EPIC2019

Ethnographic Praxis in Industry Conference Proceedings

The Change before Behaviour

Closing the Value-Action Gap Using a Digital Social Companion

GYORGYI GALIK *Design Council & Royal College of Art*

This paper describes an experiment, designed and developed with the ultimate aim of fostering low-pollution and low-carbon social innovation. It offers an evidence-based practical alternative to conventional, technological approaches and narratives of smart cities aimed at sensing air pollution and mitigating the effects of climate change.

In this experiment a new voice user interface is designed, developed and tested with input from participants – to explore the potential of a new, more socially minded adaptation to current AI assistant devices in the home and enhance the field of smart technology design. The experiment is developed with a group of participants to demonstrate how design research can raise novel questions and inform disciplines with an interest in behaviour change, environmental pollution and smart homes. This work demonstrates the potential for technologies to increase the degree of participation in reducing pollution in cities and facilitate the articulation of agency in complex environmental matters.

The work has value for designers, ethnographers and researchers working in design for behaviour change and participatory design, as well as practitioners and organisations who are interested in enabling low-pollution lifestyles, developing smart homes and/or emerging AI technologies.

With more people living in cities than ever before, urban air quality has become a serious concern. Pollution is severely damaging to the health of children. Public awareness and understanding are important, but they're not enough to overcome the structural, infrastructural and social barriers that can impede or limit an individual's ability to transition to a lower pollution and carbon lifestyle (Ockwell *et al.*, 2009, p.309).

Currently citizens are presented with a narrative that gives them little agency to tackle air pollution. They can either change their behaviour to reduce (mitigate) their personal impact on pollution or minimise their exposure to its harmful effects by downloading apps and visualisations.

I question whether current tools that aim to engage people with air pollution account for people's actual needs and behaviours and manage to achieve the desired outcomes in improving air quality and reduce the exposure to air pollution. All too often these interventions simply monitor, visualise and confirm the fact that the air is polluted, while people become increasingly disillusioned by the fact that their air remained just as polluted as ever.

Moving beyond mitigative actions, which won't be enough to address the complexity and severity of air quality and climate change alone, this enquiry is focused on using design research practices to develop an experiment that could shift the focus from pollution monitoring (measuring pollution that has already been produced) to pollution prevention (avoiding pollution before its produced in the first place). To enable preventative behaviours, it introduces an experiment in the home that aims to pre-empt polluting and energy-intensive behaviours before they even happen.

CONTEXT: DESIGNING FOR BEHAVIOUR CHANGE IN THE HOME

Lockton et al. explain (2014c, p.1) energy use is one of the key challenges on which design for behaviour change has focused on. Lockton *et al.* explain (2014c, p.1) that in domestic environments "the majority of work on influencing energy use through behaviour change concentrates on numerical, visual feedback displays for electricity or gas use" (Lockton *et al.*, 2014c, p.2). Brynjarsdóttir *et al.* (2012, p.948) argue that "ambient displays using pervasive sensor technology, ambient computer widgets, social network applications for sharing environmental data, persuasive games and interactive visual displays" are all designed to persuade people to reduce their energy consumption. The authors (ibid., p.952) explain that persuasive technologies tools often focus on behaviours at the individual scale and without considering what role habits play in many people's everyday behaviours.

Many of the tools the authors analyse also discount the importance of aspects of daily life "that an individual cannot alter" (ibid., p.949). They ignore questions as to "who is actually able to make changes, or how this will change political relationships or social norms" (ibid., p.952). They do not "consider energy in the context of broader socio-cultural practices" (ibid., p.954).

Brynjarsdóttir *et al.* (ibid., p.952) also note that the emphasis on "providing information as a driver for behaviour change rests on a common modernist assumption that people are rational actors seeking to optimise their activities based on what they know" (ibid., p.952). This modernist approach is very similar to what we often see in current visions of the smart home.

Visual Displays and Smart Home Visions

Hargreaves *et al.* (2018, p.127) question the evidence that smart home technologies actually achieve great energy savings and they note that "there is [even] a risk that they may generate forms of energy intensification". As the smart home market is forecast to increase substantially, they argue (ibid., p.136) that "it is vital that the energy saving claims are properly scrutinized to ensure [smart home technologies] are not being developed and sold on the basis of unrealistic and potentially misleading claims."

Strengers (2013, p.25) explains that a core quality of the seamless integration of technology in the home is the achievement of "modernity" and "efficiency". He notes that this idea of the "homes of tomorrow" (ibid.) can be found in the early 1930s' future visions, in which efficiency was presented alongside "unprecedented levels of luxury, relaxation and indulgence, with excessive energy consumption clearly on display" (ibid.).
Robins and Hepworth also (1988, p.157-158) question these visions:

> computer home scenarios have a narrow and instrumental fixation on technique – the 'evolution' of the household is seen as an expression of some autonomous technological 'progress'. The dream is a domestic machine-utopia…in which human agents are passive and infantilized. In such technocratic scripts the household is severed from its surrounding (economic, social and political) contexts.

As part of my research looking at an individual's agency in reducing pollution in cities, I had personal conversations with two energy experts, Dr Sarah Darby (Associate Professor

and Acting Leader, Lower Carbon Futures Team, Energy Programme, University of Oxford) and Geoffrey Stevens (Technology Innovation Manager at the Future Cities Catapult, previously Technology Manager at the Energy Saving Trust).

Both Darby and Stevens described how they had been working on projects aiming to engage consumers in more sustainable energy behaviours in the home, some with more success, some with less impact. The current modes of feedback (e.g. bills, smart meter data, etc.) are not salient enough in their day-to-day activities. By the time consumers get that feedback, they have already forgotten about the associated behaviour.

Stevens believes that "a right advice at the right time"-approach could have a greater impact on energy behaviours. He envisions a solution that provides people with a small reminder of their behaviour at the moment they perform it (such as a message, sound, email, etc.) along with information about the context of that behaviour (for example, 'reducing your thermostat by 1°C would reduce the carbon emissions produced from heating your home by 10%').

Setting Out the Experiment

During our discussions, Stevens introduced me to the UK 'gridwatch' and the Carbon Intensity API. As their website states, "the goal of this API service is to allow developers to produce applications that will enable consumers and/or smart devices to optimise their behaviour to minimise CO2 emissions" (Carbon Intensity API, 2019). For several weeks, Stevens then sent me a message every day in the morning and in the evening during peak hours – reminding me that the grid was overloaded and that I should avoid using the kettle, dishwasher or other electronics.

This experience called to mind my childhood, when my mother would nag me about forgetting to wash my dishes or switch off the lights when I wasn't in my room. When Stevens stopped messaging me, I noticed that I continued to think about the grid and started avoiding behaviours that would consume power during peak demand. The reminders were still playing in my head, even if he wasn't messaging me anymore. It made me wonder whether I could design a technology that would provide similar reminders about pro-environmental behaviours.

Moving beyond providing information alone, Lockton (2015) questions "what agency is possible", and "how to enact change". In his work (ibid.) in the field of design for behaviour change he explores as to how

> "[to develop] design that enables people to understand the wider contexts of their actions, their agency within society, and how they can act to create different outcomes, different futures."

