Collective intelligence for promoting changes in behaviour: a case study on energy conservation

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ORIGINAL ARTICLE

Collective intelligence for promoting changes in behaviour: a case study on energy conservation

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Abstract Climate change is one of the biggest challenges humanity faces today. Despite of high investments in technology, battling climate change is futile without the participation of the public, and changing their perception and habits. Collective intelligence tools can play an important role in translating this "distant" concept that is climate change into practical hints for everyday life. In this paper, we report a case study grounded on collective intelligence tools to collaboratively build knowledge around energy conservation. A preliminary study to raise energy awareness in an academic environment is summarised, setting the scene to a more ambitious initiative based on personal stories to transform energy awareness into behaviour change. The role of the collective intelligence tools and other technical artefacts involved are discussed, suggesting strategies and features that contributed (or not) to users' engagement and collective awareness. Lessons learned from both studies are reported with a sociotechnical approach as implications for design pursuing behaviour change.

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1 Introduction

For more than 20 years, discussions around the impact of climate change keep challenging the highest world authorities to debate thresholds between socioeconomic development and carbon emission reduction. Periodically, these leaders are gathered[1] targeting consensual plans to control this contemporary issue.

While these discussions happen at top level, the civic society, whose attitude is also a key piece towards any pro-environmental scenario, still have a blurred perspective of the extent of the problem and how to cope with this social issue. In general, people rely mainly on the broadcasted media such as newspapers and TV as a source of climate-change-related information (Capstick and Pidgeon 2014; Piccolo and Alani 2015). Discussions, though, are not rarely polarised between scepticism to exaggeration, sometimes driven by radical activists or even biased by editorial lines that reflect political positions (Painter 2011; Capstick and Pidgeon 2014). From the society's perspective, translating this debate that impacts life in a broad sense into practical tips for guiding everyday behaviour has been a challenging task.

Narrowing down the climate change issue to energy generation and consumption does not make it a simpler problem to be tackled. Paradoxically, although central and ubiquitous, people in general do not have a clear understanding on how they are using energy.

[1] The Conferences of the Parties—COPs, organised by the United Nations.

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A survey across 17 countries evidenced that people do not fully equate electricity usage with its environmental impact. When asked to select the factors that negatively impact the environment, only 42% cite individual electricity consumption, despite the fact that traditional fossil fuel-based power generation is still a major producer of carbon emissions (Accenture 2010). Deficit of information on individual consumption is also a recurring problem that does not contribute to the scenario. Despite of this lack of awareness, many cross-country policies and technologies to increase energy efficiency still rely on individuals' engagement to be successful (EEA 2013).

Although tackling climate change goes much beyond individual electricity consumption, raising awareness of energy—independently of the socioeconomic context and consumption level—is considered an essential part in this battle. Engaging with this issue is a social change that benefits the whole population, therefore, a common good (Schuler et al. 2015).

Raising energy awareness comprehends "making energy visible" in daily routine (Hargreaves et al. 2013) and acquiring "knowledge about how and why to reduce waste by operating devices more efficiently" (Spagnolli et al. 2011). How and why to reduce energy waste, however, does not refer to a unique and clear solution. Personal and contextual choices are not only built-on by simply connecting cause and consequence, or moral based (Dourish 2010). Social norms, values, socioeconomic, and political context are some of the cultural forces that influence how people perceive the issue and adopt (or not) new practices and/or technology to promote changes.

The collective intelligence (CI) approach (Malone et al. 2009; De Liddo et al. 2012) adds a new perspective to technology to support energy awareness and eco-friendly choices. For DeLiddo et al. (2012), CI tools are conceived for situations of uncertainty about the impact of actions. Rather than relying only on feedback or persuading specific behaviour, as the usual approach in the literature, CI technology acts by mediating the civic participation towards building a collective knowledge, helping to produce collective viewpoints. Discussions and dialogue are part of the learning process which is socially constructed. Contextual barriers, personal values, political scenario, and other external issues' part of the solution can be brought to discussion.

This paper reports a case study of promoting collective energy awareness by exploring the potential of CI with two different tools and contexts. We first bring into discussion results of a study in the workplace. When compared to domestic environments, workplaces gather people with a diversity of experiences, perception and autonomy around energy usage, and the level of consumption information are even poorer, evidencing other sociotechnical aspects that influence the collective knowledge construction. In this exploratory study, we relied on an instance of the EvidenceHub[2], a collective intelligence tool for community deliberation, and a tangible and public feedback to motivate engagement in a university department. This study has been detailed in (Piccolo et al. 2014a, b).

