C-Aware: Introduction to a Case-Study of Cross-Cultural Participatory Design of Persuasive Visualizations

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ABSTRACT

Globalization is a financial motivator for cross-cultural design, yet global *responsibility* for CO_2 emissions (which are a key contributor to climate change) forces us to consider how existing design knowledge for persuasive technologies might be rapidly and effectively transferred across national boundaries to encourage beneficial energy-related behavior change. In this short paper we introduce the C-Aware project, its aims regarding persuasive displays relating to emissions, and the project's user-centered participatory approach to design that involves staff from three workplaces: two in the UK and one in China. The paper outlines a set of cultural uncertainties that may impact on emissions-related displays and on the suitability of participatory design, and states how the chosen design approach hopes to raise and address these. The planned activities will take place in the first half of the year, and it is intended that the results will be reported at the Transnational HCI workshop.

Author Keywords

User-centered design, paper-prototyping, energy.

ACM Classification Keywords

D2.2 [Software Eng.] Design Tools and Techniques

General Terms

Design

INTRODUCTION

Over the course of our lifetimes, each of us will leave a digital history that reflects our patterns of behavior. This trail consists of our interaction with services, the contexts within which we choose to use them, and our reactions to them. We refer to this trail as our *lifelong contextual footprint*. As networked technologies – building management systems, smart energy monitors, location-aware mobiles, etc. – proliferate, energy use in buildings is becoming an increasingly significant element of our lifelong contextual footprint. Yet while these technologies may both contribute data to our digital trail (by recording

our energy-related behavior), and make our trail visible to us (by displaying recorded data), current representations of our energy use leave us in the dark about links between our behavior, emissions and climate change.

Making those accountable for energy-consuming behavior aware of its impact may reduce global emissions. However, making a consumer aware and *willing* to alter their behavior is not trivial: understanding of accountability, the responsiveness to the framing of consumption, and personal motivations to change behavior vary between individuals. In addition to variations between socio-economic demographics, cultural differences (both within and across nations) have a vital impact on the responses of individuals to technological interventions [1] and on their relationships with energy and emissions [16, 17]. Over the last few decades, cultural dimensions have been proposed such as those put forward in [6, 11, 14]. Designing for these differences is an unavoidable challenge: in order to achieve real global impact on emissions we must consider the population outside Europe and North America who emit 64% of the CO_2[1]. There is strong international pressure on key nations such as China, which has targeted a 40% to 45% cut in carbon intensity against 2005 levels by 2020[2], to raise awareness of links between behavior and environmental impact amongst their public. Despite new internal initiatives (e.g. the State Grid Corporation of China has plans to reduce CO_2 emissions by 10.5 billion tons over the next 10 years[3]), the urgency of a need for global reduction necessitates that knowledge transfer of existing successful practice in design of sustainable and "persuasive" technology takes place where possible: this

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[1] Energy Information Administration data on world CO_2 emissions from consumption of energy in 2009: http://tonto.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=90&pid=44&aid=8

[2] China announces targets on carbon emission cuts: http://english.gov.cn/2009-11/26/content_1474008.htm

[3] SGCC white paper on Green Development (the first among Chinese Corporations): http://www.sgcc.com.cn/ywlm/socialresponsiility/whitepaper/

existing design knowledge can only be applied in new cultural contexts if the differences in context are fully surfaced.

C-Aware

The C-Aware project aims to develop and trial a range of persuasive technologies [7], to deliver visualizations of energy consumption to individuals over the course of a day, including consumption at home, work and while travelling. These technologies will be driven by consumption data provided by energy monitoring infrastructure deployed in three work buildings (two in the UK, one in China) in which three project partners are tenants, and into the homes of employees working at each of these workplaces. The project hopes to surface not just cultural differences that result in variations between the interfaces across the three deployments, but also how the cultural differences affect a user-centered design (UCD) process that leads to the user interfaces, in particular how feasible UCD exercises such as paper-prototyping [12] are as universal design activities and how these exercises can be prepared for in non-Western settings. Initial rounds of design activities have taken place in the first quarter of 2011, with further activities planned for the remainder of 2011.