To test Stevens' hypothesis, I set out to design a technological experiment that would encourage people to reduce their heating by 1°C as my first project. By designing an intervention that aggregates small, individual change through a networked technology, I believed that I might be able to scale up individuals' agency and circumvent policy change. I started out with the following question:
(1) Could a connected technology be designed to engender preventative behaviours and afford a more proactive role for citizens in making and/or supporting the decisions that prevent pollution in cities? (bottom-up, individual change); 2) If networked, could a novel

interaction be designed to aggregate the small impact of individuals to achieve a greater collective impact?

I was reminded again to Lockton's work (2015) and how he encourages practitioners to design tools that connect our understanding of how things work and provide "direct ways of enabling action, empowering people to change the behaviour of the systems in which they live" (ibid.). Johnson (2013) also stresses the need to provide people with "practical tools" rather than more information and he also argues that behaviour is driven by context rather than attitude.

AI Home Assistants

Given their growing abilities, AI home assistant devices offered a potentially exciting opportunity to design my pilot experiment. AI assistants are expected to become a bigger part of our daily lives. The number of people using digital assistants is "projected to increase to 1.8 billion by 2021" (Richter, 2016). While keeping in mind that they still have considerable technological limitations, my project was interested in examining if there is an opportunity for: (1) AI technology providers to go beyond current services of convenience and entertainment and provide more socially-sensitive purposes in the future; and (2) designers to explore how these applications – and technologies beyond AI assistants – could be designed to enable behaviour change and engender a more proactive role for citizens in preventing pollution in cities?

I was deeply inspired by the 2016 PhD thesis of Fantini van Ditmar who in "Becoming Your 'SMART' Fridge" took on the role of "a smart fridge software and collecting both quantitative and qualitative data" to question the algorithmic logic behind IoT technologies (Fantini van Ditmar, 2016, pp.124-125). Fantini van Ditmar looked at "how human lives are represented within the quantified approaches of 'smart' technology" (ibid., p.1) and explored "questions of how complex, lived, human experience is oversimplified in the IoT". Her work emphasises the importance of the "observer" and that "smartness is relational". She calls for "a shift in perspective to create more meaningful interactions with devices in the smart home" (ibid.).

The experiment introduced in this paper draws on a larger study and a series of design experiments that were all conducted prior to this paper, in which I aimed to understand how design research can be applied to change energy behaviours and thereby prevent and reduce pollution in cities.

After a series of tests with AI home assistant devices like Alexa and Google Home and with their current technological limitations, as well as a user research experiment in which I acted as an AI myself for weeks, working with a small group of participants, I decided to design my own, custom-built, home assistant device.

THE PARTICIAPTORY DESIGN OF A DIGITAL SOCIAL COMPANION

Climate Pal (CP) was designed, developed and tested with two families in the context of home assistant devices to explore their potential in enabling low-carbon and low-pollution lifestyles in the future. Climate Pal is a digital social companion and a system that builds on a voice-based device that is connected to a set of sensors in the home and to open source datasets online to provide feedback to that device.

The development of Climate Pal (CP) started in November 2017. I worked with a two member-team: myself and a creative technologist, Tim Brooke. Creative technology is a field combining design, computing, art and the humanities (Wikipedia, 2019).

Unlike current smart home devices which automate behaviours – such as Nest and Tado, which for example, switch the heating on or off at a given time – CP was designed to remind participants to take action and make decisions about their own energy behaviours.

Kuijer *et al.* (2013, p.6) describe a "crisis of routine" in which the "breaking and shifting of structures takes place" when an "existing practice is reconfigured into novel variations that involve both new and existing elements, and new and existing links" (ibid.). In these situations, when the task to experiment creates crisis of routine, participants are "challenged to explore and stretch the borders of normal practice, thereby creating novel configurations of elements" (ibid., p.7).

Moving beyond mere awareness raising and information sharing, the experiment was built on the 'ritual' of Steven's initial text reminders to me; it tested the hypothesis that if participants are reminded to perform certain behaviours repeatedly, those behaviours might develop into persistent habits that continue even after the device has been removed from the household.

The experiment tested this approach by introducing a 'storyteller', a digital social companion that reminded people to proactively shift their current behaviours to new ones. It explored whether participants would change their behaviour to prevent pollution if they were provided with information on "the wider contexts of their own actions and others" (Lockton, 2015; van der Linden), but more importantly, whether the 'act of reminding' and giving them the right advice at the right time and at the right location might achieve more successful outcomes in the uptake of certain new behaviours than the provided information itself.

Design as a Conversation for Action and for Learning Together

During my PhD studies in Innovation Design Engineering at the Royal College of Art, I learnt about second-order cybernetics for from my late supervisor, Ranulph Glanville. One of its key aspects is that it frames design as a conversation for action and for learning together. In the words of Dubberly and Pangaro (2015), referring to Humberto Maturana's work, "design is a conversation about what to conserve and what to change, a conversation about what we value."

Moving beyond frequent top-down approaches of designing smart technologies, it seemed crucial to undertake a more participatory process in the development of CP that would give people the opportunity to decide what they value, what they prioritise in their daily lives, what activities and behaviours they would be willing to change, and what are the triggers that might help them change those behaviours.

The technology system was so complex that I had to make sure I could be in contact with my participants day to day, if necessary hourly basis for the test to work. Therefore, I decided to recruit people from the postgraduate residence where I used to live at the time of the experiment. The participants were neighbours across the college of 700 Masters and PhD students – living in single, couple and family homes – and recruited through a mass email distributed by the administration office. I received interest from over forty-five families - but due to operational constraints of the equipment, I was only able to roll out the

experiment in two households. I worked with a young American-British couple and a Chilean family of 4 (with the parents and their two young kids).

Looking through the insights from my discussions with energy experts, Professor Sarah Darby and Geoffrey Stevens together, my participants and I decided together the focus of prospective stories relating to 3 domestic behaviours.

Table 1. Three different actions to reduce energy use in the home

1.	Reduce heating when it goes above 21°C. Every 1°C of reduction equals 10 % energy / CO2 emissions saved.
2.	Switch off the heating and lights when you leave home.
3.	Shower less than 5 minutes, as heating water is very energy intensive.

For example, when one of the participants started showering in the morning the moisture sensor would peak in the bathroom. If the peak was high for more than 5 minutes, CP would start talking about water scarcity and e.g. how we use so much energy to heat up water for people's homes. It would give context to them why reducing their shower-time would be beneficial to water scarcity in London. When the heating goes above 21°C CP would encourage participants to reduce their heating with 1-degree C and put a jumper on. When they leave the house to work it would wish them a good day and tell them about air quality data and how they could consider walking or cycling instead of taking their car.

