



## University of Dundee

### Our Friends Electric

Rogers, Jon; Clarke, Loraine; Skelly, Martin; Taylor, Nick; Thomas, Peter; Thorne, Michelle

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# Our Friends Electric

## Reflections on Advocacy and Design Research for the Voice Enabled Internet

**Jon Rogers**  
**Loraine Clarke**  
**Martin Skelly**  
**Nick Taylor**  
**Pete Thomas**  
DJCAD  
University of Dundee  
Dundee, UK  
j.rogers@dundee.ac.uk

**Michelle Thorne**  
**Solana Larsen**  
**Katarzyna Odrozek**  
**Julia Kloiber**  
**Peter Bihr**  
Mozilla Foundation  
Berlin, Germany  
michelle@  
mozillafoundation.org

**Anab Jain**  
**Jon Arden**  
Superflux  
London, UK  
anab@superflux.in

**Max von Grafenstein**  
Berlin University of the  
Arts  
Berlin, Germany  
m.von-grafenstein@udk-  
berlin.de



**Figure 1: Karma, Eddi and Sig.**

### ABSTRACT

Emerging technologies—such as the voice enabled internet—present many opportunities and challenges for HCI research

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and society as a whole. Advocating for better, healthier implementations of these technologies will require us to communicate abstract values, such as trust, to an audience that ranges from the general public to technologists and even policymakers. In this paper, we show how a combination of film-making and product design can help to illustrate these abstract values. Working as part of a wider international advocacy campaign, *Our Friends Electric* focuses on the voice enabled internet, translating abstract notions of Internet Health into comprehensible digital futures for the relationship between our voice and the internet. We conclude with a call for designers of physical things to be more involved with the development of trust, privacy and security in this powerful emerging technological landscape.

## CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**.

## KEYWORDS

Internet of Things, voice, internet, advocacy, design research, product design, speculative design, critical design, film

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Jon Rogers, Loraine Clarke, Martin Skelly, Nick Taylor, Pete Thomas, Michelle Thorne, Solana Larsen, Katarzyna Odrozek, Julia Kloiber, Peter Bihr, Anab Jain, Jon Arden, and Max von Grafenstein. 2019. Our Friends Electric: Reflections on Advocacy and Design Research for the Voice Enabled Internet. In *CHI Conference on Human Factors in Computing Systems Proceedings (CHI 2019), May 4–9, 2019, Glasgow, Scotland UK*. ACM, New York, NY, USA, 13 pages. <https://doi.org/10.1145/3290605.3300344>

## 1 INTRODUCTION

In a recent article for the *MIT Technology Review*, there is a strongly worded warning that the internet is going to be weaponised by chat bots with voices indistinguishable from humans [38]. This is an acute viewpoint that represents the social power of the internet being amplified by the developments in voice technology and increasingly centralised machine learning. It is also an example of the dramatic increase in the voices of academic researchers calling for a healthier internet. For HCI and design research, this motivates a new direction for practical research that shows not just what is wrong with the internet, but also what we can do about it.

There are, of course, a host of opportunities that this technology could bring about. It provides powerful new ways to interact with computers that were previously in the realm of science fiction. These include new ways to monitor our mental health, as conversational interfaces, to combat the digital divide and provide new forms of big data for public good [16]. But they also have the potential to amplify cybercrime, automated persuasion, and smart microphones that can listen in to private conversations for the financial gain of the host companies [8]. All of this takes place in a market dominated by just a handful of international corporations that currently present a dominant narrative around consumerism and entertainment.

We believe that there is a role for designers and researchers in highlighting and challenging these issues, and in advocating for change. Writing about artificial intelligence, Crawford and Calo [9] recently called for the value of design to be placed at the forefront of ethical research. While urging technology developers to engage with the methods of design, they also caution that designers need to consider their roles in imagining negative future scenarios, concepts and products. Our work explores the role for design research in

advocating for better technology and having real world impact. In this instance, we focus on the voice enabled internet as a current battleground in the fight for online privacy and trust, but the potential role for designers extends into the wider internet and into technology and society generally.

In this paper, we describe an example of combining product design and film-making to explore and illuminate issues around the voice enabled internet. As part of a wider international advocacy campaign run by the Mozilla Foundation, *Our Friends Electric* explores possible future scenarios for using our voice to interact with the internet. The film translates the abstract values of Mozilla’s Internet Health campaign [37] into a format that is accessible to both the general public and domain experts, supporting reflection on the issues and highlighting possible alternative directions for design in this space. We will conclude with reflections on the role of design in the advocacy landscape and specifically how HCI researchers and designers can turn their particular skills towards illuminating the complex issues around emerging technologies. Finally, we highlight a need and opportunity to target this type of activity more explicitly towards the policy and regulation that will shape the future technology landscape.

## 2 BACKGROUND AND CONTEXT

### The Voice Enabled Internet

According to *The Economist*, 4% of US households had an active Amazon Echo, Apple’s Siri interprets 2 billion voice commands a week and 20% of US Android searches are conducted by voice [15]. In India, millions of smartphone users navigate the Internet with their voice, while China’s Baidu, which has 660 million monthly active users, regularly releases powerful voice features through its artificial intelligence service Duer. The smart speaker market alone is estimated at unit sales of 100 million globally by 2020. Amazon is notably pushing the market with their “far-field voice experiences” designed for commercial device manufacturers to readily use Alexa Voice Services. As we write this, Amazon has announced a range of voice-powered hardware including microwaves and clocks [29]. This landscape demonstrates how the desktop and mobile internet are cross-fading into the Internet of Things. Physical, connected devices are increasingly providing smart speakers and microphones that are always on and recording constantly.

There have been a number of notable areas of development where voice technologies embedded in our lives have started to raise questions around our notions of etiquette, consent and cultural norms in relation to our relationships with machines. News stories in recent years have included Alexa’s “creepy” laugh [27], Burger King’s TV broadcast to Google Home [25], the HSBC voice break-in by a twin

brother [26], and the backlash against Google Duplex fooling call recipients with its near perfect imitation of a human [28]. Pervasive voice recording systems make for attractive targets to governments and criminals alike, and researchers have already identified vulnerabilities, such as the ability to encode hidden messages into music that can be played to activate voice assistants and access data [7].

However, despite these potential privacy and security breaches in home voice assistants, consumers remain largely unconcerned [19]. Technological countermeasures to mitigate these potential security threats are in the most part reacting to threats as they become known and are not yet taking proactive or predictive measures [20]. Regulatory frameworks such as the EU's General Data Protection Regulation (GDPR) call for "privacy by design and by default" but to date little has been done by way of putting design actively into this framework [46].

