Social networking sites as platforms to persuade behaviour change in domestic energy consumption

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Abstract. This paper describes a pilot investigation into the use of the social networking site Facebook as a platform for persuasive applications. The application domain is behaviour change in domestic energy consumption and the study focuses on determining peoples' attitudes towards the hypothetical coupling of the consumer product Wattson, which can monitor domestic electricity usage, to a Facebook application termed Watts Up. The Facebook application presents visualisations of users' own electricity consumption as well as that of their friends. Users' attitudes towards this notion were accumulated and analysed using grounded theory. Some user indications revealed negative opinions about the concept based, for instance, around privacy and confusion; however the balance of opinion appeared to favour the underlying idea that revealing other people's energy usage data would lead to competition and peer influence to reduce energy consumption.

1 INTRODUCTION

The responsible consumption of energy in domestic homes is a topic of considerable current importance. Heightened awareness of the global negative impact of the depletion of non-renewable energy resources and global warming, coupled with both the current economic situation and rising energy bills, means that many household consumers are increasingly likely to be motivated to reduce their energy consumption. However, research [1] has shown that many people are unaware of the day-to-day cost of, for instance, electricity consumption and that the obfuscation of information presented on household meters and quarterly bills presents a significant barrier to the understanding of daily energy use.

So-called *smart-meters* which present information in ways that are more easily understood by the consumer (e.g. via visualisations of daily/weekly usage presented online in web-pages) have recently become a focus of research and evaluation (e.g. see [2]); however – at least in the UK – such devices are not yet routinely made available through energy suppliers. Nonetheless, individuals can choose to purchase one of a range of consumer devices that will show, in a real-time fashion, their own electricity usage to them within their home. These devices include the Owl [3] and Eco-Eye [4] which both display energy usage in a relatively utilitarian fashion. An alternative product is the Wattson [5] by DIY Kyoto which embraces a more aesthetic design ideal (its developers include alumni of London's Royal College of Art) and could be categorized as an ambient display [6]. The Wattson is shown in a domestic setting in Figure 1. The device can show instantaneous usage of electricity in kWatts or as an annual fee in UK £pounds. It also has a series of LEDs embedded in its base which emit an ambient colour based on current usage (such as blue for low usage). Users of the Wattson can optionally choose to use a piece of software which logs their usage and presents it via visualisations. Furthermore, users can also choose to upload their usage statistics to the Kyoto website and make it publicly available to other users. Although the take-up of this functionality seems limited (based on casual observation of forums on the DIY Kyoto website) it is a step towards the persuasive use of such technology as it promotes awareness of other people's usage as well as one's own.

Figure 1. Wattson Device in a home setting

Social networking sites such as Facebook and MySpace have seen phenomenal growth in the number of people using them in a very short space of time. Reportedly, Facebook has in excess of 200 million current users [7]. The emergence of freely available software development tools such as Facebook Platform and OpenSocial has released the potential of deploying small software applications to very large numbers of people in a viral fashion. The success of seemingly trivial applications on Facebook has shown that people are willing to invest daily time in interacting with the applications they install as well as recommending such applications to their friends. The Facebook application metrics site AppData [8] shows top installs having many millions of monthly users whilst even the most trivial of applications can have tens of thousands of users. Given the number of users and their social connectivity – it seems logical that Facebook could provide a very powerful platform for the delivery of persuasive applications and this has indeed been suggested by a number of researchers (e.g. [9] [10]). Nevertheless, the number of applications that have been

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evaluated in an academic context for this purpose remain very limited.

Figure 2. User's view of their hypothetical energy usage once they install Watts Up in their Facebook profile.

Social Psychology can offer us an insight into why social platforms like Facebook can be powerful motivators into behaviour change. Individuals join Facebook *voluntarily* and add applications to their profile on the same basis. The main function of Facebook is to provide the user with an online network of their chosen friends they can interact with in various ways. The *attractiveness* of such friends in terms of their similarity and familiarity to us makes it more appealing for social interaction to take place [11]. This forms the basis of interaction between friends and a primary reason why we add them to our 'friends list'. There is likely to be more attitudinal change between friends when the friendship attributes of familiarity and attractiveness of other friend's qualities are present.

