5-2012

Design of Eco-Feedback Technology to Motivate Sustainable Behavior: Cultural Aspects in a Brazilian Context

Lara Schibelsky Godoy Piccolo
The State University of Campinas, lpiccolo@cpqd.com.br

Arno Scharl
MODUL University Vienna, scharl@modul.ac.at

Cecilia Baranauskas
The State University of Campinas, cecilia@ic.unicamp.br

Design of Eco-Feedback Technology to Motivate Sustainable Behavior: Cultural Aspects in a Brazilian Context

Lara Schibelsky Godoy Piccolo
CPqD Telecommunications Research and Development Center
The State University of Campinas - UNICAMP
lpiccolo@cpqd.com.br

Arno Scharl
MODUL University Vienna
Department of New Media Technology
scharl@modul.ac.at

Cecilia Baranauskas
Institute of Computing / NIED
The State University of Campinas - UNICAMP
cecilia@ic.unicamp.br

Abstract

The perceived lack of connection between global environmental problems and an individual's immediate context is among the main reasons why people prove resistant to changing their decisions and actions towards a more sustainable way of life. By bridging this gap and better relating individual behavior to its local and global consequences, properly designed eco-feedback technology may evoke intrinsic and extrinsic motivations and may help to translate awareness into collective action.

The concept of culture encompasses the way people relate to the environment and to technology. It influences the perception of control mechanism and guides individual and collective behavior. Considering cultural aspects when designing eco-feedback technology, thus, may improve its persuasive force. This paper presents a conceptual analysis of relevant cultural aspects of the Brazilian society that impact eco-feedback technology adoption and appropriation, and discusses new forms of communication and collaboration that support these processes.

Keywords

Eco-feedback technology, sustainability, motivation

1. Introduction

Despite credible warnings, emissions and related environmental problems have continued to grow. From the policy-making level down to personal voting and purchasing decisions, the observable actions have not been commensurate with the extent and threat of environmental

problems. Although public concern has risen dramatically in the past few years, a much smaller percentage is actually taking action (EESI 2007). Reasons for this discrepancy include the widespread perception that risks such as climate change will predominantly impact geographically and temporally distant people and places (Cogoy and Steininger 2007; Marx et al. 2007), and the lack of personal efficacy – i.e., the belief that the own actions will not make a difference and one's voice will not be heard. Personal efficacy is a critical motivating factor in behavioral change (Bowman 2008) that can be supported by Eco-Feedback Technology (EFT) to share knowledge, motivate sustainable behavior, and coordinate environmental action. Properly designed, EFT not only provides information, but can also stimulate attitudes change in a sustainable manner (Fogg et al. 2007). This technology aims at creating awareness and understanding about the way everyday attitudes impact on the environment. Mobile phones, ambient displays or online visualizations inform about individual or group behavior related to energy, water and other resources, in order to achieve an environmental impact reduction (Froehlich et al. 2010; Piccolo & Baranauskas 2010).

To properly design persuasive technology it is necessary to go beyond traditional usability concerns mostly related to efficiency, effectiveness and learnability; it is important to consider the user as a complete human being (Harrison et al 2007; Picard and Klein 2002), who has emotions, individual's motivations, and also is part of social groups.

Among the most important design challenges to motivate users is to take into account cultural elements of a society, since culture guides even unconscious behavior, influences learning, awareness, affect, and attitudes towards change. In a social approach, culture embraces people's assumptions about the society and economic systems, aspects that influence decision-making and attitudes towards the environment. Larouche et al. (1996), for example, analyzed cultural aspects of French-speaking and English-speaking groups in Canada, and evidenced significant distinction in eco-literacy and people's concern for local environmental.

The culture of a society is not only learned but also acquired, being composed of three modes of behavior that alternate in dominance (Hall 1959): the *informal mode*, which is made up of activities done automatically, learned in everyday life; the *formal mode* that is regulated by rules, for this reason resistant to change from the outside; and the *technical mode*, where artifacts support and reinforce behavioral patterns. According to Hall, the more acceptable way to introduce cultural change is at the technical mode, where changes are easily observed and transmitted to others, establishing the basis for new formal systems. When accepted and adopted, this change becomes embedded in the informal mode.