### Design and Advocacy in HCI

To some extent, it can be said that most HCI research contains an element of advocacy as it strives for better and more human-centred technology. More recently, a "civic turn" [31] in HCI has seen a strand of work emerge that more explicitly engages with the use of technology for activism, including adversarial design [12], which engages with political issues and embraces conflict. Jenkins et al. [30] refer to design and the action of designing as a way to bring computational artefacts into a discourse with human actors. They propose that digital devices can actively advocate for change in the world and that devices can be volunteers or activists in this world view. While addressing advocacy, their work takes an approach of understanding how HCI can support other people's advocacy campaigns (e.g. housing justice), rather than in using design to advocate for specific HCI issues

Most recently, the rapid emergence and impact of internet-related technologies—including the Internet of Things, the voice enabled internet, and artificial intelligence—has led some researchers to take a more explicit stance on the effect of these technologies and the possibilities for design-led interventions. Pierce and DiSalvo [43] approach what they call "network anxieties" by using design to highlight and give identity to features of anxiety as a way of turning design back on itself in order to tackle the problems that it creates. They note that "design's unique position to inventively address network anxieties stem from its ability to give vivid and graspable form to imaginative and compelling, if troubling, future possibilities" [43]. While addressing similar topics, our work differs by exploring a role for design within the context of an international advocacy campaign around Internet Health.

### Internet Health

The issues around voice are indicative of challenges facing the internet as a whole. High profile events in 2018 have dramatically highlighted significant concerns about the negative effects of the internet on people's lives. This includes the manipulation of elections and political discourse, growing tensions between free speech and harassment, alongside increasing concerns about how to secure the Internet of Things. Responding to these challenges, the Mozilla Foundation has developed the concept of Internet Health, surveyed annually through their Internet Health Report [37], in relation to five features:

- Privacy and security: is the internet safe and can we trust systems to protect us?
- Openness: how open is the internet and can everybody participate and innovate?
- Digital inclusion: is the internet equally safe and meaningful for everybody?
- Digital literacy: who can read, write, participate and ultimately succeed on the internet?
- Decentralisation: who controls the internet?

This is just one of a wide range of manifestos that aim to guide designers and developers towards creating technology in a more ethical and responsible way [18], but for our research, Internet Health provided a key set of values that point the way towards a healthier voice enabled internet. However, these values sit at a high level of abstraction: therefore, a key element of our work is to explore how we can translate these values into actionable research and advocacy.

### 3 OUR APPROACH

The objective of our research was to create a design research film at the interface between research on, and advocating for, a healthier approach to the design of physical products that use our voices to interact with the internet. The first stage of this research was hosting a four-day workshop at the Rockefeller Foundation's Bellagio Centre in Italy, where we invited experts to translate abstract values of Internet Health into actionable research directions. Of several possible design responses discussed at the summit, we moved forward with the idea of a design research film that would help to communicate these values to a wide audience. Throughout the paper, we will refer to this event as the Bellagio summit.

The second step was to co-develop the film and a series of research objects that demonstrated possible future directions of voice assistants in the home. Working in collaboration with the design agency Superflux, whose co-founder attended the Bellagio Summit, we aimed to embed the actionable directions from the summit alongside wider research into a narrative that appealed to a wide public and research audience.

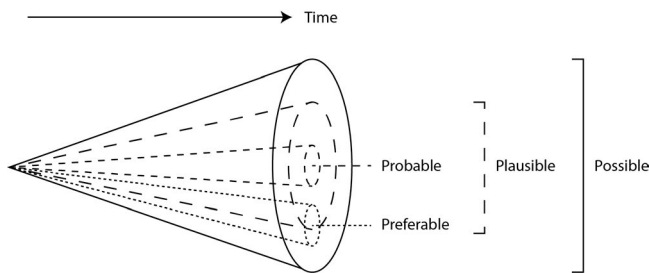


Figure 2: Voros’s Future Cones, adapted from Amara [1].

Our intention behind creating the film is illustrated by Voros’s Futures Cone [50] (Figure 2), which frames different futures as combinations of possible, plausible, probable or preferable. In his model, possible describes all futures imaginable, while a subset of these futures focusing on those most viable is described as plausible. A narrow subset, seen as most likely, is described as probable, while our favoured futures—which might extend beyond the realm of plausibility—are described as preferable. At a time when commercial offerings of home voice assistants powered by AI are becoming commonplace, we wanted to show plausible futures that provide some kind of preferable options but also expose practical realities of a cautionary nature. In other words, we aimed to strike a balance between design research and advocacy.

Rather than sensationalising or fetishising technology in a utopian or dystopian sense, the film focuses on voice assistants in a mundane domestic context. This places our work amongst a wide range of design research taking place in this context, which aims to explore the day-to-day realities of living with new or emerging technologies [23, 51]. More broadly, our approach of using product design to depict fictional futures aligns with a range of design-led research including speculative design [14], experience prototypes [6], research products [40], provotypes [5] and design fiction [35]. There is also a growing body of research that highlights the usefulness of video for speculating on human and non-human relationships from differing perspectives, for example by showing ways of giving a machine’s view on the world [41] or exploring new forms of power dynamic between humans and machines [32].

Finally, in order to understand the impact of the film and evaluate its effectiveness, we conducted a series of surveys and interviews one year after the release of the film. This included talking to many attendees of the Bellagio Summit, as well as other experts from a wide range of disciplines including Internet Health, design, policy and law.

#### 4 OUTCOMES OF THE BELLAGIO SUMMIT

In order to translate Internet Health from a general set of values into an actionable framework, we convened a four-day

summit for experts to discuss the development of a healthy approach to the voice enabled internet. The experts were from fields that included speech recognition technology, machine learning, design, open hardware, law, art and internet activism. The purpose of the summit was to unpack Internet Health in the context of the voice enabled internet and to then co-develop a series of potential avenues of exploration and wider questions that the voice enabled internet posed. Below, we describe the key outcomes from this workshop. This is not meant as a summary of the event, but rather as a way of framing key research themes that arose. Later, we will describe how these themes were translated into a design film that embodied these concepts.

We frame these themes in the following positioning statements:

**The consent model is dead.** The current way in which we use our voices to interact with machines assumes consent. Voices are not individually locked, so any voice within listening range of a device shares the same consent model as the owner. There is no current model that enables individual consent preferences and no way to authenticate different users with different levels of access. This raises privacy and security concerns and poses the question of finding new ways of building consent into voice interactions.

