Influencing Behaviour by Modelling User Values: Energy Consumption

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Abstract. A variety of social and digital media technologies are being used to influence a change in an individual's or group's behaviour. A major challenge is in understanding what leads to or prevents different forms of influence from having an effect, what those effects are, how long they take to come about and for how long they last. This research is concerned with the problem domain of climate change and with using social and digital media technologies to influence users to change their energy consumption behaviour. The objective is to understand how user information may be utilised within the development of persuasive technologies and behaviour change support systems. This paper contributes fundamental and applied research on how user values, lifestyle aspects and energy consumption behaviours may be modelled to support systems in delivering relevant and personalised information and knowledge that can influence behaviour change.

Keywords: User Profiles, Values, System Design, Influence, Energy Consumption Behaviour

1 Introduction

There is growing interest in understanding how social and digital media can be used to influence an individual's or a group's behaviour in areas including health, defence and security, climate change, and more. Research in this area seeks to understand fundamental and applied aspects of what leads to or prevents different forms of influence from having an effect, what those effects are, how long they take to come about and for how long they last. This requires an understanding of both the explanatory and predictive aspects of different forms of influence. In addition, research into how digital technologies might play a role in influencing behavioural change is of concern to researchers in cyber influence and persuasive technologies [5].

This paper contributes fundamental and applied research on influencing behavioural change in the area of carbon reduction. There are a myriad of reasons why serious action needs to be taken to reduce our carbon footprints. A plethora of highly commendable courses of remedial action are being taken including developing alternative and/or more efficient technologies for creating, storing and using alternative forms of energy. A major concern of others and our research

is to change people's understanding and behaviour towards energy usage and to bring about reductions in carbon rich energy consumption. Our means to do that is through people and society themselves, and our medium for mediating that change is personal and societal digital solutions. Our approach is to understand people's values, to recognise those values as being important influences on behaviour and to create, using the medium of digital technology, data, information and knowledge resources that are both personal and community-based to influence people to change their behaviour towards lower carbon energy usage.

People use information that is created, accessed and stored on their laptops, tablets and smart phones to help them make both everyday and important decisions. People are enabled to create, and share information and knowledge. This information and knowledge creating, searching, and sharing, results in people and broader communities adopting new ways of acting, doing and behaving. It also supports the establishment of new communities which in turn create and share new information and knowledge.

Persuasive technologies [5] and behaviour change support systems [8] have been defined as "computerized software or information systems designed to reinforce, change or shape attitudes or behaviours or both without using coercion or deception" [8]. An aside here is that it is questionable if such systems do truly avoid using any form of force to try to change people's behaviour. Many forms of force exist – some of which use both social conscience and the person's own conscience to influence behaviour change. These are forms of force, as are those which seek to create cognitive dissonance to influence behaviour change.

Within the area of energy reduction some systems use predictive modelling to calculate and provide feedback on potential energy saving opportunities for the user (e.g. work by Fischer [4]). Other approaches promote pro-environmental values and attitudes with the goal that this will influence a change in behaviour. One major criticism of such systems is that they prescribe changes in behaviour without understanding why people behave in particular ways, or why particular behaviours are carried out. Consequently, many case studies report a lack of long term engagement [7, 11, 19].

A primary aim of our research is to understand how people's values can influence long-lasting behaviour changes. From this understanding we can then investigate attributes of software systems to influence people to reduce their high carbon, energy consumption behaviours. This paper outlines how user values, lifestyle aspects and energy consumption behaviours may be modelled within software systems and utilised to deliver relevant and personalised information and knowledge that can influence behaviour change.

2 Current Approaches

Software systems that influence energy consumption behaviour vary in their design, and their requirements are often based on popular theories of behaviour change, such as the behavioural model of rational choice [16], value-belief-norm model [18] or action-behaviour-choice [15]. These theories and methods allow

designers to get a better understanding of what user information is necessary, how to model this information, and how the system makes decisions based on this information to influence a change in behaviour in a personalised way.

Some current approaches utilise predictive modelling and simulation techniques to calculate and provide feedback about potential energy saving opportunities at certain time periods. Designs that decide what is best for the user solely based on limited sources of data (such as electricity usage) are in danger of forcing users to conform to efficiency targets without understanding the motivations or reasons behind why particular energy usage behaviours happens. Here again, many case studies have reported limited success and a lack of long-term engagement [3]. People soon find this unacceptable and either disable/ignore or find ways to work around the system. Hence, what the system was (unknowingly) compromising or preventing was more than just energy usage it was an important aspect of their life that people were not prepared to have compromised or prevented.

Other approaches aim to promote pro-environmental values and attitudes with the goal that this will lead to a change in behaviour [14, 21]. However, a person holding a particular value or attitude does not necessarily act upon it [2, 6, 15]. In this case there is a failure to recognise that people hold multiple values and life causes them to prioritise, compromise and trade-off these different values. Simply creating pro-environmental values creates more conflict and compromise. This results in pro-energy values having little influence on behaviour. Of course if we understood what these different values were and how people resolve the conflicts, make compromises and prioritisations, we might then be able to more effectively influence behaviour. That is exactly our aim.