Thus, people from different cultural backgrounds may require different forms of feedback technology to motivate pro-environmental behavior change, for example, emphasizing collective aspects instead of individual ones for more socially oriented groups (Chen et al. 2010).

This work focuses on challenges associated to the design of eco-feedback technology to motivate a sustainable behavior in the Brazilian scenario; conceptually the paper sheds light on how culture influences the perception of the impact on the environment, how people associate it with everyday attitudes, and how people relate themselves to technology. This effort is part of research that aims at introducing motivational aspects in the design of consumption displays for promoting a social change, initially instantiated in the electricity utilization. The paper is organized as follows: the next section sets the background for the work on culture and motivation; section 3 presents an analysis of the Brazilian scenario based on Hall's ten areas of

culture; section 4 discusses implications of the findings on design issues, and section 5 concludes pointing out further work.

2. Culture and Motivation

Humans' behavior is guided to achieve the well-being, and motivation is a culturally influenced force that gives behavior energy and direction (Reeve 2009).

An often-repeated pattern of behavior may become someone's habit, which is usually exhibited unconsciously. When repeated by the social group, these patterns of behaviors are reinforced, being rarely questioned amongst community members (Kolkman 1993).

Intrinsic motives, such as physiological, psychological, and social needs, are the stronger sources of motivation. When in line with personal values an external reason, such as money and prize, may also start motivation, but to internalize it, a person needs to make sense of the value or the merit of the attitude, acting in autonomous way (Deci and Ryan 1985; Reeve 2009; Piccolo and Baranauskas 2010). As Figure 1 illustrates, autonomy is the force that internalizes an external motivation, which is influenced by culture.

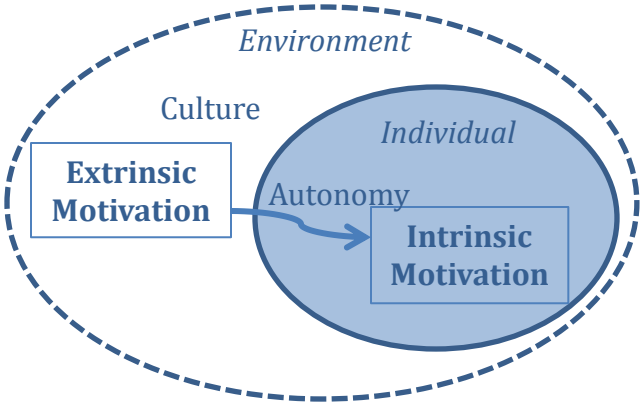

Figure 1: Concepts related to motivation

This research hypothesis is that mapping some cultural aspects may help designers to identify what are the most present intrinsic motives, values or beliefs that could contribute (or undermine) the internalization of external motivations. Informing the design process, this approach may firstly contribute to the adoption and appropriation of an eco-feedback technology, and then to the promotion of autonomous pro-environmental behavior by means of the technology.

According to Hall (1959), a culture is a complex series of interrelated activities. The taxonomy he proposes – the *Primary Message Systems (PMS)* – allows mapping a culture in such way that it makes possible to identify the main aspects that make a culture different from others (Hall 1959; Kolkman 1993). The ten categories of implicit behavior of PMS are:

- *Interaction* is a central cultural term that describes the specific relation of people with their environment.

- *Bisexuality* refers to the behavioral differentiation according to gender, age, race, etc. Kolkman (1993) renamed bisexuality to *Classification* when applying the model to evaluate how innovation affects a culture.
- Association: refers to how people interact with others, the social organizations.
- Learning and acquisition: means how the knowledge is transmitted from a biological origin to formal and informal learning processes.
- Defense: concerns how people defend themselves from hostile forces from nature and within the human society; includes religion, medicine and law enforcement.
- Play: time and places are associated to play. Play and learning are closed intertwined.
- Exploitation: refers to adaptations, including the material ones, to exploit the environment.
- Temporality: involves cycles and rhythms, how people deal with time.
- Territoriality: regards taking possession, use and defense of a territory.
- Subsistence: includes from individual food habits to the economy of a country.