**Visibility is at the crux of trust.** Voice interactions happen outside a direct physical contact point, such as a keyboard or mouse, and out of line of sight as afforded by screens. The idea of a disappearing computer has a long history in HCI and ubiquitous computing, but it has long been recognised that it risks amplifying existing challenges and introducing new ones [47]. In the context of the voice enabled internet, devices are typically black boxes, and it can be unclear when devices are recording, transmitting and receiving data. Beyond the terms and conditions, there is no way for the general user to know what is going on behind the scenes. Therefore, we need new ways to meaningfully demonstrate that an object can be trusted that are readable by everyone.

**Behind every object is an ideology.** All objects embody the ideology of their designers. This is as true for the design of a domestic environment as it is for technology. Voice assistants typically present only a small subset of internet functionality that is biased towards the services of the technology provider: for example, Amazon, Google and Apple’s smart speakers can access their own music services and stores, but not each other’s. The openness and neutrality of the internet does not exist when accessed through these devices. Here we wanted to explore directions of research that started to advocate for better consumer awareness of the ideologies behind consumer smart speakers.

**Our bodies are our sensors.** In an essay reflecting on the work of the US non-profit Public Labs, Dosemagen and Rogers [13] discuss the notion of our bodies being powerful

ways in which effects of our environment are detected. They describe work with people living near industrial oil refining facilities, where residents relied on their senses to navigate the uneven power dynamics of their local area. They knew the smell of sweet almond and rotten eggs, which pointed to benzene and hydrogen sulphide in the air. As machines become more attuned to our bodies, particularly to our voices, what new opportunities and challenges might arise?

## 5 DEVELOPING OUR FRIENDS ELECTRIC

Having developed a set of core values to communicate, the script was developed as a collaborative process between researchers and Superflux. The creative direction and overall plot were led by Superflux, while narrative elements relating to the key points from the Bellagio Summit and Internet Health were led by the research team. The co-development of the script intertwined with the concepts and the development of three research objects that acted as props to imagine possible future voice assistants. In contrast to the normal association between writing a script and then building props to support the narrative, both were developed simultaneously and each drew heavily from the others' almost daily developments. This form of co-production fostered a flat hierarchy between the designer of the plot and the designer of the things.

### Script Development

Given the prominence of voice, language was a common point of discussion. We aimed to move away from the "command and control" tone used by current voice assistants, which adopt a common format of a wake word followed by a command (e.g. "Alexa, buy me a doll house"). Of particular interest was the development of more human ways of talking, including adding "saltiness" to the tone of the voice assistants. One source of inspiration was #UNRAVEL [17], an interactive sound piece that changed its language after 9pm to include swear words and content of an adult nature. We also wanted to ensure humour and playfulness, to help viewers engage with the film and avoid interactions that patronised users. A notable influence was to avoid the "humblebrag" tone of Facebook's Jarvis concept video [24].

We wanted the devices to reflect the reality of where AI could potentially go by drawing a line under the ability of machines to become artificially conscious, as depicted in the majority of sci-fi scenarios. Daniel Dennet stresses the limitations of strong AI or artificial consciousness [10, 11], arguing that this is so far in the future that it is not one of the pressing concerns for AI. Instead, we aimed to show that we should not be fooled by the increasingly illusory nature of these devices' 'intelligence'.

It was important from an Internet Health perspective to include what decentralised learning might look like from a

user's perspective. If learning was not to be in a centralised AI then it needed to be on a localised machine. With this in mind we wanted to draw analogies between early human language acquisition processes of asking a lot of questions and what it might be like for a machine to acquire new language and meaning in this way. Building on the growing need more trusted privacy and security and anticipating the arrival of new data protection legislation (the GDPR was under a year away at the time of development), we wanted to ensure that the film reflected this.

We also wanted to extend models of both trust and digital literacy that included users being able to take control of their devices in ways that extended beyond the limited degree to which current commercial products offer. This would include visible, physical control to give people both the ability to reprogram their devices and visibility over what that programming was.

The film would be shot in a domestic setting, as we wanted to represent life in a home. Our intention was to represent as broad a user base as possible, taking homes that represented different people at different stages of their lives, going beyond the types of middle-class nuclear family normally seen in similar representations, such as Amazon's Echo commercials. This might mean, for example, showing more than one language being spoken, or challenging gender stereotypes. Based on these goals, three concepts were developed, each of which would become a segment of the film, reflecting one or more of the aims set out above:

- Eddi, a decentralised voice assistant that would learn as it spent more time with the user.
- Karma, a voice assistant capable of using your personal data to make phone calls on your behalf.
- Sig, a companion with a programmable personality that can be altered by the owner.

### Product Development

Simultaneously, a series of three research objects were developed to act as props in the film. The research objects were designed to meet the minimum functionality requirements to enable the viewers of the film to suspend disbelief on the reality of the devices. We discussed embedding actual voice control functionality, but decided that this would limit the script to existing technology. A decision was made early on in the process that the research objects would reference commercial appliances and draw from people's associations with smart speakers and hi-fi systems, but we were also careful that the devices were not identifiable as being based on any specific existing product or service.

In essence, the intention was for the AI-ness of the voice in the film to come across more than the devices themselves. Simple elements of colour, light and movement were used to

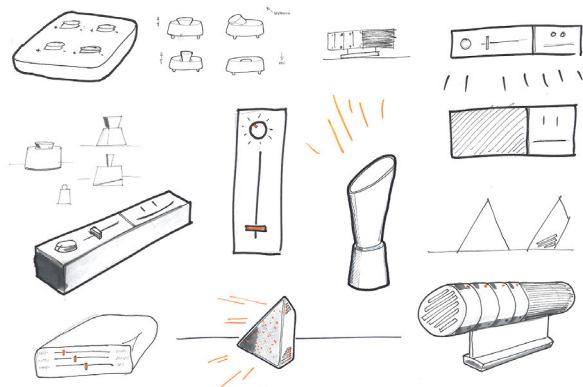


Figure 3: Initial sketch options for the three episodes.

provide suggestions of interactions but were not intended to convey a full product behaviour, but rather to bring the viewer along with the narrative of a consumer product from a general sense. We reference both the cylindrical form of Amazon Echo and Google Home, alongside traditional icons of hi-fi systems. An example of this type of iconographic design in HCI is Prayer Companion [22], where we see a shared design value in abstracting symbols and reference points from existing familiar artefacts that are already located in people’s consciousness.