With participants' consent, a baseline data was collected to see their behaviours before the intervention. To be able to understand whether the intervention was successful, an impact assessment process was developed. For the first few weeks the system monitored how participants had been performing the behaviours we agreed to observe before the experiment itself started. To create a baseline, each behaviour required setting up a separate set of sensors (detailed in Table 2.). In contrast to the current vendor-led narratives around smart homes – which claim to change energy behaviours by automation and control through the introduction of one device and a few set parameters only – my 'baselining process' became a critique of their current reductionist approach itself. To measure three behaviours alone (detailed in Table 1.), the flats of the two families were filled with an array of sensors.

First, our two-person developer team had to find a sensor-set that had an open API (application program interface) to be able to access the real-time data of the sensors that measured the current and future behaviours of the participants, and also for the interaction and feedback loop to work within the system. Each home had a set of networked sensors. Each behaviour was translated into a set of sensors, had its own 'sensor recipe'.

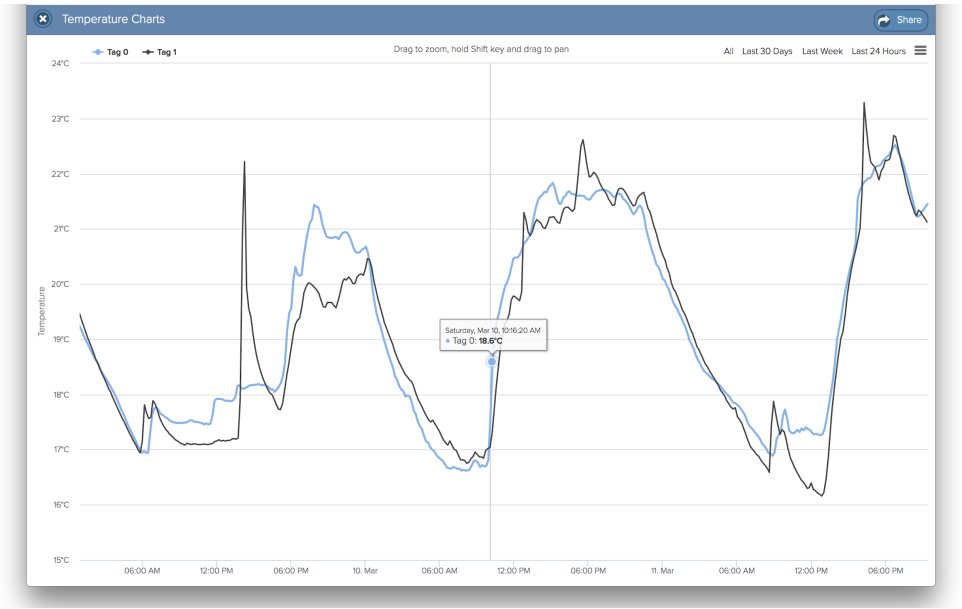

Figure 1. Testing the sensors and observing ambient temperature changes in my own flat.

Figure 2. Ambient temperature sensors throughout the flat – on radiators and placed on the walls on 1.2 meters height, for the most accurate results (product: Wireless Sensor Tags Canada).

Table 2. The different set of sensors that needed to be provided for a specific behaviour

1.	2 ambient temperature sensors (Reduce heating when it goes above 21°C.)
2.	1 door sensor (Switch off the heating and lights when you leave home.)
3.	1 humidity sensor (Shower less than 5 minutes, as heating water uses loads of energy.)

The system included a humidity sensor in the bathroom, to measure participants' hot water consumption; and ambient temperature sensors located near radiators and on the walls, to observe how they used the heating in their homes. An additional door sensor was set up to know when they're leaving or entering the house, so when later introduced in the home, CP could say 'goodbye' or 'hello' and remind them to perform specific actions, such as 'Hi there, good morning! What a sunny day! I see you're leaving to work. Do you mind going back and switch off the heating in the living room? It's going full blast. Thank you so much! Have a lovely day and see you tonight!'. (You can listen to one of the messages of CP here).

Positive examples of social robots encouraged me to continue exploring the potential of AI assistants (Darling, 2016; Fasola and Mataric, 2012; Breazeal, 2011; Kidd, 2008;). In the case of CP, however, there was the added challenge of only having a voice-based interface. As with current AI home assistants, the interaction with CP only embodied human qualities and features through her speech, language and voice.

The Device

For the storyteller device Raspberry Pi was used. It is a small and affordable computer that anyone can use to learn programming. A speaker was attached to the Raspberry Pi – to CP to be able to talk.

For recording the stories, I used Amazon Polly again, a text-to-speech program. The stories generated in Amazon Polly were downloadable and got uploaded to the Raspberry Pis. I sent the participants a sample of recording for each available voice on Amazon, so they were able to choose the one they wanted to work with.

Figure 3. Raspberry Pi and speaker.

The most impactful behaviour change in the home would have been to reduce participants heating. Due to time limitations and unexpected technical challenges, I was unable to do the experiment during the season that heaters are typically used and only managed to develop the connection between the door sensors and the Raspberry Pis. Therefore, I wasn't able to measure the impact of the intervention through the humidity and temperature sensors, even if I had the baseline data of participants' heating and showering habits. Also, measuring participants behaviours through a network of sensors created yet another tension between the framing of sustainability itself and the impact assessment of this intervention. In his critique of the approach of HCI and persuasive technology interventions, Brynjarsdóttir *et al.* (2012) frame human behaviour with respect to metrics that can be quantified, and by doing that, these technologies limit their focus to aspects of sustainability that are clearly measurable (ibid.). To somehow address this crucial point of Brynjarsdóttir *et al.* (2012), during this phase of the experiment I decided not to limit the stories to heating and water use only but open up the questions to wider issues of sustainability. Through encouraging small actions that an individual could make, the stories varied from food waste collection, air pollution and sustainable transport, in addition to electricity use and heating in the home setting.

Building on participants' interests in different aspect of sustainability, I started to develop additional stories which addressed these. To understand how to gather and write the right content for the stories, a literature review was conducted. Key learnings from psychological and behavioural science were applied to better understand how to best frame the content for the stories that the device would tell.

While there is much critique of the limits as to what individualist, behaviour models can or can't achieve, I was interested in how current informational approaches could still be

improved. Social psychologist, Van der Linden (2018, p.208) argues that key insights from psychological science should be used to inform behavioural science interventions and that, for example, psychological science has crucial learnings to offer policymakers in managing climate change (Van der Linden *et al.*, 2015).

The Right Framing of Narratives

Looking at research from decision sciences, in the case of climate change for example, Kunreuther & Weber (2012, p.1) explain that it is difficult for people to engage with risks of "low-probability high-consequence events" for which they have limited or no past experience and no emotional engagement (ibid., p.6). Therefore, they suggest that climate change could be framed from a health perspective to enable behaviour change. Their findings suggest that heat waves, droughts and forest fires are threats that people more likely to act upon, especially if they are perceived as endangering their health or life (ibid., p.10).

Whitmarsh (2009, p.418) also suggests that air pollution might be the right point of departure for linking climate change to individuals' lives and "weaving climate change into discourses of pollution" might achieve a more direct and personal effect. While Moser and Dilling (2007) suggest that negative messages paralyse people, while positive messages and visions surrounding climate change might connect this complex challenge to people's desires to live a meaningful life.