Therefore we need to identify, understand and make good use of the complex information about people's values, how they affect their everyday lives, and how they might have implications on their energy consumption behaviour. In addition, while there may be common values and common aspects to people's lives we need to recognise their individual and personal forms, their differences, and their relationship to consequential behaviour. Hence we need to personalise and tailor any influences to the individual.

3 Our Approach: Values-based User Modelling

Designers of software systems that aim to influence behaviour change need to take into account the broad spectrum of ways to frame behaviour change interventions, in order to make them personalised and relevant to individuals and groups of people. Based on existing work into the content and structure of values [13, 1], lifestyle aspects [1, 10, 20], and energy consumption behaviour [20] we discuss our motivation and outline how this information may be modelled to personalise and tailor behaviour change influences.

3.1 Motivation

Our underpinning philosophy is that saving energy is not always the governing or guiding principle around which everyday lives are organised. Everyday lives are organised primarily due to values, around contexts and ways of living. Software systems that aim at influencing behaviour change therefore need to take into account the complex trade-offs that are made to meet the demands and challenges of everyday life while maintaining the values they hold. Of course the value of nature and the environment is a value that many individuals hold [13], and performing activities with the sole purpose of curtailing energy-use may be instrumental in supporting this value. However, it is important to recognise that this is potentially one of many values that an individual or group hold and strive to maintain.

People have many values. They are used to select and justify activities, and to evaluate artefacts and events (including other people and themselves)[13]. The values people hold are considered as important influencers and drivers for their specific energy related behaviours [6, 12]. Those values may be articulated in rather generalised forms by collective terms. Existing research into the structure and content of values can be seen in work by Schwartz [13] who presents a set of 10 universal value types including security, conformity and tradition among others. Similarly, work by Rokeach [12] also presents work on collective values including a comfortable life, social recognition and wisdom. Each of these types contains subtypes of instrumental motivational values; for instance the value type of security contains a set of 7 instrumental subtypes such as family security, healthy, social order, and so on. However, these generalised value forms take on real meaning and influence at a much more personal and individual level. Moreover, the values for an individual are constructed and operationalised through the connections they have with the terms and contexts of their everyday life.

Activities, artefacts and events are important aspects of everyday life. They are related to the way in which individuals spend their time and are instrumental in supporting their values. An activity may be defined as a set of actions that have a goal [10]. For instance, the activity of cooking may be performed and in doing so will support the value of health and wellbeing. However, the activity of cooking may be performed to create healthy meals to maintain the value of health, or alternatively, to provide food for many people at a family event and subsequently supporting the different value of family. Therefore, activities alone do not dictate energy consumption behaviour. Values provide a powerful motivational and determining function on activities and behaviour.

In addition to activities, there are other types of important information. These are events and artefacts. For instance, a family member's birthday party may well require them to have a birthday cake to mark the occasion. This would give rise to very different cooking behaviour than if an individual was cooking an evening meal for themselves. This suggests that information about the activity alone may not be enough information to explain why behaviour is performed in a certain way. Using the example of a birthday party, it is possible to see that

everyday life is connected and/or constrained by values influencing particular events (e.g. birthday) and particular artefacts (e.g. cake).

Due to the constraints of values on activities, events and artefacts, energy related decisions and energy consumption behaviour is a consequence of the way in which individuals and groups of people make decisions and trade-offs. The decisions and trade-offs are between their important values, determining their lifestyles, motivating their activities, and contextualising events and artefacts and determining their energy related behaviours.

3.2 Main Information Types in the Influence Structure

Table 1 lists six types of modelling information that act as drivers of our energy consumption behaviour. They are all defined as objects as they would be represented as separate objects within a software system object model.

Name	Description
`Value`	Something of importance to an individual or group.
`Lifestyle Aspect`	Ways that values are supported in their socio-cultural context.
`Activity`	What people do, a set of actions with a goal.
`Event`	Something that happens, natural or created.
`Artefact`	An object - physical or informational.
`Energy Consumption Behaviour`	Behaviour that has direct implications on an individuals carbon footprint.

Table 1. Influence Structure - main information types

A Value represents something that an individual or group see as an important part of their lives. Lifestyle Aspects represent the socio-cultural context in which people live their lives. They provide patterns that may change during different periods in people's lives, they maybe self-chosen, circumstance driven – or a mixture of both. Activities represent what people do. They can be related to work, home, entertainment, caring for others, etc. Artefacts are largely physical in some form, but include images and sounds such as in the case of music. Informational artefacts are also relevant; such as news, facts, or ideas. Events can be natural events such as sunsets and/or created events such as birthdays. Energy Consumption Behaviours are behaviours that are directly energy consumption related, they can include both using energy such as providing heating for warmth or cooking and saving energy such as turning the thermostat down or creating heat from renewable energy sources.