The PMS has also been applied to guide design by considering human values and cultural aspects in other contexts, such as by Kolkman (1993), Pereira and Baranauskas (2010), and Pereira et al. (2010).

3. The Brazilian Scenario: Findings of a Cultural Analysis

Following the PMS (Hall 1959), the cultural analysis presented in this paper classifies typical behaviors that might influence technology appropriation of an EFT, both those related to technology usage, and the related to the environment. As Hall (1959, p.57) states, "*each PMS is obviously so rich and complex that it can be made the subject of a lifetime's work"*, this analysis has not the pretension of being complete, mapping all the complexity of the Brazilian culture; quite the contrary, it intends to be a simplified, although helpful, view with the purpose to guide the EFT design, highlighting aspects that should not be easily observed in traditional design processes.

Besides a literature review about socioeconomic aspects, preliminary results of a quantitative survey subsidized this analysis. The survey happened in the Brazilian State of *Minas Gerais* on November/December of 2011, in the context of a Smart Grid Technology deployment project called *Cities of the Future*, which encompasses the design of electricity consumption displays for the Web, tablets, and smartphones. Among other issues, the survey had the purpose of providing information about how people relate to energy. The participants were those responsible for the energy consumption in the households, which were randomly selected among those households that will be covered by the project. The survey methodology considered two groups of 140 participants each: the first group (G1) consisted of mostly rural or small cities inhabitants, 55% of respondents studied until primary school and 13% had higher education level; while the group 2 (G2) is mostly urban, 35% of higher educated people, with higher income compared to G1.

The following sections describe some findings according to the taxonomy of PMS.

3.1 Interaction

Interaction describes how people interact with the environment, with each other and with technology. Leav (2008) observed that young people in the United States spend more time with electronic devices such as computers, mobile phones and television sets than in direct contact with natural environments. Consequently, nature has become an abstract concept for many of them, especially in urban areas. This phenomenon is not restricted to the United States; it can be observed worldwide. In Brazil, more than 84% of the population lives in urban areas (IBGE, 2010).

However, our quantitative survey evidenced that the connection between individual attitudes towards consumption and perceived global consequences is weak or does not exist at all, even in rural areas. The two groups of 140 participants were asked how energy consumption reduction could contribute to the environment. In G1, almost 60% declared to not know the answer. About 22% said to save water, and only around 17% answered to avoid the construction of another power plant; 39% of G2 respondents did not know the answer; 24% said to avoid new power plant, 14% to save water and 14% do preserve forests. Considering that the connection is mostly unknown, the environment preservation represented only around 10% of declared motives to save energy in the first group, and 21% in G2, suggesting that the educational level influences the connection between electricity consumption and the natural environment.

New media and interactive technologies have an important impact on the way people communicate with each other. In 2010, 48% of the Brazilian population had already used the Internet (CETIC.br 2010). This number is predicted to increase due to current political strategies of digital inclusion. Social networking platforms such as *Facebook, Google+* and *Orkut* have reached more than 90% of Internet users as of 2011 (ConScore 2011). Moreover, statistics on the adoption of mobile devices indicate that technology is pervading all social levels, with 78% of smartphone owners belonging to lower socio-economic layers (Convergência Digital 2011).

This behavior suggests that being digitally connected to other people is a popular intrinsic motivation. According to Nokia (2011), people like sharing personal stuff – e.g., 95% of the survey respondents declared they are interested in sharing their energy saving achievements with neighbors, family and friends.

3.2 Classification

The most important dimension is age. Individual age and the values of one's generation impact the perception of climate change and the every-day use of technology. The Y generation – people born from mid-1970s to the late 1980s – started a change in the way people relate to technology. This generation is characterized, for instance, by the use of social media and digital content consumption (Carli et al 2011). According to CETIC.br (2010), about 65% of people between 10 and 24 years old had already used the Internet in Brazil and 24% between five and nine years old.

While electronic devices are naturally present in all aspects of their lives, older people still see technology as a tool. This difference is highly relevant to EFT design decisions. Age also influences the perception of regulations and control mechanism that impact their lives, as described subsequently.