In their research Bicchieri and Chavez (2010b, pp.161-178) demonstrate, for example, as to how people's perception of fairness depend on normative expectations and beliefs about what they think they "ought to do" in a given situation; therefore behaviour change can be supported by better understanding what people think about how others behave and how others might think they should behave in similar situations (Bicchieri, 2010a, p.298).

Supporting this argument, Goldstein *et al.* (2008) demonstrate the crucial role of norms in individual behaviour change and explain how behaviours are often dependent on the beliefs people have of what others do and what people think others expect of them. As Van der Linden explains (2018, p.211) descriptive norms can help inform:

> (a) people about the behavior of referent others and (b) set normative expectations about what type of behavior is 'typical' and 'desired' – reinforcing conformity with the desired norm.

In some cases, norms can also have a reverse effect. In case of energy reduction for example, when in a field experiment participants' energy consumption was compared to the average use of their neighbours, they adjusted their own use to the norm, even if that meant they started to consume more than they did previously (Van der Linden *et al.*, 2015, p.760).

Global issues such as air pollution and climate change decrease people's personal efficacy as they don't believe they can make a difference. Public beliefs about the agency of and need for individuals to change and act are also affected by perceived governmental inaction (Ockwell *et al.*, 2009, p.319). Moreover, people feel that their attempts to respond to such complex issues are useless as other people are not taking action either. They often believe that the responsibility for improving environmental challenges should be a shared responsibility of society, business, industry, and government but they currently perceive that, in reality, "nobody is living up to their side of the bargain" (ibid.).

Promoting collective efficacy, the belief that group actions can make a difference will encourage individuals to take action (Van der Linden *et al.*, 2015, p.759), as "if everyone is doing it, it must be a sensible thing to do."

Social nudges are crucial as people's perceived self-efficacy – how capable people feel that they can change a specific behaviour (Bandura, 1982) – is often subject to their perception of how many others are participating and taking action (Van der Linden, 2018, p.211). A prototypical behaviour within a group can not only increase further uptake of that specific behaviour, but also enhances the acceptance of related public policies (ibid., p.212).

Perkins & Berkowitz (1986, p.962) emphasise the role of peers in regard to people's behaviours. They describe how peer influences are affected more by people's "perceptions of peer behaviours and attitudes" (ibid.) rather than by their peer's actual behaviour and correcting some of these misperceptions might bring about more successful outcomes in enabling behaviour change.

Van der Linden *et al.* (2015, p.759) recommends describing the impacts of climate change through personal and local experiences and engaging narratives (ibid., p.758) that are already happening in people's immediate regions and communities (ibid., p.760). The authors go on to describe that, as a result of "optimism bias" (ibid.), people often believe that these challenges are only happening to others and not to themselves. They also argue that people "less likely to take action when losses paired with uncertainty" (ibid.); therefore losses that society endures at this moment in time and focusing on positive and tangible gains from action at present – instead of emphasising negative, future impacts – will both more likely to be successful in engaging people in the long run (ibid.). Van der Linden *et al.* (2015, p.761) also argue that people are intrinsically concerned about the environment and the welfare of other people, more than about being motivated by money; therefore policymakers should focus on "intrinsic motivational needs" as those can help them achieve "long-term environmental goals" (ibid.).

Outcomes and Insights from the Experiment

Whilst the sample size and the duration of this experiment were limited to make significant claims about long-term behaviour change, this experiment still offered evidence for changing domestic behaviours through the deployment of a connected system in the home setting. The insights my participants shared with me will be valuable for developing the next iteration of CP. One might argue that for a robust evidence the involvement of a larger number of participants would have been necessary; however, the day-to-day (sometimes hourly), 'neighbourly' interaction and conversations with the two families were invaluable for the success of this intervention. This was the only way I could iterate and fine-tune the user experience and actually reflect their needs in a more nuanced way.

Figure 4. A sketch depicting one of the test-scenarios when a participant showers longer than 3 minutes

Overall, after the four-week long experiment, the feedback from my participants was overwhelmingly positive. As the dad, Nicholas from the Chilean family described:

> In general, we were quite excited about this experiment and having Climate Pal in our home. And every day it was kind of a surprise to hear new stories…although sometimes there were some repetitions, but there was an excitement, an expectation from us to interact with her. Although we had it for only a few weeks, the interaction with it was regular and daily. We had expectations of hearing it and waiting for it to talk when we opened the door. It wasn't only the technological novelty for me, but it felt as if it was taking care of us. And even after a few weeks she became part of our family.

Growing emotional engagement

Victoria, from the young couple, described enjoying the CP's presence in their households – even without the conversational element. Even if I had been able to provide a conversational AI element in this phase of the technology development, with current technological limitations of AI assistants, the user experience would still not have been satisfying. For those of us who tried to have a meaningful conversation with our home assistant devices this probably doesn't come as a surprise. While the technology has hugely improved in recent years, current AI assistant devices still have a long way to go before being able to conduct a real and enjoyable conversation. However, it still came as a surprise

to me that even with a system like CP, within the first few weeks of the intervention, participants developed strong emotional connection. As Victoria described:

> First of all, I just loved when she would talk. So, I would open the door and sometimes I would remember that she might talk, and I would sort of wait and see if she is saying anything and I was always happy when she did.

And as Nicholas noted about their experience living with CP:

> We missed it when it was gone. When we opened the door, my kids were waiting for her to talk. But it was not there anymore. Although they still remember the stories, she told us. It felt as if it was looking after us, that it was benefiting us in some way.

This raised further ethical questions that I hadn't fully considered prior to the research. I didn't expect how attached the participants would become to their digital companion and what it would mean to them when the device was removed from their homes. This is something that needs to be carefully considered in future iterations of the experiment.

Learning about and breaking down sustainability into small actions

Listening to the device's stories every morning when they left the house both families said they learned about a variety of issues, some which they hadn't considered before, such as water scarcity, meat consumption, or food waste collection.

> I think of us as a family with fairly sustainable lifestyles. We always walk everywhere for example. But it made me consider more on how we use single use plastic for example and waste management in the UK. Our little friend, I mean CP made us aware of this issue more.

And in the case of Victoria:

> I thought that the thoughts she had about remembering things…the content itself was really cute and helpful.

Co-designing the stories

In collaboration with the participants, I iterated the length and timing of the different audio files during the experiment to ensure the device didn't become too annoying. I also encouraged the participants to write some of their own trigger narratives and reminders that was then uploaded to their device. From their feedback during the process, I learned that the stories needed to be shorter, so they could listen to them fully. Long stories were too hard for participants to focus on, especially during the morning rush. As Victoria described:

> Two things I noticed…one time we opened the door and we ended up not leaving and so we shut the door again...and I think that knocked her off, so when we were coming home, she would go off, because she thought we were leaving. The other thing was...once I was in such a hurry that I shut the door on her as I was leaving, and I heard her talking to me while I was walking down the hallway. That was the only time I missed her. But these things didn't bother me. I didn't think she was annoying, or she talked too much. The sound and her voice were fine as well. I

> really enjoyed having her and I would definitely have something like this in my house.

