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Experiencing mundane AI futures

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Abstract: Whilst popular visions of Artificial Intelligence (AI) are often presented through the lens of sentient machines, our lived experience of AI is more mundane and exemplified by so-called 'smart' products and services. Whilst this mundane reality is often presented using design approaches that make their operation appear simple and innocuous, these smart systems, and the data they use and collect, can challenge and even disrupt ordinary expectations. Our ability to manage smart technologies effectively is key to the field of Human Data Interaction (HDI), which seeks to shape systems design and empower users by implementing core principles of legibility, agency and negotiability. However, how these principles manifest in practice is yet to be fully understood. We seek to understand key challenges confronting HDI by situating smart products and services in everyday life and creating a mundane experiential future that houses AI in a caravan for evaluation with the general public.

Keywords: artificial intelligence; experiential futures; design futures; experience design

1. Introduction

AI and data collection have become a central feature of our day-to-day lives, in particular through the rising prevalence of what are oft described as *smart products and services* within our homes. These include for example, thermostats, streaming services, and personal assistants such as Amazon Alexa. However, the underlying operations relating to AI and the data collection and processing by these networked products and services are predominantly obfuscated, for example when the user's voice is being recorded to train AI assistants.

While the awareness of our relationships with AI and data infused smart products and services may not be of immediate concern to most users, when this activity is unexpectedly brought to the fore it challenges many of our existing expectations, such as matters to do with personal privacy in our homes. For example, many Roomba vacuum cleaner owners were shocked to learn that the latest versions of the device produced detailed maps of their homes. These were then relayed to the manufacturer to help develop its AI algorithms, but the manufacturer could also potentially share these maps with third parties. While an automatic vacuum cleaner may seem an attractive prospect, a digital device which maps the

interior of your home in order to—potentially—sell that map to the highest bidder, is clearly a more complicated proposition. From this example, we can see the tension that home data collection by smart devices places on our expectations of privacy.

Whilst computing power has been increasing over many years within the products with which we share our homes to increase functionality and replace mechanical controls, it is the increasing "networkification" (Pierce & DiSalvo, 2017) of these devices to facilitate new services that is fundamentally changing our relationships with them. To address this challenge, the term Human-Data Interaction (HDI) has been coined to describe this new area for research.

> "HDI places the human at the centre of these data flows, and HDI provides mechanisms which can help the individual and groups of people to interact explicitly with these systems and data." (Mortier *et al*, 2016)

While HDI is still a new field, three core design principles for data enabled products and services have been identified: legibility, agency and negotiability.

Legibility recognises that the full extent of our interactions with data flows and data processes are generally opaque. We would distinguish the term from transparency which is primarily related to providing open access to data and algorithms, which does not necessarily make it accessible to non-expert users. Legibility is primarily concerned with ensuring that the use, storage, and sharing of data and associated algorithms are made clear and understandable to users. For example, owners of Vizio smart televisions were unaware that 100 billion data points related to their viewing habits were being collected every day until it was made public in 2016.

Agency relates to how users of data-enabled systems are able to manage their data and who has access to it. Aside from the basic ability to opt-in or opt-out of data collection, agency also relates to how data is stored and used, including the ability to modify data and the inferences that may be ascribed from it. Consider the domestic smart energy meters that are currently being rolled out in the UK. Users have little agency to optimise their tariffs or control who has access to the data which reveals a great deal about the users' lives and has ultimately reduced their uptake.

Negotiability acknowledges the transactional nature of data collection, particularly in the context of trading functionality. Negotiation seeks to facilitate an ongoing engagement by users in data collection and use so that they can withdraw access completely or in part, and derive value from data collection themselves. For example, if you choose not to connect your Roomba to your Wi-Fi you lose some of the features offered through the mobile app such as remotely scheduled cleanings, customised cleaning features, and any voice control functionality provided by Amazon's Alexa or Google Assistant. In this instance, the trade-off for loosing this functionality is increased certainty that your data is secure (as it is not leaving your house), however the negotiation is very one-sided. In the Roomba's case (as is frequently true) the terms equate to 'give us your data or we do not provide functionality'.

Failure to enact HDI may ultimately affects our willingness to adopt and accept networked devices as part of our lives (Lindley et al, 2017), and our willingness can easily be negated when such devices act contrary to our expectations or needs.