A collaborative online mood board was created to allow the object designers, film-makers and wider project team to co-create a shared visual language for the props. This visual process allowed for debate around the qualities that we wanted the objects to embody. For each design, two sketched form options were shared with the wider team, a collective decision was made for each one and a making process followed.

Concept development was rapid and the making process allowed opportunities to explore useful interactions and affordances—e.g. illumination and movement—for each film segment. The props had to be designed, made and sent to the film-makers in a three-week time period so decisions were made fast. Once the initial prototypes were in development, a work in progress description of the behaviours was shared to allow the film-makers to develop a detailed plan for the three shoot locations.

## 6 THE FILM

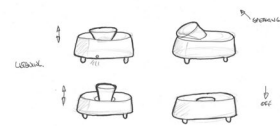
In this section we describe the finished film, highlighting specific features we would like to draw out of each segment. It was in these details where specific advocacy and research elements were situated for the viewers’ attention. Sometimes

### Movement / playful

This concept explores the nodding behaviours from the agent prototype. Less silly. Less clumsy. Subtle movement to show when talking and when listening.

Status LED. Small white LED on bottom edge of prototype to blink in time with beep beep sound effects - sound can be added in film.

Movement will be coded to button push to allow easy filming - e.g. three modes - listening, speaking and set up LED flicker.



Thoughts  
- floating dog / organic slow movement. Central part moving Sam up and down - subtle.  
- fairly complex mechanical movement for time to make.

EPISODE 01 - OPTION A

BUDDY

Figure 4: Example of product sketching as part of a dialogue with the script writers.

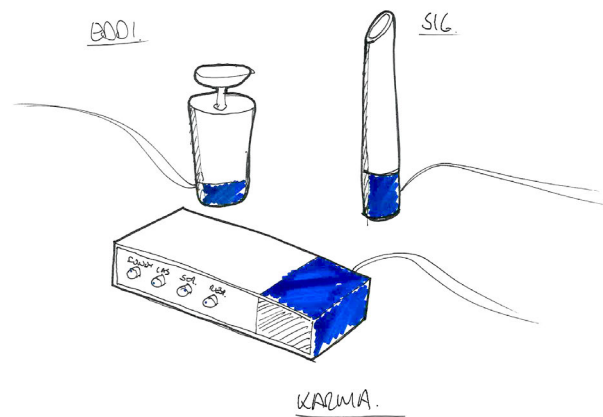


Figure 5: An illustration communicating the shape and form of each object to the film-makers.

this was deliberately subtle and in others we were more forthright in the positioning of the message.

**Note:** We recommend watching *Our Friends Electric* [49] before reading further.

### Eddi – Growing With You

Eddi (Figure 6) is a decentralised voice assistant that learns with you. Whereas existing voice assistants use a centralised intelligence that is trained by many users, Eddi builds its knowledge from scratch. It does this by asking questions—a lot of questions, in a way similar to a young child. The physical behaviours of the object demonstrate when Eddi is listening by lifting the central column (Figure 7). Spinning LEDs are integrated to show when the object is thinking or speaking.

At first, Eddi’s incessant questions are infuriating to the user. But as the episode progresses Eddi becomes more tuned to the user’s needs—having previously asked why he wants



Figure 6: Eddi moving into “listening” mode by raising its central column.



Figure 7: Screenshot from the Eddi segment.

to know the weather, it is later able to predict when he will want to take an umbrella with him. Eventually, Eddi is able to detect that the user is going to the bathroom a lot in the night and that this might signify an underlying medical problem, automatically creating a doctor’s appointment and adjusting his calendar.

This concept relates most strongly to the Internet Health value of decentralisation and asks what the human experience of a learning AI would be. It raises questions about the changing nature of the experience as Eddi learns and the transparency and visibility of this process, and to the privacy concerns around a device that detects your patterns of behaviour. It also speaks to the idea of a body as a sensor and the increasingly intimate relationship we have with devices. When making inferences about the weather, it is clearly useful, but does making inferences about an intimate health condition cross a line or not?

### Karma – Your Voice as You Want It

The second segment features Karma (Figure 8), a voice assistant with a tuneable personality, which is capable of adopting a user’s identity and making phone calls on their behalf. The



Figure 8: Karma features controls to adjust the voice and personality.



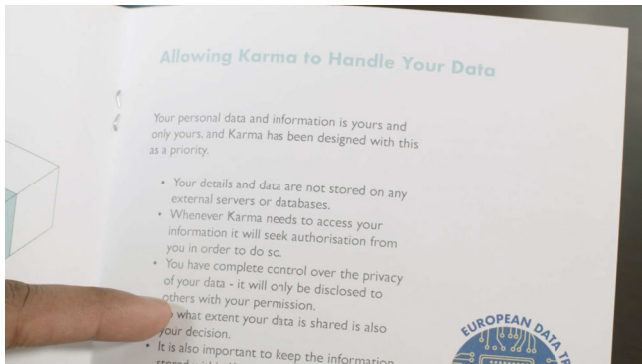
Figure 9: Karma in a kitchen shared by several housemates.

device itself resembles a piece of hi-fi equipment, including six dials for a user to control facets of the machine’s personality: humour, politeness, mood, personality and confidence. During the film, Karma is set to work ringing the users’ energy company to demand a refund. As the call progresses, Karma’s politeness and confidence are tweaked and the call becomes increasingly hostile. Although not made explicit, the voice on the other end of the line sounds similar to Karma, suggesting that the energy company is also making use of a voice assistant.

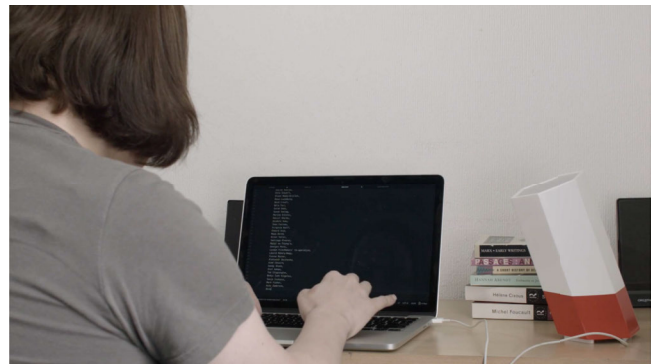
The film also features a scene where the residents of the house discuss a manual that came with Karma, which includes an EU data protection mark (Figure 10). This was intended to be evocative of the EU’s GDPR, which would pass into law six months after the film was released. We also wanted to show a development in the conversational interaction with Karma over Eddi where there is a shift from command and control (e.g. “Eddi what’s the weather today”) into something more conversational (e.g. “Tell us a joke Karma”).