By identifying some CI characteristics that favoured to build the energy awareness, we moved forward towards expanding the research scenario. Main lessons learned have been now considered in an energy trial, reaching around 150 people in the UK beyond the academic environment. The EnergyUse[3], an online platform for visualising consumption and sharing experiences of energy savings has been developed to establish a community of energy champions, people that can actually help to create practical hints of energy conservation and environmental protection to be spread to the society.

In the next section, we present an overview of studies on energy awareness and engagement from the literature. Then, we introduce a theoretical perspective relating technology, energy awareness, and behaviour. Some findings in terms of collective intelligence obtained from the study on energy awareness in the workplace are then discussed, setting the scene for the energy trial. Then, we discuss the energy trial in terms of users' participation and the impact of the tool as perceived by a group of community leaders and energy champions. Findings from both studies are then put together as implications for designing CI for behaviour change. We then conclude the paper pointing out future works towards enhancing the tool and assessing results.

2 Related works

The literature reveals that providing adequate consumption feedback is crucial to promote energy conservation, but the interest for this type of technology tends to last for a short time, limiting its impact (Schwartz et al. 2013; Darby 2010). Hargreaves et al. (2013) found out that monitoring consumption with in-home displays could either empower users to bring consumption into discussion among the family and to change behaviour or, in the contrary, raise a feeling of frustration or guilt by the few monetary or environmental achievements. Discussion was recognised in this study as a first step towards changes.

It is acknowledged that people tend to act in a certain way to be in line with others in similar context, following social norms (Goldstein et al. 2008). However, adopting norms just to avoid guilty or to fit in usually does not

[2] https://evidencehub.net.

[3] https://energyuse.eu/.

lead to a sustained change in behaviour (CCCAG 2010). Even though, the European Environmental Agency (EEA 2013) recognised that community-based initiatives have a stronger potential to lead to long-term behaviour change, better yet when there is a pre-existing relationship between participants. This report (EEA 2013) reveals that relying on existing acquaintances and influential people to promote and establish social norms is an important factor for the success of a community intervention.

Likewise, Petkov et al. (2011) affirm that people are interested to compare consumption against people they know (even with substantial difference in the households), suggesting that social comparison could be effective for co-workers or local communities. In working environment, building consensual collective practices especially towards shared equipment is essential, and people need to feel supported to take responsibility for conservation (Schwartz et al. 2013).

These findings from the literature established the basis for the investigation described in the next sections.

3 Technology influencing behaviour

To make an influence in the way people perceive things and act within their environment, is crucial to understand some mechanisms that guide behaviour, and the impact of technical and sociocultural elements.

With an anthropological perspective, Hall (1959) defines three alternating modes operating behaviour, leading us to understand the impact of technical devices.

- *Informal* made up of activities done automatically and learned in everyday life; behaviour happens without reflection, for instance, by following other people's typical reactions. The way we use many electrical appliances, for instance, is strongly dominated by the informal mode.
- *Formal* regulated by rules and then resistant to change from the outside, like acting in a specific way to respect work practices.
- *Technical* where artefacts, including technologies, support, and reinforce behavioural patterns.

Changes in the technical mode can be observed and disseminated with less resistance (Hall 1959), setting conditions for a new formal system. When accepted and adopted, changes become embedded in the informal mode.

New technologies, though, specially the social ones, tend to be more than operational tools, impacting the formal and informal levels in a direct way. CI tools, for instance, facilitate the dissemination and the adoption of ideas among a social group, enabling the change to reach the informal mode more effectively.

The design of technology to inspire a common good can be informed by elements in the three modes, strengthening the potential impact towards a social change. The Socially aware approach (Baranauskas 2014) understands design as a three-layer dynamic process originated in the society considering first informal aspects (e.g., people's values, beliefs), then formal elements (regulation, for instance) towards the construction of a technical system. The technical layer, on the other hand, impacts on the external layers towards influencing the society. This understanding suggests that an innovation introduction may fail when considered only at the technical level for not being compatible (potentially) with people's perceptions or current regulations, for instance.

The design of a CI tool then should be considered from a sociotechnical perspective, providing conditions for people make sense of the social issue, understand what to do, and how to do things in the new reality.

3.1 Promoting changes in behaviour

Technologies do not change people's behaviour; people do change their own behaviour. Many models or theories from psychology or social sciences explain how this process occurs from different perspectives. One theory, though, in our view suits the CI tool design purpose by identifying conditions or opportunities that must be provided to promote and achieve a sustained new behaviour. The 5 Doors is a hands-on Theory of Behaviour Change based on other formal theories from psychology and social sciences (Robinson 2012). It describes five conditions that need to be present in the environment for changes in behaviour to be possible:

1. *Desirability* take into account people desires, frustrations;
2. *Enabling context* modify the social and technological context to enable action;
3. *Can do* build actor's self-efficacy;
4. *Buzz* generate positive buzz, interest;
5. *Invitation* frame a compelling invitation.