Very recent investigations of Facebook have produced a series of named patterns that attempt to spread persuasive behaviour by embedding them in applications [12]. These patterns make use of the built in features of the platform such as the friend selector and messaging functions to mitigate the spreading of an application through a social network in a viral fashion. One such pattern is called 'Provoke and Retaliate' where one friend can take action on another friend, for example by sending a virtual gift or a graphical representation of encouragement. This generates reciprocity whereupon the friend on the receiving end feels socially obligated to respond. Using this concept it can be supposed that reciprocal interaction could take place in an energy monitoring application where friends view each other's energy information and can both send/receive encouragement and warnings based on their energy use. Other persuasive factors are Cognitive Dissonance [13] and Group Polarization [14].

Cognitive dissonance is manifested when someone holds two or more inconsistent beliefs; an example of a person's energy awareness attitude could comprise, for instance two statements such as (i) I know that energy consumption is having a bad impact on the environment, but also (ii) I always leave the lights and heating even when not at home. These conflicting ideas can induce cognitive dissonance therefore creating more awareness and in turn a drive to reduce the dissonance through changing their behaviour and attitude. In this case the behaviour change would be to stop leaving the lights and heating on to align with their belief of energy consumption having a negative impact.

Group Polarization was a term that was known as' Risky Shift' up until the 1960's. Risky Shift was the idea that an individual makes more risky decisions than a group. However further research proved this to be incorrect, with the realization that groups make more 'extreme' decisions than individuals [15]. More recent research has revealed that when Group Polarization happens online its effect is even greater [16], therefore increasing the potential persuasiveness of an application in an online setting. This effect shows that if a group of people have a meeting and discuss a particular topic such as Climate Change then the participant's ideas and views are strengthened even more than they were before, since such group meetings create a highly persuasive environment. However this can also have a negative effect: for example, if an inherently racist group of people have a discussion about racism then their views on racism are inflated and strengthened. Group Polarization is manifested in groups of Facebook friends who are part of a particular group with a common theme such as 'Feed a child with a click' [17] that raises awareness of children dying from starvation, thereby strengthening the views of the users who join the group. Such groups can be created for energy awareness and discussion areas integrated into applications such as Watts Up. By doing so, Group Polarization could be leveraged creating a persuasive environment where a group of Facebook friends share common beliefs based around an energy conservation theme.

In this paper we present an investigation of people's attitudes to the energy consumption monitoring device Wattson and also to a hypothetical software application that allows people to view their own and their friend's electricity usage via a Facebook application. The paper is organized as follows. Firstly, in Section 2, we describe the Facebook application and its hypothetical link to the Wattson. Next, in Section 3, we describe our user evaluation of such a concept interpreted using grounded theory. Section 4 presents the analysis of the collected data interpreted using grounded theory. Finally, section 5 presents our conclusions and provides brief directions for future work.

2 RELATING WATTSON TO FACEBOOK

The focus of this paper is on the hypothetical use of the Wattson device in combination with a conjectured Facebook application named 'Watts Up'. The concept explored is the capability of the Wattson to send measurements of the user's current energy usage to the Watts Up application. When the user visits Watts Up, they can see their own energy usage represented numerically and graphically from within their Facebook account. Additionally, they can also check on any of their friend's energy usage if they too use the Wattson device with Watts Up. It is envisaged that by being able to view other friend's energy ratings, it may introduce a 'competitive' element where users thereby compete by lowering their energy usage, thus having a positive impact on the environment. Social Approval [18] would be a key element as a user who consistently used more energy than the rest of their friends would likely be liable to provocation by their friends in the form of comments or any other persuasive facilitators the application offers. By 'conforming' to the norm the user's mental model of acceptance by their friends is

consolidated, particularly through reciprocal positive encouragement. It should be noted that the Wattson is not actually used throughout the investigation; rather it is a simulation of its potential use when coupled with the Watts Up application. The user interface to the Watts Up application however was implemented using the Facebook Platform and made available as an application to users on Facebook.

The concept of Social Learning has shown that people can learn new behaviours and adopt attitudes by observing. Through this observation they can note possible rewards and punishments and are likely to perform this rewarding behaviour themselves [19]. As such, a form of league table or virtual reward scheme could be implemented in 'Watts Up' to facilitate the notion of good energy conservation practice being rewarded, particularly when those rewards are not only automatically granted by the system, but also by their friends. This can be reinforced further particularly if the friend giving a reward is older or more experienced. Examples of this are community websites that encourage people to stop bad habits, such as smoking [20], [21]. These sites post up success stories of people who have quit smoking. Additionally, they also provide the facilities to send encouragement messages to others that can be personal or posted publicly on a board where others can take inspiration and encouragement from them.