3.3 Association

In general, people agree with the necessity of central administration and governing structures, a trend that is amplified by education. 80% of illiterate people approve the view that "each person only has to care about what belongs to him/her, while the government cares about public issues", and almost 75% of the population do not support the view that everyone must care about public issues (Almeida 2007), suggesting a weak personal commitment for global resources.

3.4 Learning

The way people learn about the climate change or environmental impacts differs by age and location. Older people might have witnessed events in the last decades that reflect climate change, while young people probably studied it theoretically at school. The lack of connection between concrete individual attitudes and environmental impacts, however, may be considered a common issue. People from cities, for instance, perceive the environmental impact of air pollution, while people from the coast may easily notice the sea level rise.

Another aspect related to learning concerns the abstract concepts usually represented in EFT systems, such as amount of CO_2 emissions, charts, energy usage (kWh), carbon footprint, etc. Considering that about 70% of the population has incomplete education, these representations may not make sense for a considerable number Brazilians (IPM 2011) (Piccolo and Baranauskas, 2011).

3.5 Defense

Due to fear of threats such as traffic and crime, parents usually do not stimulate outdoors activities for kids, keeping them far from experiencing nature (Leav 2008). Religion is also associated with defense according to PMS. Although this trend changes with geographic area (people from the North and the Northeast tend to be more fatalist), 51% of low-literate people think that destiny is in God's hands, and people cannot change it (Almeida 2007). This view seems to be connected with the concept of "locus of control" that stems from psychology. People that have an "external locus of control", on the one hand, believe that actions of powerful others, such as God or government, create change. People with an "internal locus of control", on the other hand, believe in the consequence of their actions and are more likely to take environmental actions (Shipworth, M. 2002). While this simple classification does not convey the full spectrum of possible perceptions towards god, destiny, and change, it still helps explain a lack of personal responsibility for externally triggered events that impact the environment.

3.6 Play

Entertainment mediated through technology is an increasingly important cultural phenomenon. The ubiquitous presence of computers, online games and social networking platforms is pervading all socio-economic levels. Almost 90% of Internet users declared that they spend time online for leisure and the most popular activity among connected children is playing on-line games (CETIC.br 2010).

Games with a purpose motivate online users to participate in games that generate useful scientific data (Ahn, 2006; Rafelsberger and Scharl, 2009). Examples that use the concept of "play" to promote environmental awareness include *UbiGreen* (Froehlich et al. 2009) shown in Figure 2, which uses activity inference to display transportation activity information on the background of an individual's mobile phone, *StepGreen* (Mankoff et al. 2010), which tracks the

financial and environmental savings of simple green actions, *Wattsup* (Foster et al. 2010), which uses a social media application to motivate a reduction in domestic energy consumption. The *Climate Change Collaboratory* (Scharl 2007; www.ecoresearch.net/triple-c) examines games with a purpose as an innovative and cost-effective means to provide indicators of environmental attitudes, lifestyles and behaviors from very large user groups. It builds upon *Sentiment Quiz*, a development framework and Facebook application developed to acquire multilingual language resources (Rafelsberger and Scharl 2009; Weichselbraun et al. 2011).

