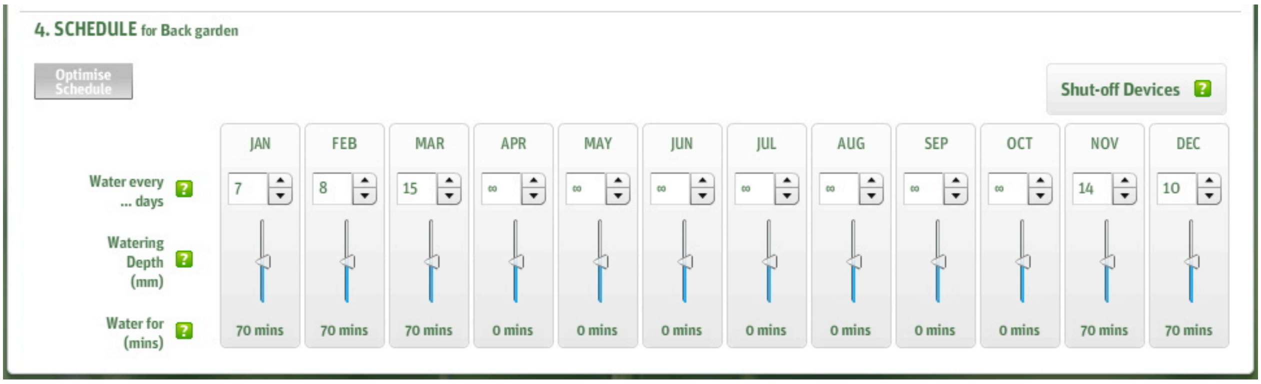

Figure 2: Schedule concertina showing how frequency and duration of watering can be adjusted.

Water tank

A 'My water tank' tab at the top of the screen allows the user to explore how a water tank would perform if connected to one or more of the garden zones (Figure 3). The important parameters here are the tank capacity, the collection roof area, at what time of the year the tank is expected to be empty (or full) and to which zone(s) it is attached.

The user is able to print out a summary of all the schedule information and water demands produced by the program.

Horticultural background

In order to understand some of the issues discussed later, it is useful first to have a brief introduction to the principles upon which the watering model is based. These are described in more detail elsewhere (Pearce et al, 2008). The model assumes that the ideal amount of water to deliver to a garden at any one time is the equivalent of a 10 mm rainfall. To apply much less than 10 mm risks encouraging shallow root growth. More than this is likely to result in loss of water as it drains out of the top 200 mm of soil – this is where most of a plant's feeder roots reside. Hence the gardener needs to know: (a) how long should a watering system run in order to deliver a 10 mm dose, given that the efficiency of application is not one hundred percent due to run off, absorption by mulch, possible loss due to wind, etc.; and (b) how frequently should this 10 mm dose be applied, given that some will transpire through the plant, some will evaporate and some will drain through the soil.

From the research done by the horticultural team, the software 'knows' about how the above factors combine to affect the water schedule. It knows about the flow rates of various common watering devices, the impact on efficiencies due to run off, mulch and climate conditions, the evapotranspiration of various plants and the impacts of different soil types. The calculation of the watering schedule has to take these parameters in to account, as well as knowledge of average rainfall and evaporation rates in the garden's location.

Currently the model does not take into account recent rainfall in the area, although this is being incorporated into the next version.

EVALUATION RESEARCH METHOD

In addressing water resource sustainability and management, social research was undertaken to evaluate how the SGW1.0 interface was received, in terms of design aesthetics, usability and relevance. This evaluation was conducted as part of a broader analysis looking at garden watering practices in suburban Melbourne gardens, and assessing the potential of integrating this technology with existing home garden watering practices, devices and information sources. This stage of research was timed to coincide with the public launch of version one of the SGW tool, with responses to be analysed to feed the requirements for the development of SGW2.0.