The adoption and acceptability of emerging and future technologies directly relates to their potential economic and societal benefits. However, the processes that drive adoption and acceptability are *rare* considerations for research into emerging and future technologies, and are often regarded as someone else's future work (Lindley et al, 2017). This 'proximate' view of the future necessarily occasions what Reeves et al. (2016) call 'pragmatic projection', i.e., the translation of grand visions into practical plans for design given what can be built here and now. However, like all plans, pragmatic projections are 'essentially incomplete' (Suchman, 1987) and ignore the 'mundane complexity' (Redstrom, 2006) that attaches to proximate futures.

> "All designers have to grapple with the unknowability of the future. Objects that are designed here and now will come into use at some future under conditions their creator can neither know nor control … even the most mundane of acts can unravel if expected outcomes are not met." (Reeves et al, 2016)

The upshot is that the discovery of challenges and barriers to adoption and acceptability typically occur only *after* potentially problematic design patterns have become established, resulting in diminished impact or unintended consequences. By framing this issue as a research challenge, we propose to address future adoption and acceptability from the early stages of the design life cycle using a novel combination of *more-than human centred design*, *design fiction* and *breaching experiments* to create **mundane experiential futures** (Coulton *et al.*, 2019). In the subsequent sections we consider the theoretical considerations which scaffold this research, before presenting our research through design approach (Gaver, 2012) to the creation and deployment of one mundane experiential future to consider how the core principles of HDI could be experienced in relation to AI in the home.

2. HDI ≠ HCD

Whilst the term HDI might suggest an alignment with the approaches associated with Human Centred Design (HCD), which seeks to maintain the perspective on the human-being as the central consideration, we instead align this research with more-than HCD considerations, which see the human as just another '*thing'* within hyper-connected and data-mediated assemblages (Coulton & Lindley, 2019). For example, this approach sees the things within such networks as much more than their physical forms and extend to include algorithms, humans, data, business models, regulations, climate, nefarious actants, etc. Each of these things brings with it independent-but-interdependent motivations and perspectives.

The particular More-Than-Human approach presented here is based on readings of contemporary Object-Oriented Philosophies discussed by Graham Harman (2018), Timothy Morton (2013), and Ian Bogost (2012) among others. The keystone to our notion of More-

Than-Human perspectives is the use of Object-Oriented Ontology (OOO), and principally through its rejection of correlationism. This manifests as the proposition that perspectives derived by human minds and bodies are not the only ones worth considering. It is particularly challenging for many technology designers because of the ubiquity and dogmatic predilection for HCD in commercial settings and education alike (Coulton & Lindley, 2019). Although we are in effect problematising HCD, our argument is primarily against how it manifests itself in designed artefacts, and we do this to promote equality for outcomes that address the common good as well as outcomes which promote the interests of the individual.

Beyond the dismissal of correlationism, the particular interpretation of OOO has been most influenced by Ian Bogost and his expositions in Alien Phenomenology (2012). While Bogost's construction of OOO builds on the work of others, his presentation is particularly accessible and relevant for design-led inquiry (perhaps due to his background as a game designer). Bogost coins a series of OOO-related neologisms (e.g. Unit Operations, Tiny Ontologies, Carpentry) and one of these, the idea of *Ontography,* is particularly useful when considering HDI.

Bogost's adoption of ontography is an inscriptive strategy that exposes the abundance of units, their operations, and their inter-object relations – it is a catalogue of being:

> "Ontography is a practice that exposes the couplings and chasms between units, where revelation invites speculation" (2012).

The experiential platform (in this case, our caravan) can therefore be viewed as a physical and experiential ontography, providing a lens through which we as designers, can begin to design and explore pathways for legibility, agency, and negotiability. In OOO, ontography is the examination of ontographs or collections of ontological modalities as possible relationships an object or indeed an assemblage of objects may take. Bogost suggests a perspective of ontography as a record of the *"things within"* (2012). This recording of objects can then be defined further by their *"collocation"* to not only the things within the ontograph, but also those around it (2012). Here, it is also useful to draw on Karen Barad's consideration of agency not as a property but as something which emerges from how entangled agencies relate to each other (Barad, 2007). In ontography we attempt to map the ontologies of relationships between human and non-human things within networked assemblages and highlight both interdependent relationships and independent perspectives.