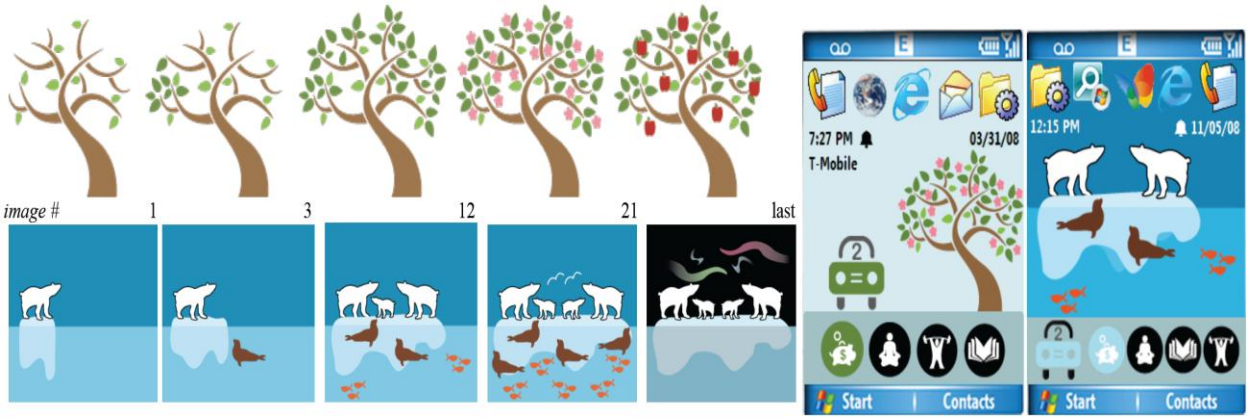

Figure 2: UbiGreen screenshots showing tree and polar bear theme progressions; the car windshields on the right indicate a user who recently carpooled (Froehlich et al. 2009)

3.7 Exploitation

Historic reasons and the abundance of natural resources in Brazil developed a "culture of waste". A restrained consumption of food, energy, water, and raw material is not part of the common sense. Although the green consciousness started to emerge, people keep wasting natural resources and confuse saving resources with being greedy or miser. Abrantes (2005) estimated that 50% of food production; 40% of the distributed water and 30% of electricity are wasted, and only 11% of the waste is recycled.

In the quantitative survey we conducted, 88% of the participants declared they are worried about the environment. When asked about what people do to preserve the environment, the following three actions were cited most frequently: waste recycling, not throwing trash on the ground, and saving water.

3.8 Temporality

Temporality is concerned with people's relationship with time. The perceptions and (lack of) experience of young people represent a good example. Since nature remains an abstract concept for most of them, they tend to be not aware of the effects of climate change that have already happened, due to the lack of valid and observable variables to compare. Irrespective of the actual drivers of behavioral change (which might encompass both short-term and long-term goals), from a sustainability perspective a move towards lower resource consumption is a long-term investment that often lacks immediate individual benefits and involves interdependent processes of different timescales.

3.9 Territoriality

Territoriality refers to ownership and territory usage. Huge distances and road transportation by trucks is a typical an expensive combination in Brazil that can be tackled by promoting the consumption of local products. Additionally, taking advantages of ownership is a way to promote personal responsibility for a specific environment. Official and non-governmental organizations dedicated to socio-environmental issues usually develop local leaderships for spreading a sustainable exploration of natural resources within a community. Using the same approach, EFT can explore local social relations to educate, locally instantiating consequences of individual attitudes and demonstrating the importance of their environment for the global context. These issues are closely connected to the concept of learning and subsistence.

3.10 Subsistence

What are the overall resource requirements to sustain a particular lifestyle? The ecological footprint calculation, as shown in Figure 3, is an important approach to demonstrate individual impact for the planet subsistence. Most footprint calculators are based on averages and do not consider Brazilian particularities, such as hydroelectric plant, road transportation, and the value of specific biomes such as the Amazon forest.

When consistent with individual or a group reality, this tool can be more effective on guiding everyday attitudes, including purchasing decisions, when clearly informing the real value to produce or to transport everyday artifacts (Patel 2010).