Shown in figure 2 is the applications tab 'My Watts' which illustrates the user's current and previous energy usage both numerically and graphically. Visualisations incorporating the typically emotive polar bear image have also appeared in related work by other authors [22]. Another important function of the application is the 'Friend Watts' tab adjacent to the 'My Watts' tab, illustrated in figure 3. This shows a list of the user's friends who have added the application and also shows in brief a graphical representation of their overall energy usage. The decision was made during development, not to include or show the energy usage of others who use the application who are not on your friends list. This can give rise to the 'Fake Friends' syndrome that Facebook is trying to avoid. The reasoning behind this is that people may add these friends to their friends list even though they do not know them at all. The consequence is Facebook's goal of an accurate social graph being completely wrong. Facebook themselves have tried to address this issue partly in their launch of the new profile layout in July 2008 which moves applications of profile pages and onto boxes possibly making them more difficult to find.

3 USER STUDY

The purpose of the short study was to determine peoples' attitudes towards the coupling of the Wattson to the hypothetical Facebook application Watts Up. A number of participants, 10, were recruited – using Facebook messaging – to take part in the study, 7 participants completed the questionnaire. The method used to gather the qualitative data necessary for analysis of potential user thoughts and opinions was a questionnaire utilising open-ended queries [23]. Once gathered the data was analysed using the Grounded Theory (GT) method [24]. The questions asked were designed to encourage users to challenge the design aspects of both the Wattson and the Watts Up Facebook application in order to reveal potential good points as well as the bad points of their respective designs and functionality. The intention was to provide viewpoints for possible re-design elements to potentially improve the concept of energy awareness in the home.

Figure 3. User's view of their friends' hypothetical energy usage in the Watts Up application.

The questionnaires used in the study were embedded into the Watts Up application, with the user being able to complete and submit their answers from within their Facebook account. This provided a more integrated solution for capturing the data as the user will have viewed the features in Watts Up directly before commencing the questionnaire. A screenshot of the questionnaire embedded within Watts Up and the users Facebook account is seen in figure 4.

Figure 4. Questionnaire embedded in Facebook Application.

Two sets of questions were used in the study – one evaluating the Wattson device itself and the other exploring the notion of linking the Wattson (or similar) to a Facebook application. The questions posed to users in order to evaluate their thoughts and attitudes on the potential use of the Wattson device are detailed

in Table 1. Additionally, the questions posed to users in order to evaluate the Facebook application are given in Table 2.

Question	Phrasing
1	From your own thoughts regarding what you have learned so far about the Wattson device, describe how you think it may be able to assist you to personally contribute towards energy conservation. For example it may help to assist in achieving a cheaper home electricity bill.
2	What do you think about the Wattson's design in terms of its physical appearance? For example could it complement your home furnishings?
3	What improvements do you think would benefit the device in terms of its physical appearance? For example its size.
4	From your understanding of the device so far, please describe any barriers to using it effectively. For example is your fuse box located outside your home.
5	Would you recommend the device to your friends and family? Please give reasons for your answer.

Table 1. Questions used to evaluate the Wattson device

Question	Phrasing
1	What are your thoughts on this Facebook Application (Watts Up) in how it complements the Wattson device? For example, how do you feel it would be a useful addition to it?
2	Please describe your experience when using the Watts Up application. For example were its features easy to understand or not?
3	When using the Watts Up application, please describe what your own interpretation of your energy rating was. An example could be your thoughts on the illustrative representations (i.e. the polar bear) of your energy rating
4	In the applications 'Friends Watts' feature, please describe whether you feel this feature might be able to make you more aware of your own energy usage at home by comparing with friends. Please be as descriptive as possible.
5	Would you recommend this application if it were to be fully developed? Please explain your reasons why.