For example, Figure 1 is an ontograph highlighting some of the possible relationships formed for a voice assistant system such as Alexa or Google Home. These interdependent relationships serve to highlight different parts of the assemblage, and how they might represent independent-but-interdependent perspectives. For example, viewpoint 1 represents the user perspective as might be considered with 'HCD' approaches. The user is focussed only on the task of interacting with the voice assistant and the remaining system is basically invisible to them. If we shift focus to viewpoint 2, considering the system from the service provider's perspective, whilst this also includes the user and their device, this

viewpoint is heavily influenced by their business model which implies the user is seen primarily as a means of providing data both to improve the Natural Language Processing element of the service, but also to infer behavioural patterns of the user which can be used to profile the user for better targeted advertising (this data, in its own right, may then also be traded on the open market). Viewpoint 3 presents a climate change perspective that allows the embodied carbon involved in production, operation, and shipping to be considered even if the device not manufactured in its country of operation.

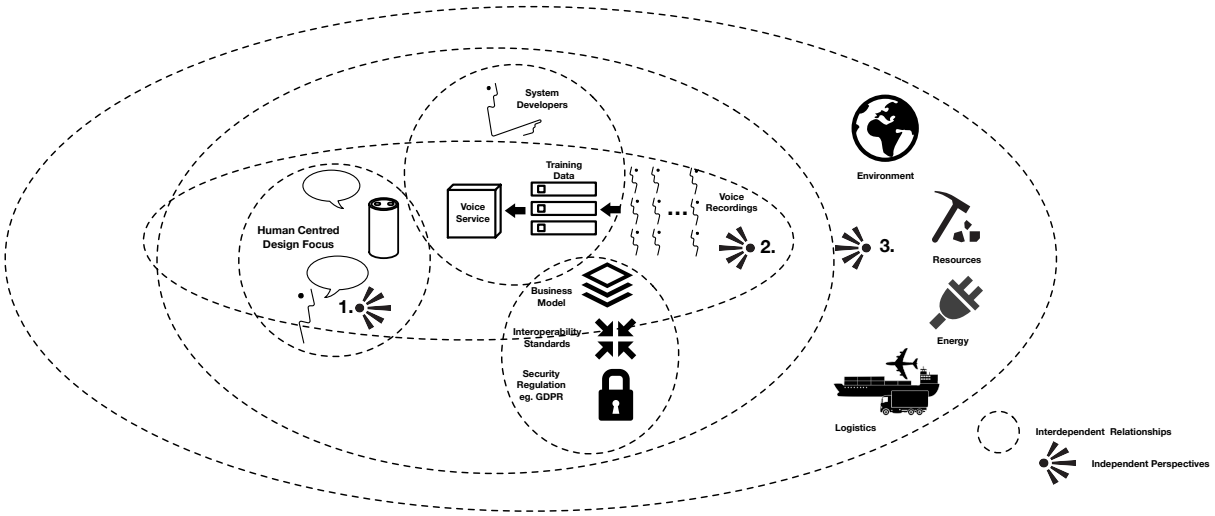

Figure 1. Ontograph of Voice Assistant, describing three different viewpoints existing within the same ontograph.

Having presented the theoretical perspective that influenced this research we will now present our research through design account of creating the mundane AI experience.

3. Future mundane experiential platform

The approach to the experience is that of an experiential future using the design fiction as worldbuilding approach (Coulton *et al.*, 2017) which diegetically situates audiences directly within the same artificial world, in order to better explore and experience how today's emerging technologies may become tomorrow's mundane normality.

Whilst it would be possible to deploy such a mundane future experience in someone's actual home or simulate a home environment at a university or gallery this would limit the potential audience with whom we could engage. We therefore decided to recreate a home environment as a mobile platform. This manifested as a teardrop caravan, shown in Figure 2, housing a familiar representation of a (UK) living room (i.e., a sofa, TV, lamps, etc.) along with integrated smart devices and support for monitoring and capturing the experiences in an unobtrusive manner.

Figure 2. Future Mundane caravan exhibited as part of the AI: more than human exhibition at the World Museum in Liverpool UK 5-6 August 2021.