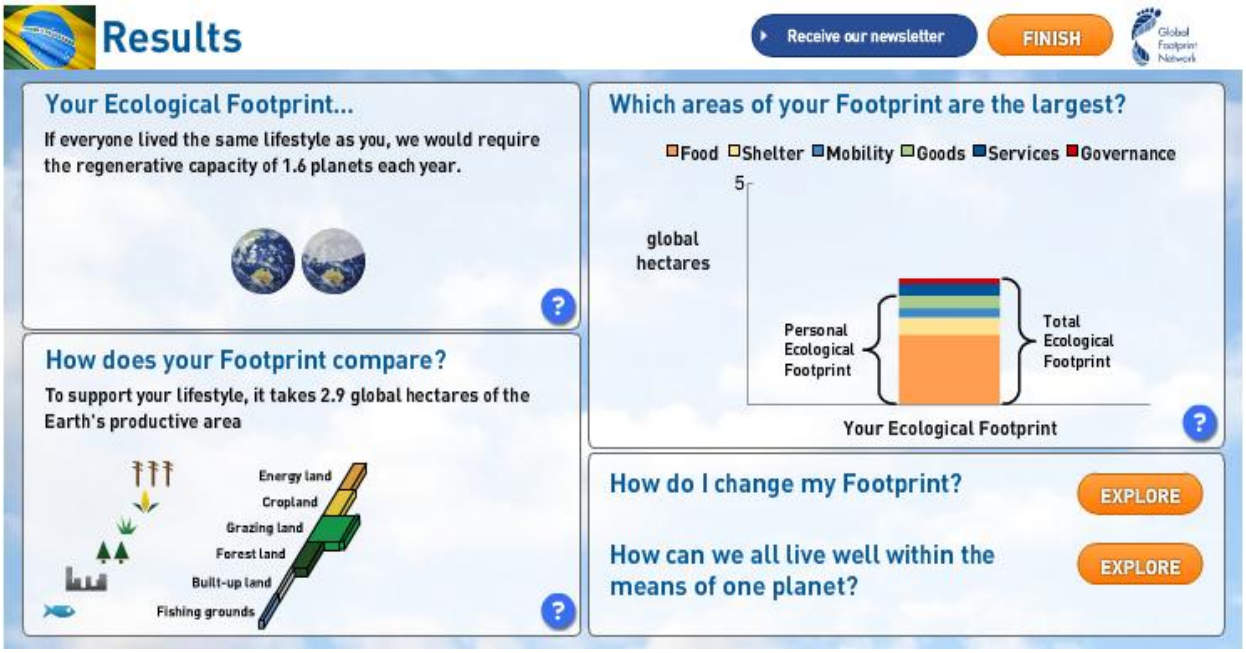

Figure 3: Footprint calculation (Source: WWF Brasil 2011)

4. Discussion and Design Issues

By evidencing the disconnection between individual attitudes to global consequences in Interaction, Association, Defense and Exploitation cultural aspects, this analysis reinforces the lack of personal efficacy (Bowman 2008) in the Brazilian context. The intrinsic motivation to preserve the environment seems to not willing to embrace a behavioral change, so that the autonomous behavior towards more sustainable attitudes must be developed by Learning and Play cultural aspects.

Contextualized to a local culture both in terms of what information must be provided and how to best represent it, an EFT may be a promising tool to develop autonomy in this scenario, in which technology is reaching a considerable part of population. The same technologies that currently keep people away from nature can be applied to developing a sense of being part of the environment. Associations with social networks seem to be an important direction to change a culture, reaching out people who must feel responsible for the Subsistence in the future. Table 1 synthetizes some design concerns related both to form and content, taken into account some aspects of designing a persuasive tool as stated by Fogg et al. (2008).

Table 1 – Cultural design implications

Content	Form
Mapping traditional local habits with negative or positive impact to the environment. Examples: pollution by road transportation, consequences of wasting food.	Avoiding charts, such as the "Which areas of your Footprint are the largest" in Figure 3, and other abstract representations to include low-literacy users.
Establishing social norms and invoking consensual social rules: developing a sense that the environment is not only a political concern, but that it depends on the attitudes and actions of individuals and communities.	Creating insightful visualizations and sensations by applying metaphors contextualized in users' reality. The polar bear in Figure 2 (Froehlich et al. 2009) is an example of a graphic metaphor, but not contextualized for a tropical area.
Sharing individual achievements.	Creating local connections with a user's location. For instance, adopting different representations such as forest, marine environment, and urban areas.
Associating natural resources with everyday consumption, e.g., establishing a connection between energy consumption and the environment.	
Providing tools that could be applied to influence others, such as educational games	Highlighting collective results of individual attitudes, such as the total amount of recycled waste in a city.
	Publishing achievements in social network platforms.
	Designing a non-web technical solution to reach those people who are not familiar with web technology, for instance, using short message services.