This segment relates to issues around privacy, trust and consent. Karma has the ability to adopt the user’s identity, but only she is able to authorise this using a personal passphrase.





**Figure 10: Karma is governed by fiction European data protection regulation similar to the GDPR.**



**Figure 12: The user programming Sig's personality.**



**Figure 11: Sig's personality can be programmed by the user.**

The physical controls also make Karma's setting transparent to anybody in the room.

### **Sig – Your Programmable Companion**

In the final segment, we start to explore the limits of a fully conversational companion. Sig (Figure 11) appears and acts similarly to current smart speakers with no obvious new interactions. But in the opening of the segment, the user is seen connecting to the back-end of the device, customising its code to alter its personality (Figure 12). The voice of Sig borrows from British sci-fi comedy, particularly Marvin, the depressed robot from *The Hitchhikers Guide to the Galaxy*, and Holly, the downtrodden AI from *Red Dwarf*. It engages in an extensive and convincing debate with the user around issues of workers' rights and the nature of labour. The emphasis here is that she has programmed the voice assistant to behave as a depressed philosopher with anti-capitalist viewpoints.

However, in the final scene, the user's complaints are misunderstood and Sig accidentally orders "one tonne of horse shit". The artificial consciousness of the assistant is revealed as being illusory as the AI reaches the limits of its

capabilities and returns to what it was designed to do—sell things.

On the one hand, this segment celebrates the Internet Health values of openness and digital literacy, as the character is able to modify the device's code to customise its personality. On the other hand, it cautions the viewer to be aware of the true nature of the machine and to question who is ultimately in control. With this segment, we start to reinforce the Bellagio Summit conclusion that every object has an ideology, and Dennet [10]'s warnings that strong AI is an illusion.

## **7 REACTION**

Our Friends Electric was released at London Design Festival in September 2017 through an invited event and a series of online publications. At the time of writing, it has received 7,200 views across Vimeo and YouTube. One year from the release of the film we asked for reaction from experts through a total of twelve interviews with experts who described their expertise as: advocacy film-maker, Internet Health, machine learning, speech technology, craft, design, medicine and philosophy. The expert group was drawn from those that attended the Bellagio Summit and the wider community working on speech technologies and advocating for a healthier internet.

### **Changing Perspectives**

As a film designed with advocacy in mind, a key objective was to change the way that people think about the future of the voice assistants and the voice enabled internet. When asked specifically about whether the film had changed their perspective, notable reactions included:

*"I really like how the examples include networks of machines and multiple people. I've been thinking too much about one person one machine."*

– Human-centred design researcher

*“It makes me think about the dangers (and power) of perceiving technology as human, which means something that feels and cares. What are the ramifications of this perception on trust?”*

– Digital humanities researcher

*“Irritating, intrusive, thought-provoking, amusing and stern—these aren’t words we usually associate with computer interfaces, but the film makes it clear that in future all these will be relevant.”*

– Digital craft researcher

The first comment points to design providing new ways of seeing a familiar problem, in this case switching perspective from a one-to-one relationship with machines to a many-to-many. The second comment shows a reconsidering of our trust with machines. The third evidences design’s capacity to add new language to describe an existing concept.

These reactions suggest that design research films of this nature have a potential to contribute to a form of advocacy aimed at professionals. In conversations with legal practitioners we found that it provided radical new ways to think about the implementation of legislation such as the GDPR. Importantly it helped to frame the practicalities of legislation in the context of the domestic setting. The reactions particularly point to the way in which design can be used to communicate complicated abstract notions into realisable form that had changed the perspective from a professional practice viewpoint.

### Comparison to Other Approaches

Some responses explicitly contrasted the film-making approach with other approaches more commonly utilised by HCI research:

*“The fictional nature of the film format provided the freedom to explore a specific set of predetermined issues. An alternative approach would be to have ‘prototypes’ in real homes and produce a film that was based on the way in which a voice assistant with a particular set of new functions is used/abused and finds its own role/value for particular people.”*

– Digital craft researcher

The response above points to now well-established design-led HCI approaches, where functional prototypes are situated in people’s homes. We considered this approach but due to the desire to embed advocacy into the work, we wanted to tell stories crafted around specific values that would reach a wider audience than a research documentary and prototype might. That is not to say there is not an opportunity to explore this in the future. It would be interesting to use film in this way in two stages—first to reach a wider audience, and perhaps recruit from a wider selection of participants,

and then to go into more detailed user experience research through deployment of working prototypes and a more documentary film approach.

### Audiences

When asked about the film’s potential audience, only one of the respondents thought that its audience was clear, while the majority were unsure. A response from a documentary film-maker involved in advocacy was that a *“punchier version might be better for a general audience”*. They further elaborated that *“the film had a bit of a pace that was too slow for broad sharing for mass engagement. It was good for other practitioners or makers, but don’t think it would have succeeded as a mass engagement piece simply because it’s a piece of ‘slow media’”*. At over six minutes long, *Our Friends Electric* was not easily digestible, pointing to the need for to create shorter films to reach a wider audience.

Based on this feedback, there was a sense that the film was more suitable for a design audience rather than the general public: *“even though it is appealing to an audience in the larger field of design, I have doubt, if the general public, can view as ‘not a design piece’”*. This is reflected in the reception of the film online: by comparison, *Uninvited Guests* [48], a similar video released in 2015 about activity tracking products, currently has 76,400 views on Vimeo after being widely shared. It is clear that we only reached a fraction of the potential public audience. There were a number of suggestions that we should consider breaking the segments up into three separate films, which might have allowed one or more of the films to reach a wider audience. For example, Karma received the most positive reaction and was also the most humorous segment—and as we will explore later, also proved to be the most prescient.

### Aesthetic, Form and Interaction

Some of the feedback indicated that the design of the objects themselves had distracted from the overall message of the film, pointing to tensions between advocacy and design research:

*“The forms all followed a particular and well-established device/instrument aesthetic. This may well have been appropriate for this set of scenarios, but it would be interesting to see broader visual languages used in the future that challenged assumptions of techno-aesthetics.”*

– Digital craft researcher

Whereas our intention was to make the objects move into the background, a designer would likely expect to see a deeper exploration of form and materials. It is clear from this feedback that our intention was not achieved and instead seemed to act in some way to reinforce design styles already

in play in the marketplace. It raises an unanswered question in this project around balancing the clear simple messages that advocacy audiences require against the expectation of design and craft research to push and pull at cultural visual language norms.