The social research involved 20 participants in Melbourne, Australia, with fieldwork interviews taking place during the late summer and early autumn of 2009, which was part of a significant period of drought. Participants were recruited through: canvassing at the 2009 Melbourne International Garden and Flower Show; snowballing from other participants; liaising with community gardening groups; and through social networks of researchers. Despite a small sample size, the sampling strategy was designed to include a degree of variability in suburban location; garden type and age; gardening expertise; watering methods, sources, devices, and routines. Qualitative methods were employed in the study, which was centred on a 'garden tour'. The garden tour involved participants taking the researcher on a walk around their domestic garden, observing the act of watering, photographing the garden, and discussing how it was watered through a semi-structured and in-depth interview. The interview questions related to: garden watering history, current routines, techniques and timing of watering; devices used and interacted with in the act of watering the garden; and sources of knowledge about garden watering. This garden tour method was employed in order to situate the research in the place where the object of study occurred, and thus to assist participants in the visual recognition and recall of the numerous idiosyncrasies of watering practices. Following this initial interview, participants were given the URL of SGW1.0 to explore and with which to model their garden. After a period of a week, a second interview in participants' homes was conducted to gather their feedback, experience and reflections of the software. Again, this interview took place in the location of practice, with the researcher sitting with the participant in front of the screen whilst the SGW program was navigated and discussed. The interviews were then transcribed for analysis.

This research method has affinities with recent work in ethnographic and qualitative analyses of water consumption and sustainability that seeks to complement approaches based on individual behavioural and consumer psychologies or large-scale quantitative and statistical methods (Allan & Sofoulis 2006; Chappells & Mead, 2008; Head & Muir 2007; Sofoulis, 2005; Sofoulis & Williams, 2008; van Vliet, Chappells & Shove, 2005). Rather than locating the research, explanations or solutions to water resource sustainability with either the individual and demand-side management (behavioural solutions) or the aggregated whole-of-population and supply-side management (engineering solutions), these approaches emphasise "intermediate-level collective processes" (Sofoulis, 2005, 447). That is, consumption is neither reducible to the individual, nor captured by an aggregation or averaging of the totality of water use. Instead, it is argued that individual action is informed (and constrained) by the material and technical dimensions of social life and that a focus on the population misses the complexity and detail of situated and everyday practices of water use. Sofoulis writes: "people's water practices are situated in particular historical, geographical and cultural contexts, are shaped by social, political, economic, and discursive conventions, and interact with particular cultural and technological formations..." (Sofoulis & Williams, 2008, 51). This methodological approach is described as a sociotechnical perspective – based on ideas from actor-network theory and a range of studies of technology and society – which considers everyday objects and practices as forms of "inconspicuous consumption" (Shove, 2003, 2), shaped around routines of interaction with taps, hoses and buckets. These objects and their use become a crucial analytical link that connects domestic water consumers to the wider systems and networks of supply and distribution.

RESEARCH FINDINGS

Communicating the underlying horticultural model

From the horticultural perspective and interaction design perspective (as described in the introduction) the tool was successful in that it brought the scientific model to the public and enabled them to use it. The indicator of this success was the general observation (as indicated in following sections) that participants could talk through many of the variables, their interrelationships, assumptions, and the data on which the tool's calculations were based.

Interestingly then, the very success at presenting the model and in delivering a simulation-style interface, brought new issues in the use and usefulness of the tool. Unanticipated in the horticultural perspective (at least in its initial expression) not only did the tool allow gardeners to use their model, it allowed them to scrutinize it. This brought out various discrepancies of belief and expectation that we can see as issues from both the cognitive engineering and practice-based perspectives discussed at the outset.

Practices falling outside of the simulation: hand watering and grey water

As anticipated, issues arose over the fact that not all garden watering techniques and practices were included within the scope of the tool. Although frustration at this is an obvious finding in a sense, these provide important context to the tool's evaluation.