This project is a development of The Living Room of the Future project (Coulton *et al.*, 2019), which was previously installed at several galleries across the UK. Whilst the creation of a mobile research platform permits engagement with a large and varied audience, it also creates a unique set of challenges, primarily the extremely tight spatial constraints. Previous installations had taken place in spaces measuring approximately $10m^2$, whereas the caravan measures only a little over $5m^2$. The primary design and fabrication challenges that this research platform presented can be explained using three key factors. Firstly, the experience is reliant on a series of networked electronic devices, many of which require a specific relationship with the audience and must be positioned accordingly. Secondly, it is necessary that the interior of the caravan be flexible and adaptable to allow the integration of not only pre-identified electronic devices, but that it also provide the opportunity for additional new and emerging devices to be added for future iterations or adaptations to the experience. Thirdly, due to this being a mobile platform, everything must be securely installed or fully integrated within the interior. It is important however that devices do not disappear from view, as suggested by 'ubiquitous computing' but rather, and in stark contrast, that their behaviour, particularly in relation to data, are made legible without being overtly attention grabbing.

We began by considering the overall experience and the role that each connected device would play. This allowed us to produce a hierarchy of needs to guide the layout and design of the caravan. The most important factor in creating an immersive experience is ensuring the audience is placed in the most appropriate and effective position, with the experience then being designed around them. As this would primarily be an audio-visual experience, the audience would therefore need to be positioned with an unobstructed view of the main screen. Despite the small form of the caravan, it is possible for three audience members to be seated at the rear, and each have an optimum viewing distance and viewing angle to the screen positioned directly opposite, as shown in Figure 3. With the audience position decided, we could then begin to consider the positioning for each of the additional interactive devices. Knowing that there would likely be additional upgrades and additions to this experience, the construction of the interior space was carefully considered to provide

the maximum possible flexibility. This was achieved by building a hollow structural framework, as shown in Figure 4, which would allow electronic devices to be installed in the most appropriate and effective position.

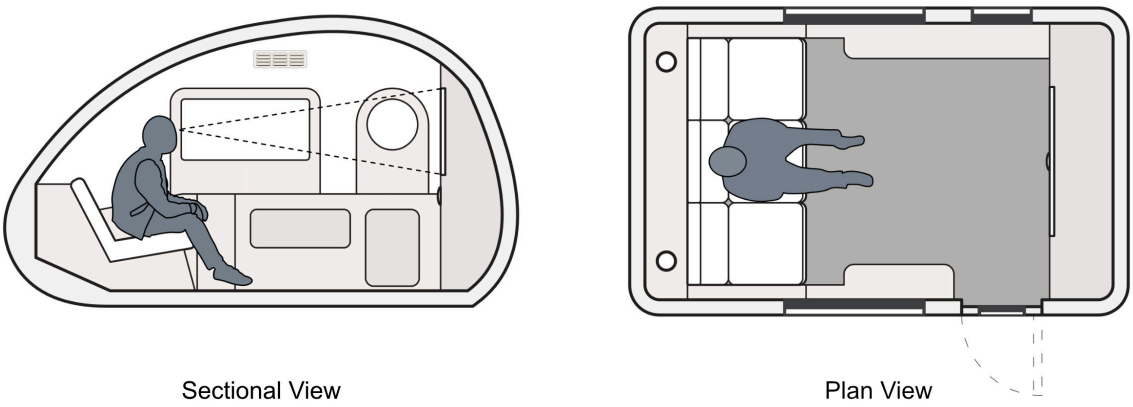

Figure 3. Future Mundane caravan layout, which was designed to immerse the audience in an audio-visual experience.

Figure 4. The interior fitout of the Future Mundane caravan was designed to provide ample space and flexibility for the integration of electronic devices.

The primary audio and visual devices are the television, active speaker system and controllable RGB lighting. These provide the main body of the experience, which is centered around a short film, offering multiple endings which are selected based on data derived from the audience's actions throughout the experience. The second most important element are the speakers, which are positioned in a 5.1 configuration. The center speaker sits directly below the television, with two additional speakers sitting either side of the screen. A further two are positioned behind the seating at the rear, with a subwoofer mounted below the central seat. This arrangement was chosen to provide an immersive soundscape and allow for experimentation with directional sound in future experiences. Controllable Internet of Things (IoT) lighting was installed along the rear panel behind the seating, underneath the seating and along the top of the front paneling. This not only provided lighting for the internal space, but also enables us to control the lighting colour and hue, acting as a visual display of the 'networkification' of devices and data in response to participant interaction.