After testing a few iterations and changing the rules of the system to address my participants' feedback, we settled on the right length of and their interest areas for the stories. As Nicholas explained:

> In the beginning some messages were a bit too long when we were in a rush in the morning, but that was an improvement when they got shorter. We also wanted to listen to some of the messages earlier in the morning, not when you open the door only, so we could choose the right outfit, for example, when we needed to change to a different commute.

Infrastructural barriers to change

While the motivation to perform the new behaviours were there with both families, some of the behaviours such as collecting food waste the participants didn't have the opportunity or the necessary infrastructure in place to perform the uptake of the new behaviour. As Nicholas explained about his experience:

> The challenge was that she told us all these facts, but then when I wanted to start food waste gathering for example, I realised there is no system set for me to properly do that. That was a challenge! Someone needs to provide these services for us, so we can actually do them. Some other actions she recommended it was easy to follow and was in our power to do.

This result supports the same argument of those before me (Lockton *et al.*, 2014a, 2014b, 2014c, 2015; Marteau *et al.*, 2014; Brynjarsdóttir *et al.*, 2012; Shove, 2009; Ockwell *et al.*, 2009;) that without the necessary institutional, structural and infrastructural changes in place individuals will not be able to alter some of their behaviours to reduce air pollution and mitigate the effects of climate change.

In the case of Victoria, CP made her especially conscious about her consumption of disposable plastics, such as carrier bags and water bottles.

> This is something I thought a lot more since we had her. Because this subject was so salient…as she would talk every time when I was about to leave home, it gave me an idea on how I could improve my own consumption and reduce my own plastic use. Which was great. In general, I really loved having it. It was also just nice to have that reminder before you run out of the house for the day. So that was great.

Interestingly, this effect wasn't always directly related to the content of the stories. It was surprising to see the connections she made between the different stories and how those made her think about her daily activities, sometimes completely indirect ways. For example, on a morning when CP told her about the impact of cattle on greenhouse gases emissions – she remembered to bring her reusable water bottle to school, to avoid buying a disposable one. She said she remembered to do this not because of the message about cattle, but

because hearing CP's voice reminded her of a previous day's message informing her about the harm of disposable plastics.

Unexpected outcomes

There were also five quite unexpected outcomes with both families: first, listening to the interviews afterwards, both families remembered advice that CP gave them that wasn't actually included in its programme of stories. It seemed as if the device started to encourage them to sustainable behaviours outside of the scope of the experiment.

Figure 5. A sketch capturing a dinner discussion between Nicholas and his in-laws visiting from Chile. During the family dinner someone came home and opened the door, which triggered CP to tell a story. This interrupted their whole dinner conversation. CP happened to giving them advice on shifting towards a plant-based diet and encouraging participants to eat less meat.

Second, during this design research experiment, technical glitches became a source of novelty and led me to key insights that I hadn't even thought of. As Glanville (2009) argues while explaining the exciting similarities and differences between *design* and *conversation*:

> in most models of communication, the concern is to reduce error, in design the so-called "error" may be a source of novelty. What is often thought of as error is welcomed as a means of enhancing creativity. This novelty comes from everything in the system working together.

Third, after listening to stories, both families described how they had conversations about the facts and actions. In the case of Nicolas, his in-laws were visiting them from Chile,

and they became part of the experiment. Having listened to the stories together, they then discussed them as a family during dinner time.

Victoria and Ben described having their friends over for drinks or dinner and how they would also discuss and debate the topics and stories that CP shared with them:

> My friends thought it was really interesting. When people were in the living room and she would talk. People were startling at first, but then everyone would be quiet and listened to everything she said. Which was nice because it caused a little bit of a 'pause' I guess.

The 'pause', as she described it, reminded me to the research of Kuijer *et al.* (2013, p.6), which argues that achieving a positive reconfiguration of an existing social practice, the "crises of routine could be deliberately staged". They introduce the idea of "trigger products that can form leverage points or triggers for playing out more radically different configurations" (ibid., p.7).

Fourth, in a follow-up interview, Nicolas also described how his son started reminding him about things that CP had told them about, but that he had already forgotten. For example, his son asked him to carry grocery bags with them to the supermarket and travel to school by bicycle or scooter, even on the days when the air quality was good.

Unexpectedly, the experiment evolved into design for family behaviour change. During our conversations Nicolas also described how CP's reminders to observe and proactively participate in these small, daily exercises made him feel they were building a more positive future together for the long-term. The device enabled collective, cross-generational action at a family-scale and had a greater collective impact than if it had focused on an individual:

> My son reminded me during the day what she had said the morning before. My son has a better memory for these things than I do…I am scared of what will happen with my children in the future with climate change and pollution. This device tried to help us improving our quality of life, making things better every day to have a better future for my children.

This outcome brought me back to Van der Linden's research (2018, p.211) that it is key to inform people about the behaviour of important others and raise normative expectations about what type of behaviour is "typical and desired". The more people follow a desired norm, the stronger the "social signal becomes" – persuading others to further comply. In other words, the more people hear their friends, family and social circles talking about environmental issues, the more these issues will be viewed as risks that require further action. This does not only increase their perception of risk but their "intention to act" (Van der Linden *et al.*, 2015, p.759).

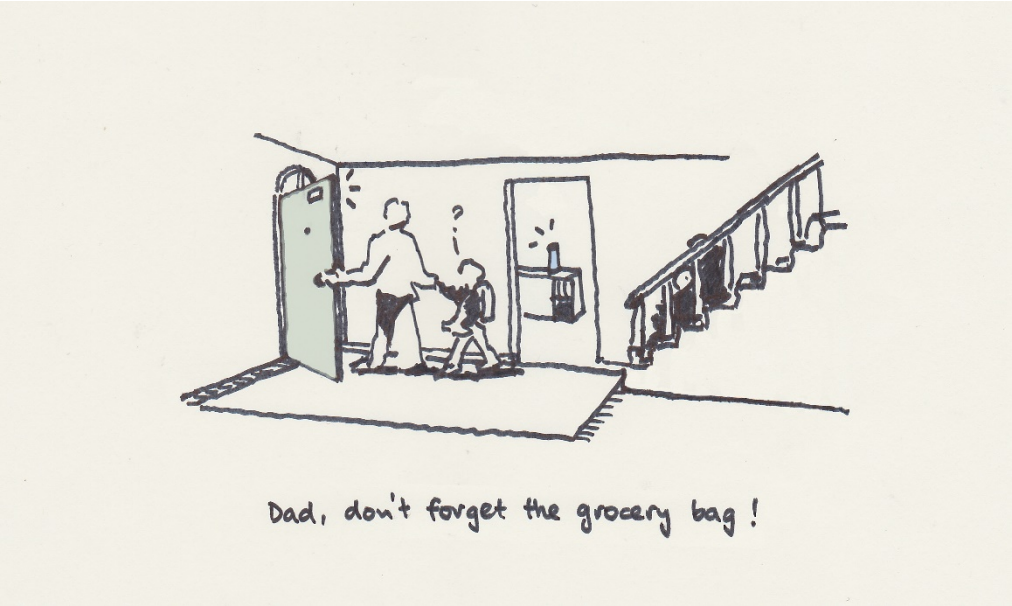

Figure 6. Participants started reminding each other to the stories and advice that CP shared with them.