Activities, Artefacts and Events are all important contextual features of Energy Consumption Behaviours. Energy Consumption Behaviours are consequential to ways in which Lifestyle Aspects are performed. Lifestyle Aspects are in turn instrumental in supporting Values. These associations form an important influence structure that can subsequently be modelled within a system to influence a change in energy consumption behaviour by tailoring implemented strategies of influence.

3.3 Applying the Influence Structure Framework

Table 1 shows that the pivotal parts of the structure are Values, Lifestyle Aspects, Activities, Events, Artefacts, and Energy Consumption Behaviour. The Energy Consumption Behaviour objects are the part of the model that is specific to the problem domain of energy-use. The remainder of the model is general and related to everyday life and decision making. In short, the model connects what people do, why they do it, and the implications this has on energy use. In order to visually represent this information and their associations, we exemplify their construction in Figure 1 based on universal values, activities and energy consumption behaviours in the literature [1, 10, 13, 20].

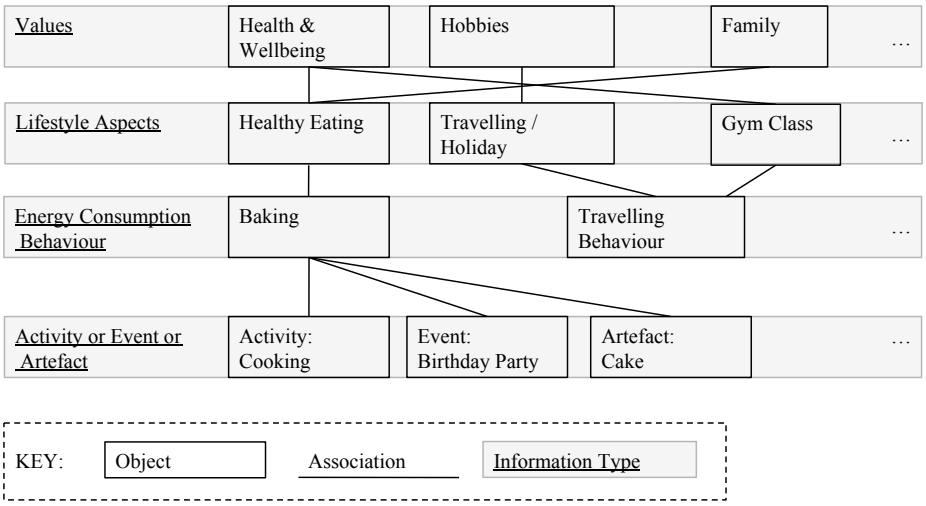

Fig. 1. Example of values, lifestyle aspects and energy consumption behaviour.

An object model was chosen as the information instances are of central importance to the system design. It formalises the relationship between information that drives decision-making in real life at the same time as representing the associations between object instances implemented within a system. In other words the decisions that individuals make within their lifestyles are *instrumental to*

their values; these are represented as *associations* between Lifestyle Aspect objects and Value objects. For ease of reading, the information type is shown for each of the four hierarchical layers.

The connection between the Lifestyle Aspect of healthy eating and the Value of health and wellbeing shows that the Lifestyle Aspect of healthy eating is instrumental to supporting the Value of health and wellbeing. The Lifestyle Aspect of healthy eating may have different ways in which it is carried out which affect how well the Value is supported. Energy Consumption Behaviour of baking is consequential to the ways of carrying out the Lifestyle Aspect of healthy eating. The important contextual information related to the Energy Consumption Behaviour of baking is the Activity of cooking, the Event of a birthday party and the Artefact of the cake.

Constructing the influence structure allows for designers of behaviour change interventions to reason logically about how to frame interventions for different situations. For instance, using the example given previously, we can see that the Energy Consumption Behaviour related to baking is consequential to the Lifestyle Aspect of healthy eating. Healthy eating is instrumental to two Values: health and wellbeing, and family. Using this influence structure, behaviour change interventions may be framed in the context of a valued aspect of a person's life that may be either directly or only indirectly related to energy. To relate this to the example, interventions may be framed by supporting valued interactions with family and/or promoting health and wellbeing through energy efficient ways of baking. The outcome of the intervention is that the person(s) is influenced to change behaviour in favour of behaviour that consumes less energy while directly supporting their highly valued activities.

4 Conclusion and Future Work

This paper argues how the construction of a user model, based on values, lifestyle aspects and energy use behaviour may be utilised within a software system to inform strategies that influence a change in energy usage behaviour. These information types were chosen as they are the key drivers of everyday decision-making that lead to energy consumption behaviour. As such the content and inter-relationship of these information types may inform intervention strategies that are relevant and personalised.

The model explained in this paper illustrates the main conceptual types that are important. A natural progression of this work is towards an implementation-level design. The additional implementation-level detail that is necessary may add lower level implementation specific detail but should not change the conceptual model. It is important to take into account the tensions and trade-offs between between values. This is because the tensions and trade-offs are important to select and understand the consequences of a particular strategy of influence.

In future work we aim to empirically evaluate the influence structure through the design an online social media system that aims at influencing a change in

energy consumption behaviour. Iterative system development will allow for the model to be specified at a lower level of granularity.

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