Table 2. Questions used to evaluate Watts Up Facebook Application

Other related studies that have taken place to raise awareness of domestic energy consumption have involved the use of persuasive computer games [25]. This involves a type of game play design where users can interact with a simulated domestic home environment. Within this they can perform various energy-usage actions such as taking a shower, watching television or cooking a meal. Instant feedback of energy usage is given on screen as well as a monetary meter which drops as they use more energy. It allows for a cause and effect simulation to take place with instant graphical feedback which isn't normally available when carrying out day to day activities. A pre-study of 100 teenagers aged 13-18 took place to determine how important they found energy awareness to be, with 70% deeming it was important. The authors have suggested that subsequent empirical research using their game design will provide a greater insight into energy conservation in the home.

4 ANALYSIS OF USER COMMENTS

In this section the data collected using the questionnaire is presented and analysed. A total of 7 questionnaires were completed which produced approximately 3,300 words of qualitative data, as derived from the responses to the questionnaire's open ended questions. Each questionnaire included responses to both sets of questions for the Wattson and for the Watts Up application. To analyse the data, as stated previously the chosen qualitative research method was GT. The format of the questionnaire was designed to encourage and elicit from the participants both the good and bad attributes of the Wattson device and the Watts Up application. By using the GT method in its procedural steps on the questionnaire data, the intention was to present a theory that encapsulates views to re-designing aspects of the aforementioned device and application. The intention therefore is that the theory viewpoints will be entirely grounded in and from the data. The GT method was applied to both the Wattson device and 'Watts Up' Facebook application evaluations separately, with reporting carried out on both. Due to space restrictions we will only fully report and elaborate on the Watts Up application, mainly as this is the level at which most of the social interaction takes place. The various steps of applying the GT method to the data will now be detailed: these are open coding, axial coding and selective coding.

Sample of user comments listed in the open coding stage, as well as their generated codes are given in Table 3 for the Watts Up application.

User Comment	Codes generated
"I think it would be useful as an anywhere access insight into your home energy needs, but perhaps more from a home automation perspective. I confess I would use it, but think it could be improved to say track usage over time."	1. Implies **anywhere access** is **useful** as a **feature** 2. Implies that **improvements** to the **presented data** could be made
"for looking back at your usage to perhaps see if there is a pattern in when it has been high so that you can change behaviors'	1. **Energy history** seems to be important 2. Implies that you will **lower energy** usage when it becomes high
"non technical minded people can use it"	1. Implies that **non-technical** people can use it easily
"Not completely sure how this application works with the device", , "I would probably not regularly check my friends energy usage."	1. Implies confusion in how the application **communicates** with the device 2. Implies **friends feature** isn't interesting
"score between my friends will encourage us to improve our usage"	1. Implies **encouragement** from friends will improve usage
"fear of having someone know how much energy I use."	1. Implies **fear** or **embarrassment** on **friends** knowing energy use
"beat their friends"	1. Implies **competitiveness** element to beat friends in usage
"found it quite simple."	1. Implies the app had a **simple layout**
"tabs make it easy to navigate"	1. Implies tabs provided **good navigation**
"I did not find the score output method obvious."	1. Implies the **energy rating** was **unclear**

Table 3. User comments and open coding for Watts Up

Following open coding, the axial coding step was then performed in order to determine commonalities between the codes. Three categories were drawn out at this step: *usability*, *engagement* and *confusion*. These categories are shown as headings in Table 3 which also shows the grouping of the relevant codes underneath these headings. Figure 5 shows a simplistic diagram illustrating the relationships between the three

axial codes. The *usability* category was defined since many of the codes derived from the data were specifically related to the application layout and the presentation of its features and functions. For example the 'anywhere access' label was deemed important as the application offered the capability to view your homes energy usage from any internet browser. This could be projected as greatly enhancing the functionality of the Wattson device, as without the application its measurements could only be viewed by the user when present in their home. The *engagement* category was directly influenced by the application's usability credence. As shown by the codes under engagement, there is a definite mixture of interaction taking place. A whole range of emotions are instigated: from fear of friends mocking another friend's energy usage (leading to embarrassment) through to constructive and friendly competitiveness. Peer pressure was noted in the feedback as being an important construct that can spur people on to contribute to energy conservation - but it was also suggested that this may also have a potentially negative impact.