With the positioning of the primary elements for this experience decided, the additional complimentary devices could then be considered, using the same process of defining their hierarchy of spatial needs to inform their optimum location within the space. The diagram shown in Figure 5., indicates the chosen locations for each of the additional devices.

The audience is guided through this experience by the disembodied voice of an AI. To provide a physical representation of this we created an AI interface, resembling HAL 9000 (Kubrick, 1968) which was positioned centrally, directly below the television. While the decision to represent a sentient AI character may seem contradictory for research aiming to disambiguate the domain of human and AI interaction, the choice highlights the common misconception of AI voice assistants appearing smarter than they are (Pilling *et al.*, 2021a). To increase the perceived capabilities of the AI guide, a webcam was installed above the television to allow facial recognition to be used as part of the experience. This provided another opportunity for making the involved technology legible and visible.

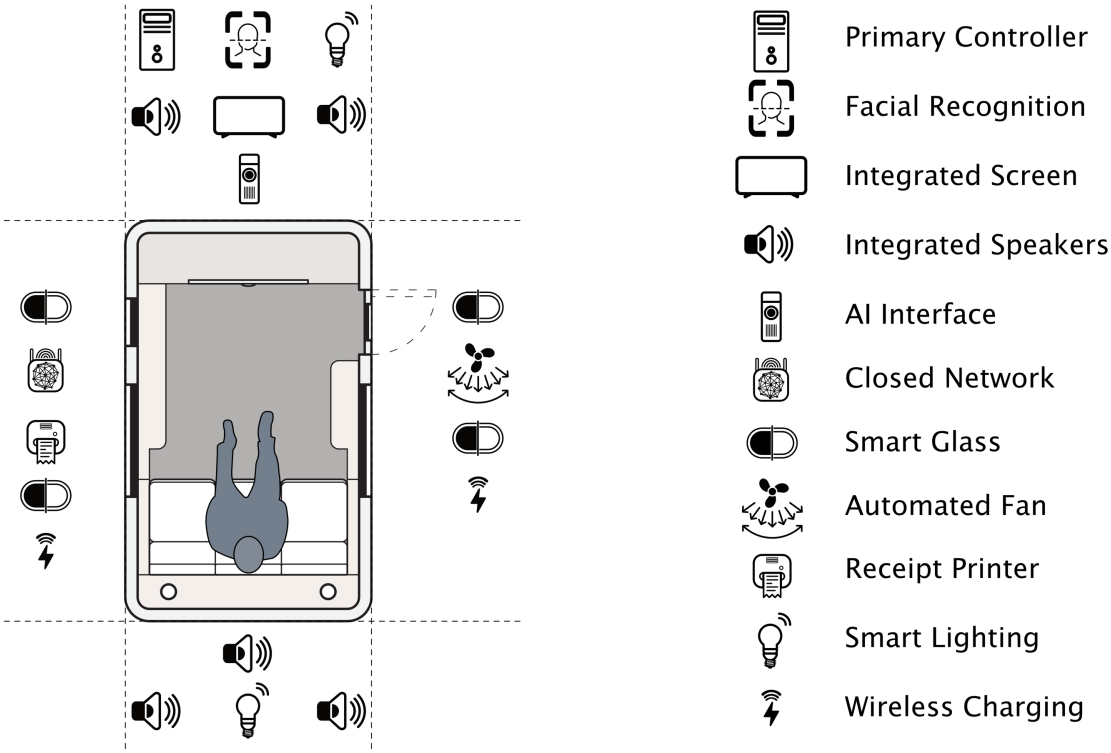

Figure 5. Future Mundane caravan layout and legend, depicting which electronic devices are integrated into the different quadrants of the interior.

To further increase the level of immersion within the experience, and better separate the space from the external world, smart glass panels were installed over each of the four windows. When turned on, the smart glass is transparent and appears like ordinary glass, when turned off however, they become completely obscured, allowing only low-level ambient light to enter and fully obscuring visibility.