CROSS-CULTURAL UCD FOR RAISING ENERGY CONSUMPTION AWARENESS

The designers within C-Aware (who are drawn from one of the UK project partners) have an institutional background of participatory and user-oriented design practice in various Western contexts, having previously participated in design activities that engaged with a range of different types of end-user, e.g. [4, 8, 9]. This past experience has shown that for paper-prototyping to provide useful results there must be *existing understanding of the context of use being designed for* so that the necessary scaffolding may be put in place to guide the prototyping activities. In a familiar environment where the context of use is well-understood by the facilitating designer, paper-prototyping may therefore be an early-stage exercise. In unfamiliar contexts, activities to familiarize the facilitator of the design process must take place in advance of paper-prototyping in order to understand the context of use. In the C-Aware project, the designers are familiar with the context of use i.e. organizational and social structures that affect behavior, visual design conventions and metaphors, and public perceptions of/exposure to information about energy consumption. This allows generation of a set of concepts and examples that might stimulate a fruitful paper-prototyping exercise. As a result, minimal engagement with potential end-users on UK sites is required to structure the activities such that these candidates will be feel both stimulated and confident. Paper-prototyping will be an early-stage activity.

The context in which displays will be used in China is unfamiliar: the designers have no personal familiarity with the Chinese organization into which the displays will be placed, and only a limited familiarity with Chinese culture. Two types of uncertainty have been identified, i.e. uncertainties in cultural context of *energy use*, and uncertainties in cultural context of *participatory design*. Until these uncertainties are addressed, useful seed designs or design elements cannot be brought to the table in paper-prototyping activities.

Uncertainties in cultural context of *energy use*

Organizational hierarchy and responsibility

There are an increasing number of cross-cultural studies [2] that explore the implications of cultural dimensions for organizations. These studies have shown significant differences in relationships between staff and their employers, and between employees within an organization. These differences may have implications for interfaces that make accountability for action visible in public. A Chinese tendency towards collectivism means that Chinese employees may be motivated strongly by organizational goals and performance; by contrast more individualist UK employees may be less motivated by representations of the team, and more so by competition within the team.

Aspirations and psychological distance

The motivation provided by a representation of energy use varies depending upon the viewer's aspirations. Based upon social psychology theory [5, 11], we would hypothesize, for example, that individuals who have fundamentally extrinsic aspirations will be more likely to be motivated by cost savings and less by altruism, while those motivated by intrinsic, or self-transcendent aspirations, will be motivated more strongly by representations that encourage actions that benefit the broader community.

In addition to values, motivation is dependent upon an individual's psychological distance from the effects of their actions [15]. In order to use climate change as a motivational factor, climate change cannot psychologically distant for the individual, i.e. the individual must understand how their actions contribute to the phenomenon, how the phenomenon affects them, and how changes in their actions convert to a personal benefit. We feel that the UK and China provide an interesting and significant comparison. The links between energy consumption, emissions and environmental impact are widely publicized in both nations through the media, education and governmental policy, yet in the UK this publicity tends to focus on how consumption is causing impact in far-off places around the world, whereas in China there have been a number of natural disasters in recent years that have been linked, implicitly and explicitly, to energy consumption: the Chinese Ministry of Civil Affairs has set up a special organization, the

National Disaster Reduction Center [4] (NDRC), to publicize environmental change information. Coupled with a stronger cultural sense of collectivism, we suggest that environmentally-framed representations of energy use may have a more immediate impact on Chinese consumers.

Energy delivery & payment

The ways in which energy is delivered and paid for have a significant bearing on how energy consumption and related emissions can be discussed and represented. As an example, pre-payment for energy in the UK is both statistically and culturally linked to lower household income: the average income of a household with pre-paid gas is £18,200 in comparison to £31,500 for a household paying *after* consumption through a Direct Debit contract[3]; a social implication here is that pre-payment may be perceived as reflecting a lack of credit-worthiness. In contrast, there is no choice in most cases but to pre-pay for domestic energy in China: there is no stigma attached to pre-payment, and payment post-consumption could be an unfamiliar concept with potentially negative connotations regarding standing debts to energy retailers.

In addition, UK consumers have a choice of multiple energy retailers and are familiar with online services that compare and recommend switches to new retailers to suit differing personal motivations (e.g. favoritism towards environmentally-oriented retailers, reduced cost, etc.); in China, despite ongoing reforms, energy generation, transmission and distribution are essentially state-vested monopolies, meaning that consumers can choose between energy types to alter costs, but not between different retailers of a particular type.