Usability	**Engagement**	**Confusion**
simple layout	competitiveness	unhelpful
non-technical	useful	reluctance
energy history	fear	visuals meaning
anywhere access	baseline rating	poor comparison
energy rating	peer pressure	help key
representation	encouragement	unclear
communicates	challenge	complacency
enhances	feel guilty	improvements
numerical/graphical icons	environment awareness	
	friends	
	embarrassment	
	comparing	

Table 4. Categories drawn out by axial coding of user feedback

There was also an element of *confusion* which highlights a failing in areas of the application's usability and engagement. There was a relatively moderate degree of confusion surrounding the use of the current graphical representations such as the polar bear and earth light bulb. However, there were also several unique suggestions in the data to combat this, such as utilisation of a help indicator or key to immediately identify what the graphical illustrations represent. This not only states a possible solution but also gives the impression from the feedback that individuals have a deeper understanding of the environmental impact by offering up alternative solutions.

Following axial coding, GT advocates the determination of a *core category* – in this case this was deemed to be *engagement*. This was chosen because there was a predominate amount of user data describing a strong link between the human interaction with the application to produce an effect on the environment. There was a strong sense of social interaction (with friends) within the data that is related across all the categories of usability, engagement and confusion. It was found that the application, although limited in interaction between the user and the application interface, still provided a major link to external social aspects through friends linked by the application. These social aspects were manifested as human behaviour between friends such as competitiveness, peer pressure and encouragement. The aforementioned behaviours were positive in general but negative emotions were also used: such as guilt and embarrassment when a user's energy usage was higher than their friends. From this it can be said that the application could be a strong motivator to incite these behaviours and emotions with the environment the chief benefactor. Additionally the application could provide a 'baseline' for a user's energy usage by comparing to their friends energy usage. However, some users would prefer not to interact with the friends feature at all giving rise to redevelopment. With some confusion on the meaning of the graphical representations for a personal energy rating the use of well placed help information could assist greatly.

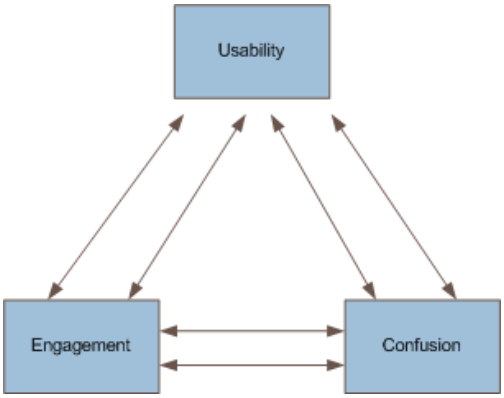

Figure 5. Axial coding category relationships

It is apparent that we can deduce a number of potential redesign concepts for the Watts Up application. For instance, the graphical representation (polar bear, earth light bulb) could be changed to give a more understandable energy rating, in terms of redesigning it would basically be a new set of images. Help icons could also be situated strategically to assist users with the meaning of anything on applications pages, would be helpful as raised by the feedback regarding confusion of graphical representations. The potential to give an alphanumeric overall rating to a user's home could be introduced such as the current rating scheme in use for cookers, fridges, washing machines etc. This could be integrated on the user 'My Watts' page of the application. Finally, to combat privacy, the option to completely disconnect from other users of the application could be integrated, effectively leaving the user isolated with their energy data remaining private.

5 CONCLUSIONS & FUTURE WORK

The paper has described a short pilot investigation into user attitudes towards coupling home energy monitoring devices, such as the Wattson, with Facebook applications which reveal not only individual energy usage data but that of people's friends. Analysis of user statements, based on Grounded theory, revealed a number of categories that must be considered in any future real deployment of such a concept. Some user indications revealed negative thoughts about the concept based, for instance, around privacy and confusion. However the balance of opinion appeared to favour the underlying idea that revealing other people's energy usage data would lead to competition and peer

influence to reduce consumption. We are currently developing the experimental design of a real system which uploads energy consumption data direct to a remote server so that Facebook (and other applications) can potentially make use of such data.

Further embryonic work has involved the use of a recently developed website, myenergyusage.com, which employs the use of a desktop application called Powometer [26]. This application has the capability to send monitoring data online from Wattson allowing members of the website to view their individual, as well as group collective, energy usage. Participant energy usage is graphically displayed using various gauges and graphs representing both real time and historic energy data. Work in progress involves the linking of the energy monitoring data to the Facebook application using open standards. It is expected that using open standard approach will pave the way for many different types of application development such as desktop widgets, mobile phone applications and RSS feeds. We believe that opening the data to as many platforms as possible is a primary step in creating more awareness of domestic energy consumption.

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