In addition to the audio-visual devices that respond to the media being shown on the television, we also installed a network connected Dyson fan, which is activated to blow hot or cold air towards the audience at appropriate times, such as during a scene depicting a cold and windy external location. We chose to use a Dyson Purifier Hot + Cold, as this provided not only the control capabilities that we required, but also had the ability to purify the air passing through it and provide data relating to its quality. Following the recent Covid-19 pandemic, the ability to show that efforts were being made to clean not only the surfaces of the experience, but also the air itself, was considered a positive way to reassure visitors who were participating in the experience. This also reflects a design choice which was taken as part of the design fiction as world building approach (Coulton *et al.*, 2017) that this research follows, reflecting the mundane reality of how these technologies become part of our everyday lives. We were also able to collect the live air quality data and using a simple graphic animation, present this on the television at the beginning of the experience for each new audience, as shown in Figure 6. The final interactive element is a receipt printer, which is installed on top of the left side panel, as shown in Figure 7. This provides a printed record of the experience, making clearly legible what data has been gathered from the audience and how it has been used to inform the experience.

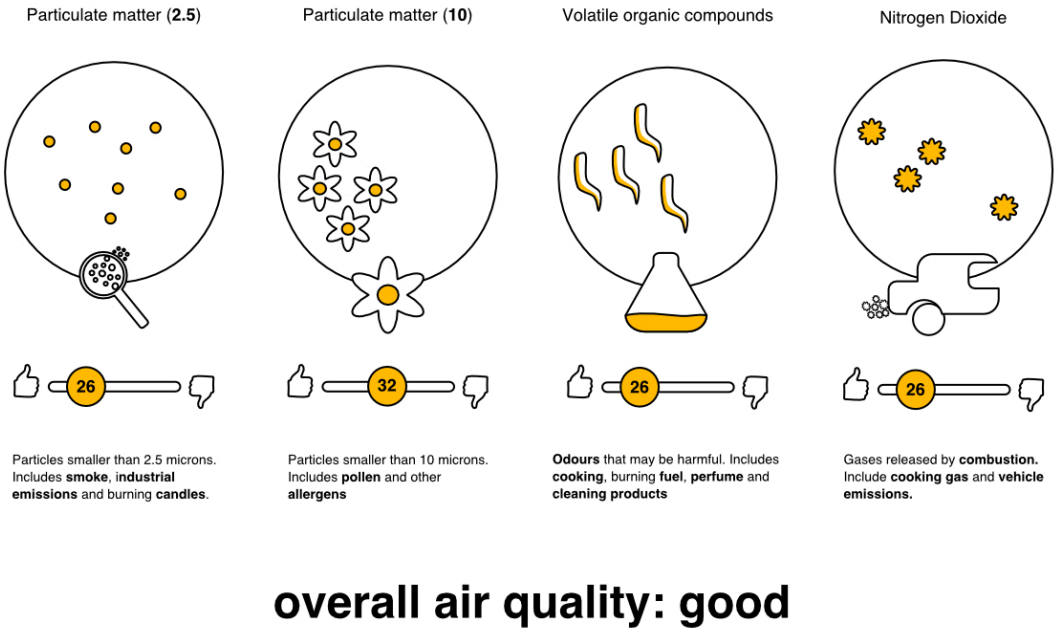

Figure 6. The network connected fan also provides air quality data, which is shown to the audience using the graphic representation above.

To address the aforementioned issues regarding data privacy and to enable the caravan to operate at remote locations without internet connectivity, the entire experience is run on a closed network, comprised of a computer installed behind the television and a router

integrated into the left side panel. This allows each of the connected devices to communicate and react to the live choices and interaction of the audience.

Figure 7. (Left image) The receipt printer provides a printed record of each experience, (middle image) a physical representation of the AI which guides the audience through the experience, (Right image) the smart fan which is used to collect air quality data and performs as part of the immersive experience.

There are already plans to implement the use of AI icons for legibility that have been designed using OOO to consider the ontology of AI (Pilling *et al.*, 2021b). These will be displayed on a secondary screen (integrated on the left side panelling) as and when the relevant interactions between the data being collected and AI systems occur.