However, in other cases feedback on the objects themselves revealed interesting insights into the design of voice interaction:

*“In the first case where the assistant tried to ask why in order to learn, perhaps the ‘mature’ sounding voice asking such a question might annoy a person. The voice of a mature man asking such simple obvious questions could lead to a skewed experience—maybe it could be childlike earlier and more mature once it learns.”*

– Interaction designer working with voice

Computer games such as Pokémon use age metaphors to show the complexity of ability of characters in a game—where we see the characters evolve into more complex forms as the game progresses. This relationship between ability and form is something that voice interaction design could learn from.

### Design Futures

Making claims about the development of future technology is not a rational science. There is an interesting relationship between fictional narratives that exist purely to entertain on a fantastical level and design research that attempts to show more deterministic plausible futures. For example, the TV show *Black Mirror* has been credited with predicting the social trends of the internet: the episode “Nosedive” closely mirrors China’s widely condemned Social Credit System [34].

Although *Our Friends Electric* was positioned to be a research and advocacy film depicting ‘near futures’ of plausible technology, we did not expect any of the functionality we depicted to become reality as quickly as it did. Only eight months after the film premiered, Google demonstrated Duplex [33], a voice assistant capable of making phone calls to place appointments, similar to the functionality seen in Karma. The reaction from experts reflected this:

*“Interesting to see how you ‘predicted’ Google’s Duplex far ahead of time”*

– Digital humanities researcher

*“Too similar to Superflux’s *Our Friends Electric*.”*

– Digital media curator

There was a strong public backlash to Google Duplex’s failure to identify itself as an AI [28], raising questions about consent models and our relationship with voice. The similarities to Karma did not go unnoticed, and the video was re-shared numerous times in the days following Google’s

announcement. This demonstrates firstly that the pace of technological development will confound attempts to envision it, and secondly that the type of design-led advocacy that we have presented here has a clear role to play in creating discussions.

## 8 DISCUSSION

*Our Friends Electric* provided a way to tangibly realise abstract values of a better digital world by exploring a series of plausible and preferable futures for the voice enabled internet. We now discuss our wider learning from the process of making and reflecting on this film and on how we can design and advocate for a healthier internet.

### The Role of Design in Advocacy

The role and responsibility of the designer is at the forefront of recent discourse in the design domain. Roberts [45] asserts that “every choice a designer makes has consequences for someone else”, concluding that their work emerges from a “belief in the ability of graphic design to increase public engagement with and participation in politics”. But advocacy for an ethical and socially responsible approach to design is not a recent phenomenon. Papanek [42] concluded that designers must “refuse to participate in work that is biologically or socially destructive”—a sentiment echoed by Garland [21] in 1964. Likewise, the web was founded and enshrined in principals that promote equality and inclusion: “by design, the Web is universal, royalty-free, open and decentralised” [2].

Whilst these principles are broadly understood and recognised within design communities, they rarely filter into the design of the enormously popular digital products we use every day. This is likely due to the conflicts arising from the diametrically opposed need to mass produce and sell goods versus the desire to contest, question and challenge the processes and impact of mass consumption in a time where consumers are forgoing their personal privacy and security in the face of financial gains [36]. Whilst there are a growing number of ethical brands and social enterprises, few product designers have taken a stand in the way that Papanek did and that influence is largely constrained to the fringes of ethical product design. The mainstream appears unaware or unconcerned by the stark warnings that Papanek made.

However, there is a tension between doing research and advocating for a better world. Research sometimes necessitates more complex and messier communication, can include uncertainty and have unanswered questions, while advocacy in general needs to be clean, have a clear unquestionable message and be highly tuned to the attentiveness of a public audience. *Our Friends Electric* attempted to play to both these worlds. To some extent, it was successful in doing so: the

reactions from the experts were widely supportive of its tone and content with positive feedback on how it could be improved. However, there is a need for further development of both the approach we describe here and new approaches in order to fully explore how design research can be leveraged for advocacy.

### Product Design and the Reappearing Computer

With much of our online computation taking place in remote, unknown locations through black box devices on and in our bodies, in our homes, in our cars, and increasingly in public spaces throughout our cities, we propose that there is a need to explore ways in which the physical design of a system or a product can bring more aspects of this disappearing computer into public consciousness. While the disappearing computer has long been a goal of ubiquitous computing research, it is becoming increasingly clear that such invisible machines raise increasingly problematic issues relating to trust and transparency. For example, the hijacking of Internet of Things products to form a botnet illustrates what happens when invisible computation takes place on our everyday devices, changing their purpose from one type of computation into another [3].

As we give our computers more agency in our lives we must also have greater knowledge of what is happening behind the scenes. *Our Friends Electric* attempted to make more transparent what was happening inside the devices: Eddi's behaviour exposed the way that it learned, while Karma's physical controls provided a visible representation of its state. Moreover, the film itself as a piece of design work makes visible aspects of products that are normally made invisible—for example, when Sig's mistaken internet purchase makes transparent the device's limitations and its consumerist ideology. These provide examples of how designers can make the workings of emerging technologies clear, both as designers of products and as researchers and activists advocating for better technology.

Odom and Duel's [39] work with metadata points towards new ways of interacting with large volumes of data through physical interfaces to create more meaningful relationships. To us, this resonates with our goals of making the invisible data and processing of much of the internet more visible through physical interactions. In a similar way, we might foster a more nurtured relationship between people and the internet. Stretiz and Nixon [47] took a positivist view of a disappearing computer that works towards "a people-centred information and knowledge society", but it seems now that the opposite is required. The only way to have this kind of society is to make the hidden interactions of the computer more visible. The task for product design is to lead the revolution towards the reappearing computer.

### Bridging HCI, Policy, Law and Regulation

We believe that the next frontier for design research should be to embrace and influence the regulations that will increasingly govern our interactions with technology. Article 25 of the GDPR calls for "data protection by design and by default" [44], but the full meaning of this remains unclear. One interpretation of this requirement—one we find preferable—includes not only technological solutions, but also broader solutions that refers to all aspects of design. This evidences that regulators, at least in the EU, have seen the opportunity for designers, have built it into the legal framework for legislation and have provided the HCI design community an open door for new forms of implementation. When designers present a range of options they are providing routes and narratives for policymakers to select.

In *Our Friends Electric*, we began to explore what legislation might mean for voice assistants: Karma's users were reassured by an EU trust mark, reflecting real efforts to create a trusted IoT label [4]. While these regulations may be criticised for being inscrutable by those outside the legislative bubble, design futures grounded in current domestic contexts provide working examples of what legislation might look like in the real world. If we can provide workable examples of futures that do not simply play into utopian or dystopian hopes and fears, but are instead more practical and actionable, then we have a better chance of the research we do making a greater impact.