The most prevalent problem was an inability to easily incorporate the use of a 'hand-held hose' as a choice of watering device to help calculate a watering schedule. From a practical perspective this difficulty relates to the broad diversity of flow rates with garden hoses (there is no standard or average rate) and the more indiscriminate spray of hoses. Many people wanted to select the choice 'using a hand-held hose' as this is a popular way of watering, and they often stalled or were unable to move forward when they couldn't quickly select this. Some 'circumvented' the system by clicking on an alternative device (e.g. 'sprinkler') as a way to get a schedule, which presents problems as the way people are then using the software potentially provides an inaccurate water schedule. Although the software provided an option to calculate hose flow rates, this required users to apply a formula after doing a number of tests with their hose. This appeared too time-consuming or difficult to most users. Not one person attempted this – people wanted a quicker and easier option.

A related problem that resulted in frustration was the inability to incorporate the use of 'grey' water into personalised watering schedules. The term 'grey' water is used here to refer any form of recycled domestic water that is captured and transported to the garden (i.e. with buckets from the kitchen sink, shower, bath, or washing machine) and not necessarily water that has contaminants in it. Most people used some form of 'grey' water and wanted an option to account for this water and its effects on the schedule. The software does not let users account for these other sources of water and their effects on a watering schedule.

This issue relates to the ease with which the tool can be integrated into or encompass the diversity of garden watering practices, technologies, and especially the more informal or vernacular methods of watering developed by domestic gardeners – what Shove refers to as 'routine creativity' (2007). Clearly, the tool is successfully used when more formal or standardised watering devices and systems (automated, reticular etc) are modelled. Yet, where it was more difficult to integrate and transform garden watering was in relation to methods and devices – such bucketing 'grey' water on the garden – which were less predictable, often fleeting or ephemeral, and harder to model with a high degree of certainty.

Levels of complexity in the simulation: experts versus novice

Reactions to the tool suggested a deep problem in that the appropriate level of complexity of the simulation might be a difficult aspect to get right in principle.

More 'expert' gardeners felt their intimate and detailed knowledge of garden watering exempted them as the audience for this website, and so thought it was more for 'novices'. Yet, many 'novice' gardeners felt that the software was too complex for them and so thought is was more for 'experts'. Thus, some want a quick and easy program to navigate; yet, others want the ability to access more detailed information about data and variables and assumptions.

Perceived limits of historic rainfall data

A second interesting source of difficulty was a problem gardeners had in trusting the historic rainfall data used by the tool.

Primarily it was the rainfall data that the program used to calculate watering schedules that resulted in uncertainty and a lack of confidence. People questioned what period the data came from; how relevant it was for the current drought conditions; and what assumptions have been made in the calculations. They questioned why the program used historical data (it actually uses rain patterns from an ‘average dry year’) and not current 'real-time' rainfall data.

So while the scientists behind the tool’s design believed the selected rainfall data were sufficiently accurate for the schedule calculation, the gardeners were troubled by it. The interesting point here is that the scientists were working from an assumption of relative stability of weather patterns (not withstanding large patterns of climate change). The gardeners, in contrast, had a view of climate and rainfall patterns as something undergoing change at a rate to render the recent, but nevertheless historic, data as irrelevant for the present.

This issue highlights a possible misunderstanding about the aim of the software itself. It is essentially a *planning* tool that enables a gardener to map out the watering requirements over a year and plan a watering schedule, to appreciate the different requirements at different times of the year, and to plan how a water tank might provide the water required. It is based on the typical weather patterns across Melbourne during a dry year, but it is not a *day-to-day scheduling tool* designed to respond to recent rain events (or lack of). The calculations required for that involve further knowledge of the garden that are not incorporated in this model.

