Object-Oriented Ontology and Its Critics

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Design Research and Object-Oriented Ontology

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Abstract: In this paper we recount several research projects conducted at ImaginationLancaster (http://imagination.lancs.ac.uk), a Design-led research laboratory, all of which consider Object-Oriented Ontology (OOO). The role OOO plays in these projects is varied: as a generative mechanism contributing to ideation; as a framework for analysis; and as a constituent in developing new design theory. Each project's focus is quite unique—an app, a board game, a set of Tarot cards, a kettle and a living room—however they are all concerned with developing new understandings relating to the ubiquitous, networked, 'smart' technologies which are often referred to as the Internet of Things (IoT). Through our reflexive account of these research projects the aim of this paper is to provide insights into, and promote new discussion about, the relevance and scope for OOO in socio-technical Design Research, and beyond.

Keywords: Internet of Things, Object-Oriented Ontology, Design Research, Research Through Design, Speculative Design, Design Fiction, Games Design

1 Introduction

The paper is structured as follows. In this introductory section, we provide some background to Design Research in order to contextualise the relationship between our work, OOO, and socio-technical research. The main body of the paper comprises accounts of several research projects. Framed by the introduction's explication of Design Research, each project's discussion is a standalone case study. Finally, in our conclusion, we provide a general discussion of our experiences in order to raise salient questions, explorations of which may help sustain an ongoing and fruitful relationship between OOO and Design Research.

Design Research is still a young field: while it has roots in the Design Science movement of the 1960s (itself a disputed term, but for our purposes we can cast it as a scientific study of design and the adoption of the 'scientific method' into design practice) it quickly evolved beyond this, embracing how it's ineffably creative character was adept at addressing "wicked problems"[1] (a term used to describe problems which are unique, ambiguous and with no definite solution[2] such as climate change or endemic obesity). Newly empowered and aware of its gift for responding to "uncertainty, instability, uniqueness, and value conflict"[3] a distinct epistemology of Design Research began to emerge which recognised that "messy and complex"

1 Rittel and Weber, "Dilemmas", 160.
2 Buchanan, "Wicked Problems", 15.
3 Schön, "Reflective Practitioner", 50.

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design practice does not mean Design Researchers have to compromise intellectual rigour[4]. This shift was described by Cross as the "designerly"[5] way of knowing. A reconition "that design has its own appropriate culture" yet is "not completely disregarding other cultures"[6]. Put differently, the designer has to negotiate between unbridled visions of what could be and the pragmatic constraints of practical and technical possibilities. Through this process of negotiation—or praxis—new understandings emerge. This is what Design Research is. From these foundations Design Research has flourished in the early 21st century. Given the 21st century's glut of undeniably 'uncertain, unstable, unique and value-conflicting'—or wicked—problems, it makes sense that Design Research is increasingly relevant.

Much of Design Research is practice-based and tends to start with open-ended research themes, as opposed to specific and tightly constrained hypotheses to be tested. Though challenging positivist paradigms, such inquiries reflect designers' preference to cast their practice as an exercise in "problem framing rather than problem solving"[7] which, in turn, requires reflection through action. Through this reflexivity new theories emerge and perspectives morph. The resulting knowledge is "contingent and aspirational"[8] (in stark contrast to positivism's desire for fixity and reduction). Truth's singularity does not make sense in design activities; there is no 'correct' way to design a chair but rather there are many ideas each of which are valid, and each of which contributes knowledge to the gamut of 'what we know about chairs'. This mechanism, within which 'stuff' and 'knowledge' are co-produced, applies to *anything* that can be designed. Hence, Design Research can happen through the design of buildings, services, graphics, chairs, gastronomy, and games alike—accepting that some kind of design process is a given, it is domain agnostic.