We end on a call for new forms of collaborative design practice that include legislators and policymakers so that there is a stronger link between the futures we might want to propose and the futures that become reality. An inspiration for us is Creative Commons, which had a founding value of guaranteeing readability by humans, machines and lawyers. *Our Friends Electric* demonstrates one way of communicating across these diverse audiences, but exploring further methods of achieving this and creating leaders capable of working across these fields is a continuing challenge for designers and HCI researchers. While we currently work at the intersection between humans and machines, we need as a community to strengthen the relationships between humans, machines and legislation. We can imagine policies and regulations, but without real world experience, we will not uncover the flaws, opportunities, risks and sustainability around what the future of the internet could become.

## 9 CONCLUSIONS

We conclude this paper with three propositions for HCI. Our propositions are framed from a viewpoint that looks out from our work in the voice enabled internet across the landscape of the development of the internet in a more general sense—an internet that we strongly argue needs to find ways to

develop in a healthier direction. Firstly, we call for the HCI community to explore ways in which it can both research and reflect on the future of technology development that also advocates for a better world. Secondly, that product design's capacity to make the invisible more tangibly visible provides an opportunity to help expose the workings of emerging technologies and create space for discussion of healthier practices. Finally, in order for HCI to amplify its change-making capacity we would like to draw attention to the opportunity for the HCI community to build stronger bridges to the policy, law and regulatory communities.

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## REFERENCES

- [1] Roy Amara. 1974. The futures field: Functions, forms, and critical issues. *Futures* 6, 4 (Aug. 1974), 289–301. [https://doi.org/10.1016/0016-3287\(74\)90072-X](https://doi.org/10.1016/0016-3287(74)90072-X)
- [2] Tim Berners-Lee. 2014. Welcome to the web's 25th anniversary. Retrieved September 21, 2018 from <https://www.w3.org/webat25/news/tbl-web25-welcome>
- [3] Elisa Bertino and Nayeem Islam. 2017. Botnets and Internet of Things security. *IEEE Computer* 50, 2 (Feb. 2017), 76–79. <https://doi.org/10.1109/MC.2017.62>
- [4] Peter Bihl. 2017. A trustmark for IoT. Retrieved September 21, 2018 from <https://www.thingscon.com/report-a-trustmark-for-iot>
- [5] Laurens Boer and Jared Donovan. 2012. Prototypes for participatory innovation. In *Proceedings of the Designing Interactive Systems Conference (DIS '12)*. ACM, New York, NY, USA, 388–397. <https://doi.org/10.1145/2317956.2318014>
- [6] Marion Buchenau and Jane Fulton Suri. 2000. Experience prototyping. In *Proceedings of the 3rd Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques (DIS '00)*. ACM, New York, NY, USA, 424–433. <https://doi.org/10.1145/347642.347802>
- [7] Nicholas Carlini and David Wagner. 2018. Audio adversarial examples: Targeted attacks on speech-to-text. In *2018 IEEE Security and Privacy Workshops (SPW)*. IEEE, Los Alamitos, CA, USA, 1–7. <https://doi.org/10.1109/SPW.2018.00009>
- [8] Benjamin R. Cowan, Nadia Pantidi, David Coyle, Kellie Morrissey, Peter Clarke, Sara Al-Shehri, David Earley, and Natasha Bandeira. 2017. "What can I help you with?": Infrequent users' experiences of intelligent personal assistants. In *Proceedings of the 19th International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI '17)*. ACM, New York, NY, USA, Article 43, 12 pages. <https://doi.org/10.1145/3098279.3098539>
- [9] Kate Crawford and Ryan Calo. 2016. There is a blind spot in AI research. *Nature* 538, 7625 (Oct. 2016), 311–313. <https://doi.org/10.1038/538311a>
- [10] Daniel Dennet. 1996. *Kinds of Minds: Toward an Understanding of Consciousness*. Basic Books, New York, NY, USA.
- [11] Daniel Dennet. 2017. *From Bacteria to Bach and Back: The Evolution of Minds*. W. W. Norton & Co, New York, NY, USA.
- [12] Carl DiSalvo. 2012. *Adversarial Design*. MIT Press, Cambridge, MA, USA.
- [13] Shannon Dosemagen and Jon Rogers. 2017. Body as a sensor. In *Future of Human Ecologies*. Quicksand, Bangalore, India, 46–56. <https://issuu.com/helloqs/docs/unbox%5Ffutureofhumanecologies>
- [14] Anthony Dunne and Fiona Raby. 2013. *Speculative Everything: Design, Fiction and Social Dreaming*. MIT Press, Cambridge, MA, USA.
- [15] The Economist. 2017. How voice technology is transforming computing. Retrieved September 21, 2018 from <https://www.economist.com/leaders/2017/01/07/how-voice-technology-is-transforming-computing>
- [16] Asbjørn Følstad and Petter Bae Brandtzæg. 2017. Chatbots and the new world of HCI. *Interactions* 24, 4 (June 2017), 38–42. <https://doi.org/10.1145/3085558>
- [17] FOUND. 2012. #UNRAVEL. Retrieved September 21, 2018 from <http://www.unravelproject.com>
- [18] Ester Fritsch, Irina Shklovski, and Rachel Douglas-Jones. 2018. Calling for a revolution: An analysis of IoT manifestos. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, Article 302, 13 pages. <https://doi.org/10.1145/3173574.3173876>
- [19] Nathaniel Fruchter and Ilaria Liccardi. 2018. Consumer attitudes towards privacy and security in home assistants. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems (CHI EA '18)*. ACM, New York, NY, USA, Article LBW050, 6 pages. <https://doi.org/10.1145/3170427.3188448>
- [20] Chuhan Gao, Varun Chandrasekaran, Kassem Fawaz, and Suman Banerjee. 2018. Traversing the quagmire that is privacy in your smart home. In *Proceedings of the 2018 Workshop on IoT Security and Privacy (IoT S&P '18)*. ACM, New York, NY, USA, 22–28. <https://doi.org/10.1145/3229565.3229573>
- [21] Ken Garland. 1964. *First Things First*. Goodwin Press, London, UK.
- [22] William Gaver, Mark Blythe, Andy Boucher, Nadine Jarvis, John Bowers, and Peter Wright. 2010. The Prayer Companion: Openness and specificity, materiality and spirituality. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10)*. ACM, New York, NY, USA, 2055–2064. <https://doi.org/10.1145/1753326.1753640>
- [23] William Gaver, John Bowers, Andy Boucher, Andy Law, Sarah Pennington, and Nicholas Villar. 2006. The History Tablecloth: Illuminating domestic activity. In *Proceedings of the 6th Conference on Designing Interactive Systems (DIS '06)*. ACM, New York, NY, USA, 199–208. <https://doi.org/10.1145/1142405.1142437>
- [24] The Guardian. 2016. Mark Zuckerberg out-robots his AI robot in saccharine holiday video. Retrieved September 21, 2018 from <https://gu.com/p/5gpqh>
- [25] The Guardian. 2017. Google Home devices stop responding to Burger King's TV ad prompt. Retrieved September 21, 2018 from <https://gu.com/p/69jt7>
- [26] The Guardian. 2017. HSBC voice recognition system breached by customer's twin. Retrieved September 21, 2018 from <https://gu.com/p/69jt7>
- [27] The Guardian. 2018. Amazon working to fix Alexa after users report random burst of 'creepy' laughter. Retrieved September 21, 2018 from <https://gu.com/p/887fk>