Granularity of the simulation: mixed garden beds

In selecting plants for the simulation of their garden, participants questioned the calculation of water requirements for areas of the garden containing mixed plants. That is, what would the effect of mixing different types of plants with different water requirements in a single area have on watering demand? Thus, defining and describing a mix of plants in an area caused uncertainty. For example, the consequence of placing a high water need plant in a generally low water need area was questioned. Does this then dictate the water schedule for the whole area? The answer is ‘yes, it does’, if the aim is for that high water need plant to survive. However, a more sustainable response would be to move plants so that they are grouped together with ones of similar water demands.

Who to believe? Surprising calculations on watering durations and frequency

Many were surprised by the recommended watering schedule (which specifies durations and frequencies based upon an aim to deliver 10 mm of water). For some it matched current practices, but others thought it was not enough water for their local conditions, i.e. - *their* plant types (high water need); *their* soil (doesn't soak in very well); or pressure of *their* taps (low). Some assumed that their practice was better informed than the model (based on local knowledge). The main difference was shorter *duration* and higher *frequency* of watering compared to the model schedule. The main question was about the model – based on historical and generalised information yet applied to current and individual conditions; and therefore whether it could be relied upon?

A behaviour of the software that highlights the importance of users gaining confidence in the advice that the software offers is illustrated by the system’s aim to deliver 10 mm of water at each watering. A consequence of this is that the vertical columns on the demand graph, which represent the watering schedule (see Figure 1), might appear to be too far below the demand line itself (but within the grey band indicating adequate water). This is deliberate in order to deliver just 10 mm of water at each watering event without wastage due to overwatering. However, the user might discover that the ‘schedule’ screen allows him or her to adjust the bars to move closer to the actual demand line. This might appear to be a better solution to the scheduling problem and indicate that the software did not work as well as it could. However, what is really happening is that the user has increased the amount of water delivered beyond 10 mm and this is not an optimum solution in horticultural terms. System responses such as this can lead users to believe that their knowledge is better than that of the system and hence lead to a lack of trust in the system.

Some wondered about the data on plants’ water requirements (especially for vegetables or exotics; or the impact of plant age) and didn't agree with, or were not convinced by, the recommendations produced. This was typically discussed in terms of watering frequency and duration: some thought the recommendations were not frequent enough and for too long a length of time (the 10 mm issue again). Many people tended, instead, to water for shorter duration, but more often. Some disagreed with the actual recommendations based on their plant types (high water need); soil (doesn't soak in very well); or pressure of taps (low).

The science suggests that many people's garden watering is 'wrong'. Whilst true for some, for many others they hold a more sophisticated understanding than is provided by the software.

DISCUSSION

Aside from the immediate usability and usefulness findings, a number of deeper considerations arose concerning the overall modelling of the tool, its appropriation into practice and the perception of gardening as a social or collective practice.

The simulation as a general solution versus the idiosyncratic gardener

Whilst the SmartGardenWatering software allows an individual to model his or her own garden, in many ways it still retains many features that tend to present an 'averaging' image to the gardener: ability to select pre-defined groups of plants; assumptions about average rainfall data; watering devices that might not exactly match the user's. However many gardeners regarded their garden as idiosyncratic and special. They had special and intimate knowledge about their garden and some even exhibited a 'routine creativity' in their approach to garden watering.

Gardeners regularly attend to the health and water needs of their gardens and so, regardless of schedule or recommendations, will still adjust watering or do something different based on their view or assumptions of the current weather, rainfall and plants' needs. Or lifestyle. This is a common problem – that no matter what is suggested by scientific data, their vernacular and located and developed knowledge of watering their garden has a specificity and intimacy that cannot be challenged or deferred to what is seen as too general and limited information a software program.

In a sense then, this could be described as users having 'gone beyond the software'; that is, many have developed improvised and innovative arrangements and knowledge that relates to their situated gardens that cannot be captured by the software.

Although this software is not trying to be a one-stop 'solution' to demand-side management and is not able to account for every variable in this diverse activity, there is in some ways a desire for this to be the case.