In the Royal College of Art's first ever research pamphlet, Sir Christopher Frayling illuminated the space with several salient observations[9]. First, he notes the difference between Research and research; the 'big R' version refers to the production of new knowledge (through, for example, a design activity) the 'small r' is a search through pre-existing knowledge (to support, for example, a design activity). Though this is merely disambiguation, given that nearly all design projects involve some background research, but relatively few exist in order to conduct Research, the distinction is crucial. It offers designers/researchers a framework to clarify their intentions and outcomes. Further to this, Frayling discusses stereotypes in order to highlight some of the problems of understanding research within design practice. Contrasting the tropes of archetypal artists, scientists, engineers, and designers, Frayling concedes there is a "lot of private territory" but qualifies that the practices of Research, doing science, making art, and designing things exist on a shared ground; there is a 'commons of practice' uniting them in some way. The point is that 'Research' is not a walled garden. Scientists operate in a creative idiom just as much as designers do the cognitive—and Research can take place anywhere on this spectrum. The big takeaway from Frayling is a characterization of how art and design activities relate to Research and research (for convenience we'll drop the 'art' part of the phrase from now on):

- Research about Design: Research focused on the experience of designers, their modes of practice, and those who use their products i.e. design activity, design behaviour and design cognition.
- Research for Design: The 'little r' type this refers to the background search for information that will enable the design (e.g. for a new chair design establishing the height of the sitter or their preferred cushion type).
- Research through Design: Usually based around an action/reflection approach the emphasis here is on creating knowledge through the process of designing.

Of course, in reality, these three classes often overlap (Figure 1). One example configuration: research *for* a design may be utilized to produce an artefact, which through an action/reflection process becomes

4 Rodgers and Yee, "Alive and Kicking", 9.
5 Cross, "Designerly", 5.
6 Rodgers and Yee, "Alive and Kicking", 3.
7 Schön, "Reflective Practitioner", 40.
8 Gaver, "What should we expect?", 938.
9 Frayling, "Research in Art and Design", 1.

Research *through* Design, the resultant knowledge later becomes the subject of someone else's Research *about* Design. Nonetheless, Frayling's categories are very useful to articulate the not-always-straightforward relationships in Design Research.

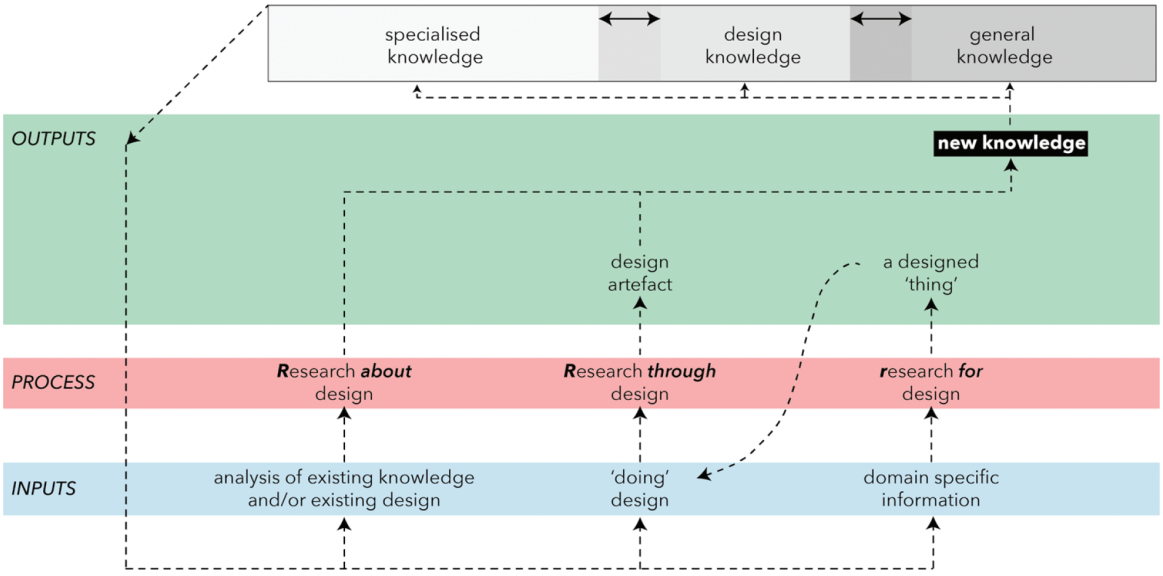


Figure 1: Diagram showing some of the possible linkages between different kinds of research and design activities, produced artefacts, and resulting knowledge suggested by Sir Christopher Frayling.