5. Conclusion

Users need to make sense of a tool to adopt it and recognize its importance for everyday actions. Addressing cultural elements in designing and contextualizing artifacts based on a user's reality is a first step towards developing EFT to motivate people to change their behavior and promote self-efficacy. By analyzing aspects of the Brazilian culture, this work highlighted two main consequences to the design of EFT: (i) the need to evidence the value of individual attitudes towards a more sustainable behavior; and (ii) to explore social media influence for promoting this culture. In the context of this research, culture does not necessarily mean a country, but a group of people who experience the environment in a distinct way.

Future work will utilize the concept of games with a purpose as outlined in Section 3.6 to provide indicators of environmental attitudes, lifestyles and behaviors from very large user groups (e.g. citizen science projects, relevant Facebook or Google+ groups, etc.). The *Climate Change Collaboratory* (www.ecoresearch.net/triple-c) aims to gather intercultural data on environmental knowledge from these groups. Thereby, games with a purpose will complement conventional social surveys and shed light on public awareness as well as perceived collective and individual threats. This will enable us to identify extrinsic motivations in a broader sense, and to transform the acquired knowledge into design requirements that could, potentially, be translated into applications that increase intrinsic motivation and trigger collective action towards a more sustainable society. Designing appropriate user interfaces for this type of application and evaluating the experience they evoke to specific stakeholder groups are important tasks to be pursued in follow-up projects.

5. Acknowledgments

The *Cities of the Future* is a R&D project executed by CEMIG, the energy generator and distributor in the State of Minas Gerais, Brazil, in partnership with CPqD, FITEC and Puc Minas. Among other issues, this project is concerned with developing the conscious consumptions of electricity.

The *Climate Quiz* is developed as part of Triple-C (www.ecoresearch.net/triple-c), a research project funded by the *Austrian Climate Research Program* of the Austrian Climate and Energy Fund (klimafonds.gv.at) that investigates new forms of communication and collaboration to translate environmental awareness into collective action.

References

Abrantes, J. (2008) *Brasil, o País dos Desperdícios*. Ed. Auriverde.

Ahn, L. v. (2006) Games with a Purpose. *Computer*, 39, 6 (2006), 92-94.

Almeida, A. C. (2007) *A Cabeça do Brasileiro*. Rio de Janeiro: Record.

Bowman, T. (2008) *Summary Report: A Meeting to Assess Public Attitudes about Climate Change.* Silver Springs: National Oceanic and Atmospheric Administration (NOAA), George Mason University Center for Climate Change Communications.

Cabral, J. (2010) Is Generation Y Addicted to Social Media? *The Elon Journal of Undergraduate Research in Communication*, 2(1), pp.5-13.

Carli D. M. et al (2011) Geração Y e a indústria de software do Brasil. *Proceddings of the VII Simpósio Brasileiro de Sistemas de Informação (SBSI)*, Salvador.

CETIC.br (2010) Individuals that have already accessed the Internet (Portuguese) http://www.cetic.br/usuarios/tic/2010-total-brasil/rel-int-01.htm

Chen, Z., Froehlich, J., Landay, J. (2010) Exploring the Cross-Cultural Effects of Feedback for Pro-Environmental Behavior Change. *Microsoft Environmental Research Workshop*, MSR Faculty Summit, Redmond, WA, July 14, 2010.

Cogoy, M., Steininger, K., Eds. (2007). *The Economics of Global Environmental Change: International Cooperation for Sustainability*. Cheltenham: Edward Elgar.

ConScore (2011) *The Rise of Social Networking in Latin America How Social Media is Shaping Latin America's Digital Landscape*.

Convergência Digital (2011) Sem celulares: 56 milhões de brasileiros ainda não têm acesso ao serviço móvel. 16/03/2011. http://convergenciadigital.uol.com.br/

Deci, E. L., Ryan, R. M. (1985) *Intrinsic Motivation and Self-Determination in Human Behavior.* NY: Plenum.

EESI (2007) *Recent Polling on Public Perceptions of Climate Change*. Washington, DC: Environmental and Energy Study Institute.

Fogg, B. J., et al. (2007) Motivating, influencing and persuading users: An introduction to captology. *Human Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications*. Lawrence-Erlbaum Associates, New York, 137-138.

Foster, D., et al (2010) Wattsup? Motivating Reductions in Domestic Energy Consumption Using Social Networks. *Proceedings of NordCHI 2010*, Iceland: ACM, pp.178-187.