By providing these conditions, be then translated into technical features, process or social dynamics, we hypothesize we can facilitate the process to transform collective energy awareness into a social (behavioural) change.

In the next sections, we discuss results of a collective intelligence studies for raising energy awareness to then analyse how we can provide the necessary conditions to pursue behaviour change.

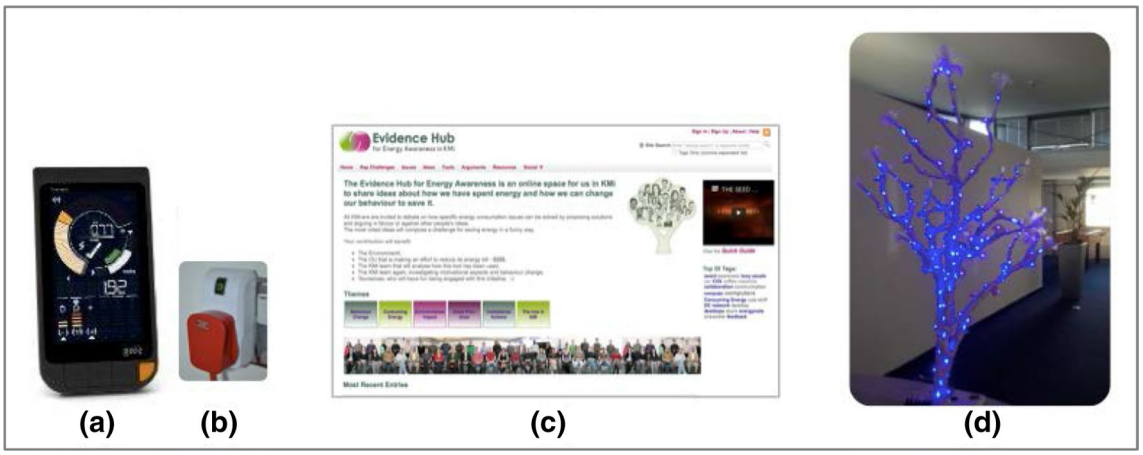

Fig. 1 Technologies applied to raise energy awareness collectively **a** in-home display; **b** smart plug; **c** online debate tool; **d** public and tangible feedback

4 Collective intelligence to raise awareness

This first exploratory study took place in a research university department in the UK in 2013–2014. Two workshops gathered 12 people each to discuss and build knowledge around energy conservation and environmental impact of energy consumption. To this end, we introduced three technologies with complementary roles:

1. Electricity monitors Smart monitors containing an in-home display (IHD—Fig. 1 a), smart plugs (Fig.1b), and a web visualisation. Beyond detailed feedback of consumption in the household in kWh and CO_2 emitted, the smart plugs provide feedback of consumption of individual appliances.
2. Debate tool the Evidence Hub is the online discussion tool for argumentative knowledge construction (De Liddo and Buckingham Shum 2013) applied to mediate the process of raising energy awareness collectively (Fig. 1c).
3. The energy tree We hypothesise that engagement with "intangible" issues may benefit from "tangible" feedback. The Energy Tree (Fig. 1d) is a public tangible artefact with visual feedback of contributions to the Evidence Hub with the purpose of motivating engagement. The more people contribute to the debate, more branches of the tree are lighted on.

Each workshop group had one instance of the online debate. To evaluate the impact of the Energy Tree, only one workshop had it in the room. The workshops were followed by 10 days of online debate with the Energy Tree placed in a public area representing, in alternating way, results of both groups. Every new 60 contributions to the Evidence Hub lighted on a branch of the tree. During these 10 days, participants could use the smart monitors to understand consumption either at home or at work. It was expected that the Energy tree would motivate online participation during the initiative. Details on the methodology applied and results obtained can be found in (Piccolo et al. 2014a, b).

As illustrated in Fig. 2, participants could come up with issues to be debated, "The lift might have a high impact in the energy consumption of the building"; and ideas to overcome those issues: "Not using the elevator when I'm alone". Issues and ideas can be supported or countered by arguments "Health reasons for using lift"; promoted or demoted by votes for or against. Users can enrich the debate adding Facts or Web resources.

Users could also identify those people they mostly agreed, disagreed, or expressed neutral comments. The dynamic map (Fig. 3) represents levels of connections among users with the colours green for agreements, red for disagreements and grey for neutral comments.