4. Experiencing a mundane AI future

This version of the Future Mundane experiential future is split into to two main parts. To begin, the participants seat themselves on the sofa in front of the television screen, as shown in Figure 8. The experience is then introduced using a voice user interface which seeks to gain consent from users to collect, process and store their data (the experience prints out a permission slip using the thermal printer which the audience must sign to proceed). In the second part of the experience a short drama is played based on a profile generated by the system. During this phase various IoT objects in the room begin to contribute to the immersion. For example, the windows become opaque, and the room's lighting adapts to each scene (the system 'knows' the outside weather and picks up a relevant colour gradient). When the lead character in the short drama is outdoors, the fan switches on, matching the wind blowing her hair. The music within the film is chosen dependent on the profile generated by the system, as is the chosen ending. The impact of particular data interactions which affect the drama do not immediately affect the media objects, which means that while each experience was uniquely tailored to the audience, they would not necessarily be able to see why or how. Therefore, these are displayed as captions at the bottom of the screen when data is being collected and subsequently used.

The consent procedure within the experience is designed to prototype the HDI pillars of agency, legibility, and negotiability. The consent involved introducing each sensor in turn, starting with the face recognition system and at each point the audience was asked to indicate their willingness to have their data collected. Whilst this provided legibility, we

purposefully did not always provide a choice other than 'Yes' or 'No'. This was intended to highlight the lack of agency and negotiability that many consent systems actually provide. When the audience in the experience said 'no' the system would either say this would result in a lesser experience or say that this was a shame as they would miss out on the video, but they could exit through the gift shop. However, during the 2 days the experience ran, none of the 75 people who participated declined consent. This perhaps indicates could be due to the setting in which the experience takes place or perhaps the beguiling nature of voice which may present a problem for future IoT systems in that, if their security is compromised, voice may present nefarious hackers a highly effective means of phishing.

Figure 8. The audience view from a seated position inside the experience. The screen provides the primary focus for the experience, with additional interactive elements responding to both the short film being played on the screen and user interactions. The images on the left and right also show how smart glass has been used to create a more immersive environment, by providing the ability to control the opacity of the windows.

The need to 'design in' negotiability is also made clear when considering 'More-Than Human Centred' theory (Coulton and Lindley, 2019). Most designed things, and the components that make them up, operate familiarly and there is no need to negotiate consent around their use. For example, things such as taps, doorknobs, light switches, and cars have, through a process sometimes referred to as 'mediation' (Verbeek, 2015) or 'domestication' (Silverstone, 2006), become so very familiar that virtually anyone knows without thinking what to expect from them. Occasionally, technological innovation upsets our familiar relationships with things, and we need help in renegotiating them. For example, car wing mirrors that increase the field of view but make objects appear smaller highlight this to drivers. In some countries these wing mirrors must carry a disclaimer, this begins a kind of dialogue with the user: because the technology has changed, it must increase its negotiability. In the case of connected products in the home, rather like the wing mirror, although outward appearance remains largely similar, the inner workings are often very different. For this reason, our relationships must be renegotiated.

5. Conclusions

The colonisation of the home by smart devices has already begun and with it comes the creation of a 'data exhaust' that is used to feed various manifestations of AI that offer personalisation through profiling. Whilst profiling has the potential to produce many positive

aspects—better health care, more immersive media experiences—it also has the potential to increase inequalities through systematized bias. It is therefore important that we develop alternative methods of design for considering technological developments that change the way we interact with them, which are currently often obfuscated and intangible. Traditional design methods enable us to see this problem from limited perspectives and do not permit consideration for the independent and interdependent relationships of networked devices.

In research we seek to re-imagine the way infused products and services are currently designed such that users are not simply treated as data-point providers but willing collaborators with the technology. This is achieved by addressing issues such as legibility, agency, and negotiability using approaches such as HDI and more-than human centred design. Whilst new challenges will emerge along the way, it is important we address the tricky elements of AI and data collection before they become highly problematic and detrimentally affect future adoption.

The development of this experiential and interactive research platform has provided unique opportunities to consider, incubate and experience different viewpoints concerning the potential effects of AI technology, data usage and IoT devices. The platform has proven to be highly engaging, offering an experience that is legible and accessible to an audience outside of the world of academia, encouraging public participation with this research and an understanding of smart devices and their operations within our own homes. Now it is 'up and running' we seek to deploy the caravan and explore key challenges to human data interaction in a smart world with the public at large.

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