Froehlich, J., et al. (2009) UbiGreen: Investigating a Mobile Tool for Tracking and Supporting Green Transportation Habits. *Proceedings of CHI-2009*, ACM, pp.1043-1052.

Froehlich, J., et al. (2010) The design of eco-feedback technology. *Proceedings of CHI '10.* ACM, pp.1999-2008.

Hall, E.T. (1959) *The Silent Language,* Anchor Books.

Harrison, S., et al. 2007. The Three Paradigms of HCI. *Extended Abstracts of CHI'2007*.

IBGE (2010). XII Population Census. http://www.censo2010.ibge.gov.br/

Instituto Paulo Montenegro - IPM (2011). Functional Literacy Indicator. http://www.ipm.org.br/

Kolkman, M. (1993) *Problem Articulation Methodology*. PhD thesis, University of Twente, Febo, Enschede.

Laroche, M. et al (1996) The Influence of Culture on Pro-Environmental Knowledge, Attitudes, and Behaviour: a Canadian Perspective. *Advances in Consumer Research* V. 23, Provo, UT: Association for Consumer Research, Pages: 196-202.

Louv, R. (2008) *Last Child in the Woods: Saving our Children from Nature-deficit Disorder*. Algonquin Books.

Mankoff, J., et al. (2010) StepGreen.org: Increasing Energy Saving Behaviors via Social Networks. *4th International AAAI Conference on Weblogs and Social Media*. Washington, USA: Association for the Advancement of Artificial Intelligence: 106-113.

Marx, S., et al. (2007) Communication and Mental Processes: Experiential and Analytic Processing of Uncertain Climate Information, *17*, 1: pp.47-58.

Nokia (2011) http://www.semlimites.blog.br/tecnologia/o-que-o-brasileiro-faz-com-a-tecnologia/

Patel, R. (2010) *The Value of Nothing. How to reshape market society and redefine democracy*. New York: Picador.

Pereira, R., Baranauskas M.C.C. (2011) Valuation Framing for Social Software: A Culturally Aware Artifact. *Proceedings of the ICEIS 2011,* pp.135-144.

Pereira, R., Miranda, L.C., Baranauskas M.C.C., Piccolo, L.S.G., Almeida, L.D. and Reis, J.C. (2011) Interaction Design of Social Software: Clarifying requirements through a culturally aware artifact. *Proceedings of the International Conference on Information Society - i-Society 2011*, pp. 310-315.

Picard, R.W., Klein, J. (2002) Computers that Recognise and Respond to User Emotion: Theoretical and Practical Implications. *Interacting with Computers*, V14, Issue 2:141-169.

Piccolo, L.S.G. Baranauskas, M.C.C. (2011) Motivational Aspects in Energy Feedback Systems Design. *Proceedings of IHC+CLIHC 2011*, ACM, pp. 313-328.

Rafelsberger, W. and Scharl, A. (2009) Games with a Purpose for Social Networking Platforms. *20th ACM Conference on Hypertext and Hypermedia.* Torino, Italy, pp 193-197.

Reeve, J. (2009) *Understanding Motivation and Emotion* (5th ed.). Hoboken, NJ: Wiley.

Scott, M., et al. (2011) Understanding Goal Setting Behavior in the Context of Energy Consumption Reduction. *Proceedings of INTERACT 2011*, LNCS 6946, pp.129-143.

Scharl, A. (2007) The Climate Change Collaboratory – A Community Portal Based on Geospatial Web Technology. *International Symposium on Environmental Software Systems (ISESS-2007).* Prague, Czech Republic.

Shipworth, M. (2002) Motivating Home Energy Action: A Handbook of What Works. Australian Greenhouse Office. http://www.environment.gov.au/settlements/local/publications/pubs/motivating.pdf

Weichselbraun, A., Gindl, S. and Scharl, A. (2011) Using Games with a Purpose and Bootstrapping to Create Domain-Specific Sentiment Lexicons. *20th ACM Conference on Information and Knowledge Management (CIKM-2011)*. Glasgow, UK, pp. 1053-1060.