4.1 Reflections on the role of the tools for collective intelligence

As a novelty, the Energy Tree attracted people to the discussion, but along the time, the social activity became more important than the tree itself. The Energy Tree worked as a trigger, a symbol that a collective action was in place and people were part of it (Piccolo et al. 2014b).

Participants pointed out the debate features (arguments, contrasting opinion) as the main aspect that engaged them online. These features of the debate also favour establishing and promoting new social norms, once the participants designate together the most accepted (or controversial) ideas. Beyond that, the debate tool was effective in mediating the dialogue between individual perceptions and beliefs

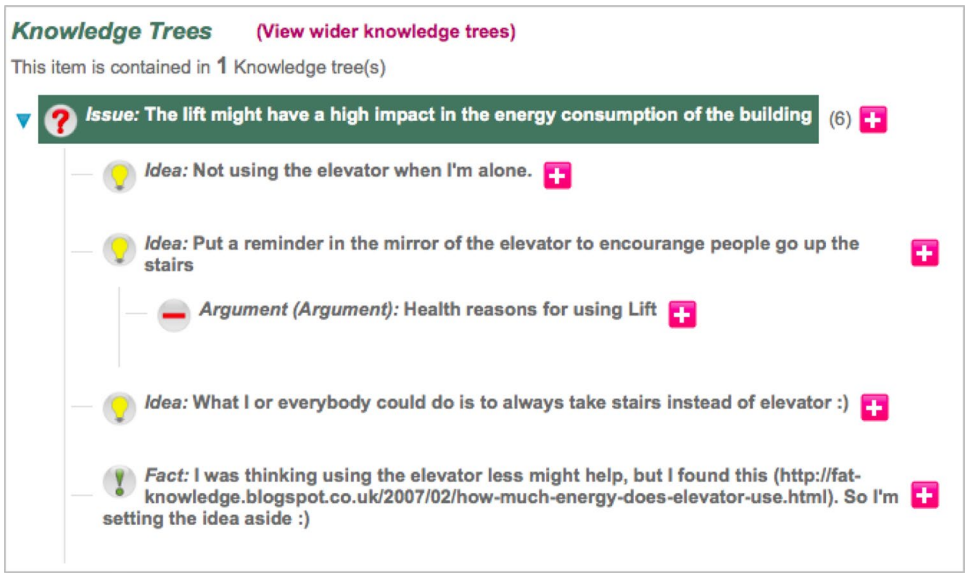

Fig. 2 Evidence Hub screenshot with issues, ideas, arguments, and facts

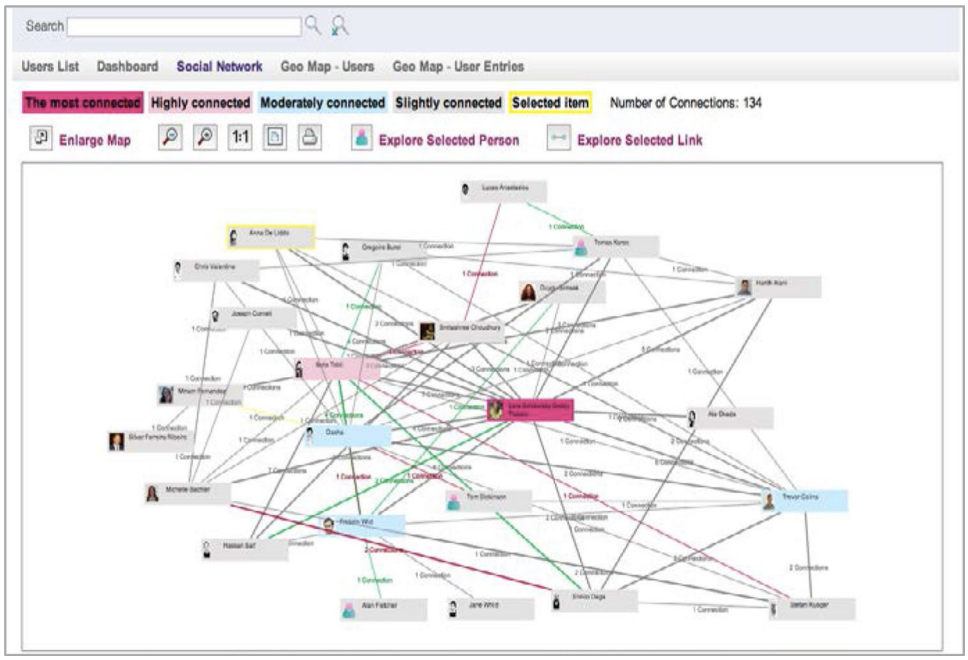

Fig. 3 Map of ideas and people connected on Evidence Hub

(informal operation mode) and work practices (formal mode).