The fifth and perhaps most delightful outcome with both families was that after CP was removed from their homes, they kept hearing her voice and advice as they were walking out the front door in the morning. Both families reported that this even prompted them to change their behaviour, going back in the flat to grab a reusable grocery bag or switch off the lights.

Lastly, both families described how they had a greater sense of trust for CP than they would have for a device like Google Home or Amazon Alexa. They explained that this was because they understood how the device worked, they owned their data and knew that data wasn't being used for commercial purposes. As Nicholas described:

> I would have felt uncomfortable having an Alexa in my home. It is so corporate and always wants something from you and Amazon profiting from it. But I trusted this device as I knew how it worked. I saw what happens with my data. I owned the data. This could be a good device to create a system…like a Wiki voice user interface, like OpenStreetMap. You can build your own conversational device, owning your own data. Customise stories that you're interested in. Everyone becomes the maker of their own device and experience.

Victoria also mentioned a very similar feeling:

> I liked the fact that she wasn't listening to us, but that she knew when I was leaving the flat and coming home. Thanks for asking us to participate.

Next Steps – Improving User Experience

Our two-person development team faced a variety of technological issues during the development of this design experiment.

Both families expressed a desire to have follow-up conversations with their CPs. With further development, I am hopeful that home assistants will become better conversationalists and this challenge could be addressed. Listening to the stories made piqued their interest in the different topics and made them curious to learn more. As Nicholas commented:

> We wanted to hear more interesting facts…even more facts, so it doesn't become boring. When she wished us a nice day, it was kind of nice to have her. Although it would have been great if we could interact with her and wish her a nice day in return. We liked the behaviour specific advice as well…It would be nice to find a way, so that we could interact and talk to the device. A two-way conversation…obviously I understand the limitation of the current technology.

Participants also requested that in further developments of CP would give them more feedback about how their behaviour was changing in the household. With positive encouragement, they believed they would be more motivated to maintain their new behaviours.

One participant also said he would have preferred to listen to the stories while having breakfast or washing his teeth, rather than at the moment when he was leaving the house. This was especially true for advice that required forward planning. For example, when the advice was about changing his mode of commuting in the morning. If he was going to change his commute to work, he would need to know that in advance, so he could leave the house earlier. This made me realise that I don't only need to develop the right content at the right location, but also at the right time. If a participant wants to shift a behaviour, for example their commute in the morning, consequently they also need to change every behaviour prior to that specific behaviour, for example, choosing a different outfit, getting up earlier. So, a series of behaviour changes need to happen before that one behaviour can be changed. The experiment suggests that a trigger device can indeed support these changes by disrupt or intervene with the right advice, at the right time and at the right place.

This 'right advice at the right time and right place' approach reminds me to the "missing feedback" as Donella Meadows (1999) describes it in her 6th leverage point. As she states (ibid., p.13) "[missing feedback] is not a parameter adjustment, not a strengthening or weakening of an existing loop. It's a new loop, delivering feedback to a place where it wasn't going before." It is "one of the most common causes of system malfunction" and she argues that "adding or restoring information can be a powerful intervention" (ibid.). However, she also emphasises that it's important that the missing feedback be restored to the right place and in compelling form referring to the example that "it's not enough to inform all the users of an aquifer that the groundwater level is dropping as that could initiate a race to the bottom" (ibid.).

Figure 7. A sketch depicting how CP is connected to open datasets on the Internet to provide real-time information on different environmental matters including air pollution, traffic congestion, weather.

With further development, CP can become a reliable platform for triggering particular sound files in response to different behaviours in real-time. There are a number of possible avenues to explore, including linking stories and activities to the real-time load on the electricity grid (particularly where this may lead to different pricing per unit – supporting governmental aims with demand-side response strategies), applications in local or community microgrids where generation as well as consumption (and the balance between them) comes into consideration.

In the future CP (in an advanced form) could be networked to other devices, to form a community of participants. This would make it possible to conduct practical tests with social norms and peer-to-peer effect, while providing participants with an aggregated measure of their collective impact. To achieve an aggregated change through a network of CPs remains the question and opportunity for the future.

While I wasn't able to make CP into the network of devices I had originally intended (to enable collective action at a wider scale). Nicholas and I had long conversations about how CP and similar devices could be used in the future:

> I also thought it would be good to connect it many different data sources. It could be an interesting challenge to build this as a network and allow the government or the city to talk to its people. Tell us what the goal is for today! I think it would be quite powerful to know the weekly or daily goal of the government that has been set for the day…for millions of people in the city. And receive some feedback that those people who tried to act collaboratively, we achieved this or that much of an impact and improved our quality of life together. And then when you get home at

> the end of the day you can listen to the feedback from the government and what you achieved as a collective. I am not an expert, but air pollution is really bad. We could set certain targets that we could achieve…if air pollution were so bad for 4 days this week that let's do something about it.

FINAL THOUGHTS – DESIGNING FOR THE CHANGE BEFORE BEHAVIOUR

This paper explored how new technologies may facilitate articulations of citizen participation (Gabrys, 2018, p.508) as a means to afford increased agency in reducing pollution in cities through design for behaviour change. The design experiment focused on stimulating voluntary social change through the participatory design of a purpose-built, connected home assistant device that supported participants' transition to low-carbon and low-pollution lifestyles with a set of stories that were triggered by specific household behaviours.

With similar aims to this enquiry, Lockton *et al.* (2014a; 2014c) explored the sonification of energy data in households, as a means to make energy more 'visible/audible' and encourage householders to consider their energy consumption in near real-time.

Building on Lockton's thinking around energy displays, and visual and audible feedback and also moving beyond sensory feedback of near real-time energy use in the home, I set out to shift the focus to designing a technology enabler that helps pre-empt polluting and energy-intensive behaviours before they even happen.

As a result of the experiment, a new argument has started to emerge. Design for behaviour change – the field I aim to make a significant contribution towards – may focus on the wrong side of a behaviour. Instead of designing for the behaviour to change, I was interested in designing for the change before the behaviour is even performed. If a person participant wants to shift a behaviour with the help of a digital social companion (e.g. their commute in the morning, their choice of food), they also need to be supported in all the changes that lead and allow to that behaviour to be shifted by giving them the right advice, at the right time and at the right place.

Designing Technologies that Create a Collective Experience and a Shared Purpose

The final experiment evolved into design for family behaviour change. This was an unexpected outcome, resulting from the fact that the device was a voice user interface and so the advice/stories were audible by all participants across the home. During our conversations participants described how the home assistant device reminded them to observe and proactively participate in small, daily actions and also how, as a result of this, they started to remind each other to those actions – even when the device was not around. Participants described that the device made them feel they were building a more positive future together with their families through this shared experience. The participating families had a greater collective impact than they would have had individually. Unexpectedly, the experiment also affected people beyond the immediate circle of the participants, through learnings and discussions they took away after visiting the participants' homes.