- [28] The Guardian. 2018. Google's 'deceitful' AI assistant to identify itself as a robot during calls. Retrieved September 21, 2018 from <https://gu.com/p/8tc6p>
- [29] The Independent. 2018. Amazon microwave: new Alexa-Powered cooker and wall clock revealed. Retrieved September 21, 2018 from <https://www.independent.co.uk/life-style/gadgets-and-tech/news/amazon-microwave-wall-clock-latest-alexa-products-echo-new-update-a8547726.html>
- [30] Tom Jenkins, Christopher A. Le Dantec, Carl DiSalvo, Thomas Lodato, and Mariam Asad. 2016. Object-oriented publics. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. ACM, New York, NY, USA, 827–839. <https://doi.org/10.1145/2858036.2858565>
- [31] Ian G. Johnson, John Vines, Nick Taylor, Edward Jenkins, and Justin Marshall. 2016. Reflections on deploying distributed consultation technologies with community organisations. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. ACM, New York, NY, USA, 2945–2957. <https://doi.org/10.1145/2858036.2858098>
- [32] Lenneke Kuijer and Elisa Giaccardi. 2018. Co-performance: Conceptualizing the role of artificial agency in the design of everyday life. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, Article 125, 13 pages. <https://doi.org/10.1145/3173574.3173699>
- [33] Yaniv Leviathan. 2018. Google Duplex: An AI system for accomplishing real-world tasks over the phone. Retrieved January 3, 2019 from <https://ai.googleblog.com/2018/05/duplex-ai-system-for-natural-conversation.html>
- [34] Fan Liang, Vishnupriya Das, Nadiya Kostyuk, and Muzammil M. Husain. 2018. Constructing a data-driven society: China's Social Credit System as a state surveillance infrastructure. *Policy & Internet* 10, 4 (Dec. 2018), 415–453. <https://doi.org/10.1002/poi3.183>
- [35] Joseph Lindley and Paul Coulton. 2015. Back to the future: 10 years of design fiction. In *Proceedings of the 2015 British HCI Conference (British HCI '15)*. ACM, New York, NY, USA, 210–211. <https://doi.org/10.1145/2783446.2783592>
- [36] Christoph Lutz, Christian Pieter Hoffmann, Eliane Bucher, and Christian Fieseler. 2018. The role of privacy concerns in the sharing economy. *Information, Communication & Society* 21, 10 (Oct. 2018), 1472–1492. <https://doi.org/10.1080/1369118X.2017.1339726>
- [37] Mozilla. 2018. The Internet Health Report. Retrieved September 21, 2018 from <https://internethealthreport.org>
- [38] Lisa-Maria Neudert. 2018. Future elections may be swayed by intelligent, weaponized chatbots. Retrieved September 21, 2018 from <https://www.technologyreview.com/s/611832/future-elections-may-be-swayed-by-intelligent-weaponized-chatbots>
- [39] William Odom and Tijs Duel. 2018. On the design of OLO Radio: Investigating metadata as a design material. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, Article 104, 9 pages. <https://doi.org/10.1145/3173574.3173678>
- [40] William Odom, Ron Wakkary, Youn-kyung Lim, Audrey Desjardins, Bart Hengeveld, and Richard Banks. 2016. From research prototype to research product. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. ACM, New York, NY, USA, 2549–2561. <https://doi.org/10.1145/2858036.2858447>
- [41] Doenja Oogjes and Ron Wakkary. 2017. Videos of things: Speculating on, anticipating and synthesizing technological mediations. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 4489–4500. <https://doi.org/10.1145/3025453.3025748>
- [42] Victor Papanek. 1984. *Design for the Real World: Human Ecology and Social Change* (2 ed.). Thames and Hudson, London, UK.
- [43] James Pierce and Carl DiSalvo. 2018. Addressing network anxieties with alternative design metaphors. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, Article 549, 13 pages. <https://doi.org/10.1145/3173574.3174123>
- [44] Genera Data Protection Regulations. 2018. Article 25. Data protection by design and by default. Retrieved January 3, 2019 from <https://gdpr-info.eu/art-25-gdpr/>
- [45] Lucienne Roberts (Ed.). 2018. *Hope to Nope: Graphics and Politics 2008–18*. The Design Museum, London, UK.
- [46] Luke Stark, Jen King, Xinru Page, Airi Lampinen, Jessica Vitak, Pamela Wisniewski, Tara Whalen, and Nathaniel Good. 2016. Bridging the gap between privacy by design and privacy in practice. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16)*. ACM, New York, NY, USA, 3415–3422. <https://doi.org/10.1145/2851581.2856503>
- [47] Norbert Streitz and Paddy Nixon. 2005. The disappearing computer. *Commun. ACM* 48, 3 (March 2005), 32–35. <https://doi.org/10.1145/1047671.1047700>
- [48] Superflux. 2015. Uninvited Guests. Retrieved September 21, 2018 from <https://vimeo.com/128873380>
- [49] Superflux. 2017. Our Friends Electric. Retrieved December 17, 2018 from <https://vimeo.com/235720958>
- [50] Joseph Voros. 2003. A generic foresight process framework. *Foresight* 5, 3 (June 2003), 10–21. <https://doi.org/10.1108/14636680310698379>
- [51] Jayne Wallace, John McCarthy, Peter C. Wright, and Patrick Olivier. 2013. Making design probes work. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)*. ACM, New York, NY, USA, 3441–3450. <https://doi.org/10.1145/2470654.2466473>