Votes dominated users' participation, representing around 68% of the interactions. As an easy way to interact, it was positive in bringing people to the debated. The ideas (12% of contributions), issues (6%), arguments (10%) and facts, and web resources (5%) were well distributed (Piccolo et al. 2014a). Although users' participation was numerous (more than 170 ideas for around 100 issues (Piccolo et al. 2014a), not all participants contributed in the same extent. Those who did not contribute significantly accused the complexity of the tool as the main reason. The perceived complexity was also evident when users were asked to select words to define the tool. Among more than 100 options of words, most of the users picked the words Useful, Innovative, Creative, Complex, and Effective.

Together, these results led us to confirm the assumption that:

1. Having a shared symbol can help promoting the collaborative aspect.
2. Voting (as a simple interaction) has an important impact.

3. The balance between simplicity and range of debate-related features is important to not compromise the user experience.
   The debate tool was perceived as an extension of the work environment, and people preferred to keep consumption information as private. Are evidences for that:
   - The idea "access to information about our energy use at a useful (but not too personal) level of granularity" was the most voted contribution.
   - Topics related to monitoring consumption (considered private) were not frequent neither popular online. Instead, it was observed that the discussions about the monitors happened mostly offline, during coffee breaks, lunchtime, or around the tree installation (Piccolo et al. 2014a). These facts led us to conclude that experiencing energy transcends context and environment. Discussions around that should reflect this ubiquitous presence:
4. A CI tool to promote energy awareness should help overcoming this contextual barrier making people confortable to share personal stories or experiences (not personal data).
   One of the purposes of the debate was promoting a link between individual actions and environmental impact using the energy monitors. However, this topic seemed to not be attractive for the participants. The fact "approximately 48 trees are needed to absorb the CO_2 equivalent an 11 months of using a 27" monitor 6 h/day", for instance, did not have any repercussion. Whereas a fact reporting a good behaviour: "I always shutdown the computer at night" was one the most supported ones. In fact, sharing personal thoughts or experiences is how people build a rich discussion. Some personal experiences were reported in an assessment questionnaire in the end of the activity, but not as part of the debate. For example, "the old one (fridge) is consuming twice as much as a new one would. Could half my energy costs for the fridge per year down to £25 or so", and "(…) it (the energy monitor) has changed the way we use quite a few things in our house. For example, we do not cook rice using the electric cooker or microwave because it consumes too much energy. Instead we use a pressure cooker".
   For bringing a personal approach to the debate, we understand that:
5. Instead of only sharing data or facts, a CI tool should instigate users to create narratives, to tell personal stories as tips or recommendations to other people.
   Following these main lessons learned from the situated study, we have now expanded the energy awareness initiative to beyond the academic environment, as described in the next section.

5 Widening the target: pursuing behaviour change

Inspired by the preliminary study based on the Evidence-Hub (De Liddo and Buckingham Shum 2013), which was recognised as effective to raise awareness (Piccolo et al. 2014b), the investigation has been evolved towards widening the audience in an energy trial and providing conditions to promote behaviour change.

Around 150 households around the UK have been gradually supplied with similar energy monitoring kits and given access to a purpose built online social platform to visualise the energy consumption and share and discuss best practices on reducing energy wastage.

Launched in December of 2015, the EneryUse.eu is featured with a forum-style discussion board. Discussions are open to everyone, but users of the energy monitors in the trial are invited to connect their devices to the platform, to explore the interactive visualisation of consumption, and to share experiences related to saving energy. The platform is meant to be a space for people to transform the lessons learned at individual context into knowledge applicable by others.

The discussions board design follows typical patterns of web forums. Users can create new discussions and topics and promote posts by voting, post comments, and bookmark discussions. The content is indexed by user-generated tags with keywords, such as appliances names, such as "kettle", or terms referring to daily activities, such as "cooking", "working in the office", and "clothes". As illustrated in Fig. 4, the number of Votes, Replies, and Visualisations of a discussion are shown. There are also dedicated areas for thematic campaigns, for nominating the top contributors and check the daily average consumption of the whole community of users.

Topics or appliances have their specific page (see Fig. 5) and users can subscribe to receive notifications when they are updated. When available, the average consumption of the community for that specific appliance or topic is presented.

Users can check their reputation score, and the electricity consumption of the appliances they monitored. They can also access the list of members and their reputation, as well as the list of tags in use.