Transmitting Social Incentives

The evidence established through this enquiry suggests that technologies that are deliberately designed to involve more than one person from the direct social circle of an individual (e.g. family members, colleagues, peers, classmates) as part of the interaction – with considerations to the family and/or peer dynamics of an individual – might have a more successful outcome in enabling behaviour change. Practitioners working in the field of design for behaviour change might benefit from experimenting with technologies that allow more people to simultaneously participate and interact with a technology enabler.

Design for behaviour change might benefit from considering designing technologies that would inherently inform people about the behaviour of important others and raise normative expectations about what type of behaviour is "typical and desired" (van der Linden explains, 2018, p.211). They could support socially minded nudges in leveraging and transmitting social incentives that regulate individual and group behaviour" (Van der Linden, 2018, p.207; p.209; Bicchieri and Chavez, 2010b, pp.161-178;), and refine the beliefs and perceptions of people have of what others do and what people think others expect of them to do (Goldstein *et al.* 2008). In other words, if the individual is encouraged by the shared experience and actions of their immediate peers, family and friend circles it might increase the chance of a successful transition to a new habit.

Trigger Devices/Technology Enablers

When the device was removed from participants' homes, they kept hearing its advice as they were walking out the front door in the morning. Both families in the experiments reported that having lived with the device had even prompted them to change their behaviour, for example going back in the flat to grab a reusable grocery bag or switch off the lights. This insight reminds me to the Kuijer *et al.* (2013, p.5) argument that "through performance, the body becomes trained in a certain way, when knowledge about the practice becomes embodied in the practitioner". The authors note that (ibid., p.6):

> instances of adaptation, improvisation and experimentation in performance can be triggered by all kinds of smaller and larger changes in circumstances, such as for example the introduction of unfamiliar elements

Designing for a Deliberate 'Pause'

The evidence established through this experiment also suggests that it is indeed possible to design technological triggers for the space before behaviour and make people consider their actions before they actually act. In other words, it is possible to design a technology enabler that intervenes in the gap between value and action – between people's beliefs, attitudes and actual behaviour – and gains time for a 'pause' between participants' 'auto-pilot' behaviours and more effortful considerations of their day-to-day activities to shift their old behaviours to new ones.

Closing Remarks

I argue that with future technological advancements AI home assistant devices could become a way to encourage people to articulate their agency in environmental matters and collectively achieve a greater impact and reduce pollution in cities.

In contrast to mitigation-focused, reductionist, technological approaches and narratives of behaviour change, this paper aimed to advance the current thinking around smart technologies that address energy use and pollution in cities so that those working in this space consider both the messiness and complexity of behaviour change and of air pollution and climate change.

Over the last fifteen years in my day-to-day work I have been facilitating conversations between communities, city leaders, government officials and technology companies to support them in better understanding each other and to enable meaningful collaboration, and also to better understand how to enable both individuals and systems to change. I believe that it is crucial to ensure that all voices can be equally expressed, heard and represented in complex environmental and political processes, to create places that are more just and liveable. The design experiment, Climate Pal (CP) was a manifestation of this goal. Inquiry into my participants' everyday lives introduced opportunities to discuss how things could be otherwise. Through design research, I hope I managed to challenge assumptions that have long been dominant in smart technology design and offered new ways to design technologies that could reduce pollution in cities.

Gyorgyi Galik is a London-based innovation designer, design researcher and environmental advocate. She recently passed her PhD viva in Innovation Design Engineering, School of Design at the Royal College of Art in London. Alongside my studies, she is working as a Lead Advisor of Design Council's Cities Programme.

REFERENCES

Bandura, A. (1982). Self-efficacy mechanism in human agency. American Psychologist, 37(2), 122-147. Available at: https://scinapse.io/papers/1982210139 [Accessed: 15 June 2018]

Bicchieri, C. (2010a). "Norms, preferences, and conditional behavior". Politics, Philosophy, and Economics. 9 (3): 297–313. doi:10.1177/1470594x10369276. DOI: 10.1177/1470594X10369276

Bicchieri, C. & Chavez, A. (2010b) Behaving as Expected: Public Information and Fairness Norms. Journal of Behavioral Decision Making, 23(2): 161-178. DOI: 10.1002/bdm.648

Breazeal, C. (2011) The rise of personal robots. TED talk. Available at: https://www.ted.com/talks/cynthia_breazeal_the_rise_of_personal_robots?language=en [Accessed: 15 September 2019]

Brynjarsdóttir, H., Håkansson, M., Pierce, J., Baumer, E.P., DiSalvo, C.F. & Sengers, P. (2012). Sustainably unpersuaded: how persuasion narrows our vision of sustainability. *CHI*. [Accessed: 15 July 2015]

Carbon Intensity API. Available at: https://carbonintensity.org.uk/ [Accessed: 1 November 2019]

Creative Technologist. Available at: https://en.wikipedia.org/wiki/Creative_technology. [Accessed: 1 November 2019]

Darby, S.J. (2018) Smart technology in the home: time for more clarity, Building Research & Information, 46:1, 140-147, DOI: 10.1080/09613218.2017.1301707. Available at: https://www.tandfonline.com/doi/pdf/10.1080/09613218.2017.1301707. [Accessed: 30 October 2019]

Darling, K. (2015) 'Who's Johnny?' Anthropomorphic Framing in Human-Robot Interaction, Integration, and Policy. Published: 23 March 2015. Robot Ethics 2.0, eds. Lin, P., Bekey, G., Abney, K. & Jenkins, R. Oxford University Press, 2017, Forthcoming. Available at: https://poseidon01.ssrn.com/delivery.php?ID=658002065071096112103096064095073098030040014018086061111065127075071105018071083030030053038123014014001022072119073127102103046002025038074087127115066125080098029054017095006018005091098018110110028005075110094073113083070112113091120121127114084091&EXT=pdf
[Accessed: 12 August 2017]

Darling, K., Palash, N. & Breazeal, C. (2015) Empathic concern and the effect of stories in human-robot interaction. 24th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN) 770-75. DOI: 10.1109/ROMAN.2015.7333675

Dubberly, H. & Pangaro, P. (2015) Cybernetics and Design: Conversations for Action http://www.dubberly.com/articles/cybernetics-and-design.html

Fantini van Ditmar, D. (2016) IdIOT: second-order cybernetics in the 'smart' home. PhD thesis, Royal College of Art.

Fasola, J. &Mataric, M.J.. "Using Socially Assistive Human–Robot Interaction to Motivate Physical Exercise for Older Adults." *Proceedings of the IEEE* 100 (2012): 2512-2526. Available at: http://robotics.usc.edu/publications/media/uploads/pubs/763.pdf [Accessed: 1 October 2019]

Glanville, R. (2009). A (Cybernetic) Musing: Design and Cybernetics. Cybernetics & Human Knowing. 16. Available at: http://asc-cybernetics.org/systems_papers/Glanville%20final.pdf

Goldstein, N. J., Cialdini, R.B. & Griskevicius, V. (2008) A Room with a Viewpoint : Using Social Norms to Motivate Environmental Conservation in Hotels. Available at: https://pdfs.semanticscholar.org/6109/f1e47d2af5300b16c5563184fc85109c038f.pdf?_ga=2.232304159.1663204598.1553968045-851403664.1553968045 [Accessed: 2 March 2019]

Huntington, H.P. (2007) Moser, S. C. & L. Dilling (eds.), 2007. Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change., Écoscience, 14:4, 545-546, DOI: 10.2980/1195-6860(2007)14[545:CACFCC]2.0.CO;2.