Uncertainties in cultural context of *participatory design*

On a more pragmatic level, we expect cultural context to affect not just the design outcomes, but also the UCD method. Participatory design activities such as paper-prototyping rely upon individual creativity and critical reflection – given strong cultural tendency towards self-identification with the organization, there may be tension with activities that seek to provoke critical reflection on the behavior of the organization. This may simply require a more positive framing of the prototyping activities ("improving" rather than "fixing"), in contrast to similar activities with UK participants, who may respond more strongly to the freedom to criticize current workplace behavior.

A confounding issue relates to respect for hierarchy, which we understand as a stronger dimension in China. Paper prototyping tends to be more creative when participants have mixed skills and experiences – in a workplace this can be achieved by forming groups from

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[4] NDRC, China: http://www.jianzai.gov.cn/

staff from various roles and levels within the organization. Given typically small power distances in UK organizations, we would suggest that a mix of levels would be less problematic than in a Chinese organization where a strong hierarchy may cause a reluctance for lower-level staff to express opinions that they perceive to be challenging to current policy. A fear of being held accountable for "controversial" ideas will extend beyond the design sessions, and steps will need to be taken to allay fears about whom the outputs of the sessions might be shared with.

Proposed participatory design activities

To address the uncertainties outlined above, a paper prototyping workshop will be preceded by a series of three remote exercises. Beyond clarification, these exercises will serve to prime the candidates for the subsequent workshop and for championing the virtue of the final displays in their workplace.

Remote exercises

These exercises will be delivered by email to 12-15 participants over the course of two weeks. In each case the participant will be asked to respond by email.

1. In this exercise the participant is asked to sit at their desk, look around them, then on paper draw a map (similar to activities in [10]) of nearby energy use, and indicate how much control over that usage and responsibility for it they feel.

2. Participants are asked to describe the ways in which their energy use relates to the environment, and whether/how this relationship is different to that of other people's.

3. This final exercise is unrelated to energy use or the environment and will ask for preferences amongst common UI and visualization conventions.

Paper-prototyping workshop

Responses from these three exercises will feed into an internal design session, which in turn will output a set of seed designs for a paper-prototyping workshop held in the China partner's workplace. The same set of participants who responded to the remote exercises will be invited and split into three small groups, each with a mix of expertise and roles. To encourage the group members to interact creatively and to foster confidence in their creative and critical ability, each group will be given several seed designs and will be asked to decide which contexts they might be most useful in, and how they might best be changed in order to be useful in their workplace. Given the various types of participant in each group, groups will be encouraged to understand varying perspectives on the designs, not aim for a consensus. Each group will then be asked to create sketches to develop an outline of a display they would like to see in their workplace, and storyboard a scenario illustrating the benefits it could bring. The groups will be encouraged to extend their scenarios to

explore how the displays will bring benefits in the long- as well as the short-term. In order to encourage creativity in a short space of time, the emphasis is on "sketching" [13], i.e. thinking and following trains of thought on paper, rather than the careful consideration of designs that is encouraged through computer-aided design tools.

SUMMARY
This text has outlined a set of user-centered design activities that form the first step in the iterative development of a set of digital displays that make consumers aware of their energy consumption. A set of these displays will be deployed in both the UK and in China. A body of literature exists regarding persuasive visualizations, values and motivations for Western consumers that may be used to stimulate UCD exercises, yet the same is less true for non-Western users. Using our understanding of Western persuasive design and energy consumption to bootstrap the design process, it is hoped that the exercises will provoke creative responses of non-Western consumers that lead to design requirements for non-Western energy-consumption visualizations, and help determine the suitability of this design process for rapid elicitation of design requirements in a non-Western context. The exercises have been targeted to account for previously identified cultural differences that may pose barriers to the design process, while focusing on cultural differences that are likely to have implications for design requirements. The exercises described here will take place during the first quarter of 2011, providing results that will be reflected on during the Transnational HCI workshop – these results will form a guiding framework for subsequent UCD activities within the C-Aware project and other transnational Horizon projects.

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