5.1 Users' recruitment and participation

Engaging people with a new platform requires some effort and motivation (Piccolo et al. 2014a). The invitation to join

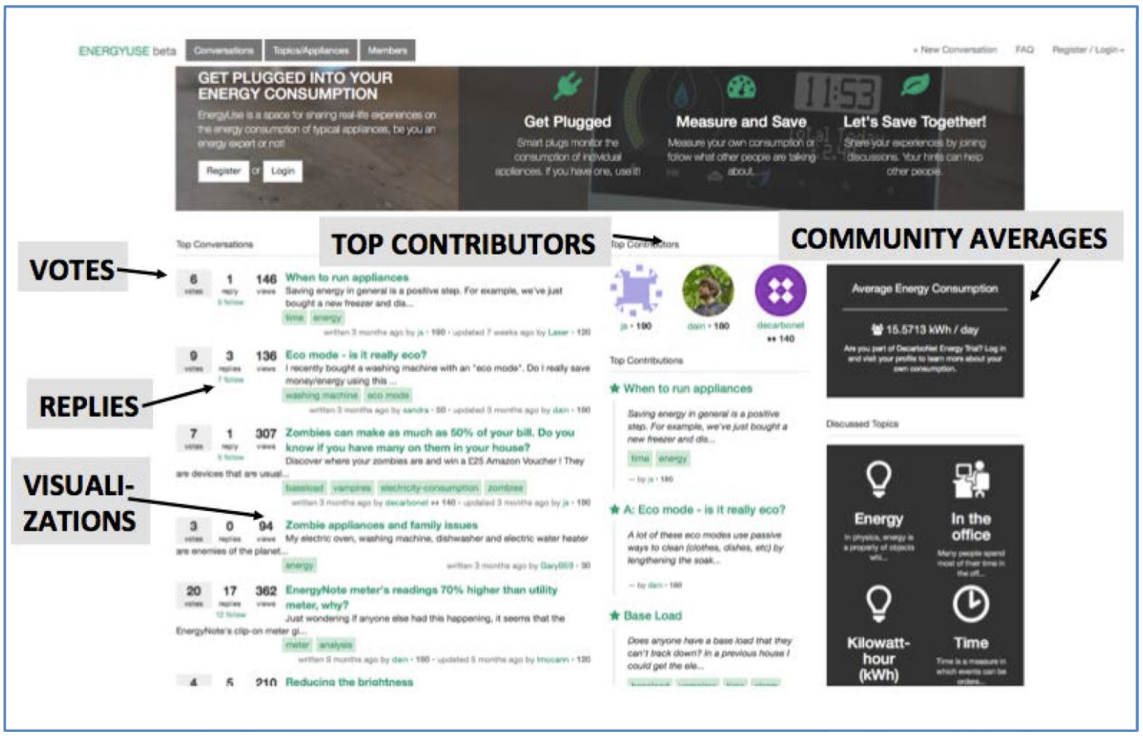

Fig. 4 Energy use discussion board with recent posts, top contributors, average consumption of the community and featured topics

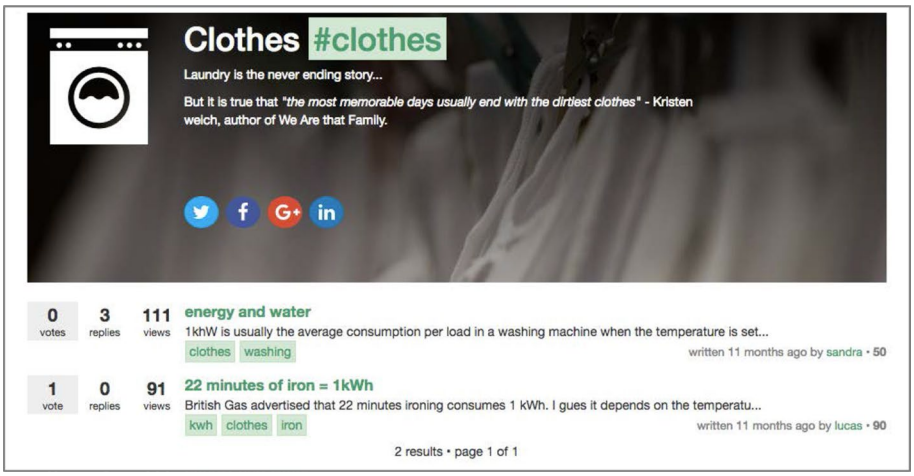

Fig. 5 "Clothes" page associating discussions about washing machine and iron

the platform then aimed to bring as users people with different backgrounds, from different contexts, but also some "energy champions", people more familiar with technology and motivated to spread sustainable practices to prompt the collective knowledge creation. For this reason, the initiative was advertised not only on social media in general, Intranets, but also within communities related to environment and community energy.