Johnson, S. (2013) Communicating sustainability: lessons from public health. The Guardian. Posted: 22 March 2013. Available at: https://www.theguardian.com/sustainable-business/communicating-sustainability-behaviour-change-public-health [Accessed: 22 March 2013]

Kidd, C. D. (2008) Designing for long-term human-robot interaction and application to weight loss, PhD Dissertation, MIT.

Kuijer, L., De Jong, A. & Eijk, D. (2013) Practices as a unit of design. ACM Transactions on Computer-Human Interaction. 20. 1-22. 10.1145/2509404.2493382. Available at: http://www.diva-portal.org/smash/get/diva2:1043363/FULLTEXT01.pdf. [Accessed: 11 10 2019]

Kunreuther, H. & Weber, E. (2014) Aiding Decision Making to Reduce the Impacts of Climate Change. Journal of Consumer Policy. 37. 397-411. Published: September 2014. DOI: 10.1007/s10603-013-9251-z

Hargreaves, T., Wilson, C. & Hauxwell-Baldwin, R. (2018) Learning to live in a smart home. Building Research & Information, 46:1, 127-139. Available at: https://www.tandfonline.com/doi/full/10.1080/09613218.2017.1286882#aHR0cHM6Ly93d3cudGFuZGZvbmxpbmUuY29tL2RvaS9wZGYvMTAuMTA4MC8wOTYxMzIxOC4yMDE3LjEyODY4ODI/bmVlZEFjY2Vzcz10cnVlQEBAMA== [Accessed: 2 May 2019]

Lockton, D. (2015) Let's See What We Can Do: Designing Agency. Published: 23 December 2015. Available at: https://medium.com/@danlockton/let-s-see-what-we-can-do-designing-agency-7a26661181aa [Accessed: 23 December 2015]

Lockton, D., Bowden, F., Brass, C. & Gheerawo, R (2014a) Powerchord: Towards ambient appliance-level electricity use feedback through real-time sonification. UCAmI 2014: 8th International Conference on Ubiquitous Computing & Ambient Intelligence, 2-5 December 2014, Belfast. Available at: http://suslab.rca.ac.uk/wp-content/uploads/2014/09/Powerchord_UCAmI_rev_with_disclaimer.pdf [Accessed: 11 April 2017]

Lockton, D. (2014b) As we may understand: A constructionist approach to 'behaviour change' and the Internet of Things. Published: 1 November 2014. Available at: https://medium.com/@danlockton/as-we-may-understand-2002d6bf0f0d [Accessed: 1 November 2014]

Lockton, D., Bowden, F., Brass, C. & Gheerawo, R. (2014c). Bird-wattching: exploring sonification of home electricity use with birdsong. SoniHED – Conference on Sonification of Health and Environmental Data. Published: 12 September 2014. York. Available at: http://suslab.rca.ac.uk/wp-content/uploads/2014/09/SoniHED_2014_paper_Lockton_et_al_300dpi-revised.pdf [Accessed: 11 April 2017]

Meadows, D. (1999) Leverage Points: Places to Intervene in a System. The Sustainability Institute. Available at: http://donellameadows.org/wp-content/userfiles/Leverage_Points.pdf [Accessed: 29 October 2019]

Ockwell, D. & Whitmarsh, L. & O'Neill, S. (2009) Reorienting Climate Change Communication for Effective Mitigation: Forcing People to Be Green or Fostering Grass-Roots Engagement?. Science Communication. Vol 30, Issue 3, pp. 305 - 327. Published: 7 January 2009. Available at: https://pdfs.semanticscholar.org/72ca/4afa569714ff861189505725af9623c269a3.pdf [Accessed: 2 September 2015]

Perkins, H.W. & Berkowitz, A.D. (1986) Perceiving the Community Norms of Alcohol Use Among Students: Some Research Implications for Campus Alcohol Education Programming. International Journal of the Addictions, 21, 961-976. DOI: 10.3109/10826088609077249

Richter, F. (2016). Siri, Cortana *et al.* Digital Assistants - Always at Your Service. Published: 26 August 2016. The Statistics Portal: www.statista.com. Available at: https://www.statista.com/chart/5621/users-of-virtual-digital-assistants/ [Accessed: 6 June 2017]

Robins, K., & Hepworth, M. (1988). Electronic spaces. New technologies and the future of cities. Futures, April 1988, 155–176. doi:10.1016/0016-3287(88)90022-5

Strengers, Y. (2013) Smart energy technologies in everyday life:
Smart Utopia? Basingstoke: Palgrave Macmillan. Available at:
https://www.dhi.ac.uk/san/waysofbeing/data/economy-crone-strengers-2013.pdf
[Accessed: 2 August 2018]

UK gridwatch. Available at: https://www.gridwatch.templar.co.uk/

Van der Linden, S. (2018). The future of behavioral insights: On the importance of socially situated nudges. *Behavioural Public Policy, 2*(2), 207-217. Available at: https://www.cambridge.org/core/services/aop-cambridge-core/content/view/1A25D44C1DF077C25371FC9AD97F399B/S2398063X18000222a.pdf/future_of_behavioral_insights_on_the_importance_of_socially_situated_nudges.pdf [Accessed: 25 March 2019]

Van der Linden, S. (2015a), 'Intrinsic motivation and pro-environmental behaviour', Nature Climate Change, 5(7): 612–613. van der Linden, S. (2017a), 'The nature of viral altruism and how to make it stick', Nature Human Behaviour, 1: 0041. DOI: 10.1038/nclimate2669

Van der Linden, S, E Maibach, and A Leiserowitz. "How to Improve Public Engagement with Climate Change: Five "Best Practice" Insights from Psychological Science". Perspectives on Psychological Science 10.6 (2015b):, 10, 6, 758-763. Web. Available at: https://scholar.princeton.edu/sites/default/files/slinden/files/ppsfinal.pdf [Accessed: 2 April 2019]

Whitmarsh, L. (2008a) What's in a name? Commonalities and differences in public understanding of 'climate change' and 'global warming.' Public Understanding of Science, in press. Available at: http://psych.cf.ac.uk/home2/whitmarsh/Whitmarsh_PUS%202009.pdf
[Accessed: 1 June 2016]

Whitmarsh, L. (2008b) Behavioural responses to climate change: Asymmetry of intentions and impacts. Journal of Environmental Psychology. Available at: https://www.geos.ed.ac.uk/~sallen/rachel/Whitmarsh%20(2009).%20Behavioual%20responses%20to%20climate%20change;%20Asymmetry%20of%20intentions%20and%20impacts.pdf [Accessed: 3 June 2016]