A finished solution versus appropriation into practice

These tensions between intended and actual use, between the design intent and the users' understanding of the object, have been described by Don Ihde, in his phenomenological account of technology, as a 'design fallacy' (Ihde, 1993, 116). In his understanding, this centres on the ways the design intention of objects are subverted or appropriated in their consumption and use, in the 'social life of objects'. Yet, conversely, this fallacy could be interpreted in terms of the users' expectations of an object's capabilities, and its inability to fulfil this.

Gardening as an individual activity versus an intermediate-level collective practice

Perhaps, this fallacy resides in how such applications are represented and understood. What their value is? Rather than being a total solution, they need to be conceived as part of a distributed and ongoing dynamic in which objects are embedded and form only a part. It is not about an individual object with a determined use but recognising the value of this designed object within and as part of a much broader complex of sociotechnical arrangements and competencies (what Shove calls 'distributed competencies', 2007, 54) related to garden watering. Shove writes: 'conventionally seen as a property of the human subject...competence is perhaps better understood as something that is in effect distributed between practitioners and the tools and materials they use' (Shove, 2007, 55).

We initially described SGW1.0 as *'a tool to be used as an instrument of behavioural change in how water is used in home gardens'*. The problem this presents is that it frames the software in terms of individual behaviour and demand-side management, when the situation (both theoretically and empirically) suggests that individuals and their watering practices are embedded in, and the product of, entangled sociotechnical networks. Perhaps both the software and users need to recognise the limitations of any intervention into such a complex activity.

Perhaps, trying to shape or change individual behaviour is naïve (see van Vliet et al, 2005); rather, SGW needs to be seen as part of a suite of technologies to assist in sociotechnical networks and practices of garden watering – not as a 'solution' on its own, but connected and interdependent with other technologies within the project of water sustainability

Key design challenge

The most significant issue with software of this kind is to instil confidence in the user. In this particular case, this could be achieved by making assumptions clearer (e.g. source of rainfall data, 10 mm water application); by giving justification information or rationales (e.g. behaviour of mixed plant zones, treatment of plant age); by giving information on how data are used (e.g. slope of land, density of planting). Anything that surprises or does not match expectations needs an explanation (e.g. an input change that does not affect graphs; a schedule change that does not affect duration; etc). In part this is about acknowledging the limitations of the software, but in part it is about helping the user see where and how the advice offered (and practices of watering afforded) by the software fits in their own schema or expertise within the context.

CURRENT WORK

During 2009 the SGW1.0 application is being reconstructed as a community web site using Web 2.0 technologies to establish a strong, vibrant community of gardeners talking about saving water (and to integrate it within the sociotechnical complex of garden watering practices). This is being funded by the Smart Water Fund (Round 6). Part of this reconstruction involves adding new features to the software: ability to save, reload and share garden models; ability to search for the models of others using a 'Google Maps' style interface; incorporation of real-time weather information; choice of different rainfall data sets. We are also implementing an extensive 'ground truthing' exercise in which the advice given by the current software is calibrated against on-site measures of soil moisture content, plant health and water use. Finally, this project aims to establish a social network to encourage and support sustainable water use, and behavioural change. This will require us to build on the research reported above and refine our design of the new system based on what we have learned.

CONCLUSION

The research presented here demonstrates that gardeners do indeed engage with a simulation tool of the type discussed and do relate that engagement to their own gardens and their practices within them. Whilst the software was very well received (and is now being sought for use by other states in Australia) a significant issue identified was the role of confidence or trust – trust in both the historical meteorological data used and trust in the way these data were manipulated by the simulation. This trust can be weakened by program outcomes that challenge idiosyncrasies in existing practice and also by a desire to model gardens at a greater level of granularity than the program allows. Simply having a 'scientifically correct' model is not a sufficient condition to engender change in practice. The authors are developing a new version of this software that aims to build on these findings in order to create a significantly enhanced and valuable user experience that will have a significant impact of garden practice.

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