Around 450 people demonstrated interested by returning a filled form. Among them, 160 were contacted, accepted our Informed Consent Form, and received the monitors at home. Participants are mostly in the UK and spread across different regions. A small group (five participants) is located in The Netherlands.

Some participants, though, have reported difficulties to install the kit themselves or to keep it working. The motives are numerous, including practical reasons (i.e., moving houses), constraints to install the kit, and also the reported lack of affinity with technology.

Out of 160 users that received the energy monitors, at the moment 77 connected their devices to EnergyUse. The platform has captured some personal experience, such as

"(…) When I moved in my house, each spot was provided with a 50 W halogen bulb for a total of 23 spots. I changed them with 2.5 W LED bulbs. The bill before the change (August, when sunset is after 9 pm) was on an average of 4.1 kWh per day, after the change (October–November) it was 2.7 kWh per day".

At the time of this writing, EnergyUse has 149 posts, with an average of 2.7 comments per contribution, and has 72 tags reflecting topics or appliances discussed. There is a thematic campaign going on inviting users to explore and reduce the "background load", devices that are constantly on, including those in standby more. Vouchers have been offered to the best or most popular tip shared.

5.2 Preliminary evaluation

To understand the potential of EnergyUse to boost collective intelligence around energy saving practices, eight community leaders were gathered for an evaluation in the city of Liverpool, UK. They are already active in energy conservation initiatives engaging a diversity of social groups, either as project officers at the community centre or as volunteers. The group age was between 35 and 72 (average 50 years), all of them familiar with computer and social media users.

The group met for three times to discuss tools and strategies to engage with energy in early 2016. One of the meetings was dedicated to EnergyUse (Piccolo and Alani 2016). The activities and main results are summarised as follows.

Participants were first invited to map their own daily routine and reflect upon the appliances they use and possible choices to perform similar activities, such as preparing meals or taking care of clothes. The group should identify issues or dilemmas, such as toasting bread with a toaster or grill, washing clothes with 30 or 40 °C, etc, as well as discuss eventual answers and arguments to some of the issues. After that, they should explore EnergyUse looking for some of the answers, adding their own hints, arguments, voting, or creating new posts. After that, their perceptions of the EnergyUse and its connection with the energy monitors were collected.

The complete evaluation of EnergyUse and other tools and strategies to raise energy awareness has been published in (Piccolo and Alani 2016). An extensive user evaluation with trialists and EnergyUse users is underway. These preliminary results, though, can provide some insights for the design of CI, as described.

5.2.1 Results and reflections

As stated in the literature, the multi-faceted battle against climate change is not easily converted into everyday practices by the society. As one participant said "There are many things going around global warming and carbon emissions. And it scares people for discussing energy. Politicians and scientists arguing, people can have this perception. But if you do in a light way, small [energy saving] actions, (…) then it is ok". In addition, reinforcing the approach of practices, another participant stated: "If you say in kWh and carbon usage, people say, what does it mean to me? Its my hygiene standards, my time…". It led us to confirm that

1. Discussing simple practices of energy conservation is indeed an adequate approach to engage with the climate change mitigation.

   According to the experiences discussed, people already rely on their network to learn about energy-related practices. Participants mentioned asking neighbours' advise on operating typical devices is a common practice, since they are likely to have similar boilers, thermostat, etc. In terms of engaging the community, participants also stated that effective strategies give space for people to speak about their own needs instead of assuming what they need to know. They also learned from their own experience that "rather than giving out leaflets or sheets of information, it is better to have a local face to give simple messages" for running local campaigns. These perceptions reinforce the assumption that:
2. Dialogue and sense of community are important elements to build collective intelligence around energy conservation.

   While navigating trough EnergyUse content, the participants expressed their lack of understanding of energy consumption from a technical perspective. "There's an assumption that people know about kWh (…) This is too technical!". In addition, posts explaining the meaning of a kWh were considered as "the sort of information everyone needs". Even the most environmentally motivated participants use money as the primary method to quantify energy consumption and not kWh or watts. Potentially, due to the barrier created by the language of previous posts referring to measurements or using technical energy terms, the participants did not feel confortable to start new discussions. "(…) open-ended question is more confusing in the end of the day".

   Similar uncomfortable feeling was revealed towards the energy monitoring kit: "I think these monitors are focused on people who know how to use (Information Technology). I do not think anybody in our community would get involved". Only one participant declared interested in installing the energy monitoring kit at home, despite of the evident need to better understand

Table 1 Sociotechnical implications for design pursuing behaviour change

5 Doors conditions	Level		
	Informal	Formal	Technical
Desirability (people's desires, frustrations)	Users should feel invited to join the community, even when they visit the tool just to consume information Users should feel confortable to freely express themselves	Create thematic campaigns, dilemmas, or other ways to trigger their desire to go online to solve a frustration (by email or meetings, for ex)	Create new issues or start new topics in an easy and inviting way Make it clear that arguments can be positive or negative
Enabling context (modify the context to enable action)	Users should feel confortable using the technology Language has to be compatible with the social group. Users should feel confortable with the language adopted for the content. Balancing technical and colloquial terms may be necessary	Technical barriers should be prevented (like installing complex equipment) Invest in an adequate user interaction, balancing range of features and simple navigation	Create space for sharing external links, references or pictures Help users to transform data into stories, narratives, experiences
Can do (build self-efficacy)	Users should feel confident to share personal experiences User should identify themselves reading tags and topics Most voted ideas tend can be seen as new social norms	Target simple actions, not the big cause (like climate change) Tag content in a meaningful way, reflecting everyday topics	Help users to select meaningful tags Show the most voted contributions Make voting an easy interaction
Buzz (generate interest)	Create incentives for users to share stories Create incentives for users to add comments and arguments	Promote good and inspiring stories Demonstrate the value of comments and arguments (positive or negative) Evidence connections among people Offer prizes or award participation	Show the number of views of discussions Recognise and award top contributors and most popular discussions Group people with similar interests Show connections of ideas Create notifications Provide ways to compare users with the community
Invitation (frame a compelling invitation)	A sense of community should trigger a desire to be part of it	Promote the community level	Provide visual representations of how people are getting engaged with the portal. If it possible, provide a public feedback of engagement Provide ways for users to identify other people they know

and compare appliances consumption that emerged during the discussions.

3. Language can create a barrier to collective intelligence building. It is necessary to bridge the knowledge from experts with the whole society.
4. The interaction with technology part of the collective intelligence solution has to be adequate to the social group skills. Otherwise, it may also establish a barrier to collective intelligence building.
   In the participants' opinion, although the tool is helpful and the collective aspect promising to community-oriented activities, EnergyUse should evolve towards making the interaction simpler for people only consuming saving tips, and not to engage in discussions. They also agreed that that most people would not use EnergyUse spontaneously and need external incentives to be engaged: "some people have a natural desire to learn more, but vouchers might help".
5. Initially, not everyone wants to engage in a discussion. Consuming information is also important, but the tools need to incentivize the next step of active participation.

6 Implications for design targeting behaviour change

Together, both user studies around energy conservation pointed some directions in terms of appropriate strategies for promoting collective intelligence building. As tools for this end, EvidenceHub and EnergyUse differ in many functional aspects, suggesting complementary possibilities to explore the impact of technical features.

We summarise in Table 1 the findings obtained from the two studies that aimed to raise collective energy awareness as sociotechnical implications for design. The findings are mapped as conditions of the 5 Doors Theory (Robinson 2012), as a way to create opportunities and an appropriate environment for people not only to raise awareness, but also to progress towards reviewing and changing their own energy behaviour. Strategies and desirable technical features are then described in the Informal, Formal, and Technical levels, as previously described as part of the Socially-aware design approach (Baranauskas 2014). The Informal level refers mainly to users' feelings; the Formal level to possible practices and strategies; and the Technical level reflects the other levels as desirable features of a CI tool.

7 Conclusion

Collective intelligence tools have the potential to contribute to the complex battle against climate change. When properly designed, they can support collective awareness by instigating generation and dissemination of inspiring practices for everyday life. It may boost the power of community actions, facilitating the process of establishing new and beneficial social norms in line with the community reality, favouring behaviour change.

In this paper, we summarised two studies around energy conservation based on Collective Intelligence tools. The first used a debate tool to raise awareness in a workplace, while the second relies on a forum-based portal for analysing electricity consumption of appliances and sharing stories of energy conservation among people across the UK.

Although the differences between the tools and scenarios suggest specific challenges and findings, they also indicated strong aspects that should be considered in the design of a CI tool that aims to promote changes in behaviour. Independently of context, sociotechnical aspects were discussed both in terms of strategies and features of the tools for engaging users, supporting knowledge building, and transforming this knowledge into actions.

Engaging people with energy saving and climate change are notably challenging and urgent tasks. We expect the analysis presented here can inspire and inform other initiatives seeking to achieve the same common good.

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