The projects we describe in the rest of the paper all have subtly different configurations of these constructs. Moreover, mixed up and mingling with the Design Research assemblage each project has a relationship with OOO that manifests in multiple different ways. For example, in the case of the Polly project OOO was initially used generativity to develop design concepts; for the Tarot of Things project, the cards facilitate a performative exploration of OOO; with the Living Room of the Future project a functional prototype becomes an analogy for OOO itself, which then becomes a conceptual framework to articulate attributes of the design that are not immediately obvious from the surface. While the configuration of various constructs varies across the projects, they are all united as being explorations of the 'Internet of Things'.

1.1 The Internet of Things

The term Internet of Things (IoT) has become the catch-all term for 'things that are connected to the Internet'. It has roots in a corporate presentation given by Kevin Ashton in the late 1990s. Ashton explained how by using sensors to gather data that could be shared across the company's computer network, the supply chain could be streamlined. He called these data-enabled parts of the supply chain the 'Internet of Things' and the phrase caught on. Skip forward 20 years and its meaning has been diluted in the haze of its own hyperbole and is often blurred by techno-optimistic visions of 'smartness'. The term applies at all scales, from wearables like smart watches, to IoT-enabled homes or cars, right through to entire smart cities and nations. It is also used across sectors; in transport, healthcare, manufacturing and any other area you care to consider—there will be an esoteric murmur of IoT rhetoric relating to it[10]. All this IoT talk, and more recently a similar buzz around AI (the various types of machine learning that rely on huge amounts of data that, as it happens, tend to be data generated by IoT devices), has unsurprisingly attracted the attentions of research funders tempted by the promise of social and economic benefits[11].

10 Sterling, "Epic Struggle", 15-18.
11 Taylor et al., "The potential of a trusted smart world", 3-5.

As will become apparent, the 'things' that have profound consequences for the IoT are not only the physical objects but also invisible elements including data, algorithms, regulations, and business models. The physical objects of the IoT tend to *look* familiar—televisions, thermostats, light bulbs and so forth—but their digital other-halves import an array of transcendent qualities. One's baby-monitoring webcam may be part of a foreign cybercrime network holding a New York tech giant to ransom; the television becomes the watcher, observing you and gathering intelligence for someone else's financial gain; and simple enquiries— "Alexa, what's the weather?", perhaps—underpin thousands of poorly paid jobs for highly qualified linguists. All of these are true, and basic, examples. Thus, whilst the term IoT is a somewhat dubious proposition—arguably more about marketing than meaningfully describing any specific class of technology or socio-technical phenomenon—the vast space it intersects with is nonetheless fascinating. The IoT, then, is clearly one of those unstable and value-conflicting propositions that Design Research is so adept at dealing with. It's also the case that Design Research's ability to rigorously consider what *could be* as opposed to quantifying what *is now* is very relevant to the language of 'proximate futures' which pervades the IoT research space[12]. Finally, as design usually plays an integrative role, mediating multiple perspectives by balancing ideas, influences and constraints, there are scant cultural or disciplinary barriers to importing elements of whatever theoretical perspective one wishes to, into a design activity. In the cases described in this article, the distributed-and-exclusive realities of the various things, data, and other actants which make up the IoT led us to consider what role OOO might play in our research.

1.2 Object-Oriented Ontology?

No self-respecting submission to a special issue covering OOO would be complete without some kind of head-on discussion *of* OOO. The significant commentary and critique of OOO that this paper offers are tied up with the processes, reflections on, and outputs of the Design Research projects themselves. However, the following introductory notes are intended to give some initial context to our interpretation of OOO. One might say that these are conceptual 'jumping off points' which provide the connective tissue joining our interest with OOO, to our Design Research practice, and onwards into our domain of interest—the IoT.

The principle pivot-point for our use of OOO is, perhaps unsurprisingly, the rejection of correlationism. Although part and parcel of the OOO stance, suggesting that human minds and bodies are not the *only* actants worth countenancing is particularly challenging in the field of Human-Computer Interaction (a research community to which we frequently contribute) because of the ubiquity and dogmatic predilection technology designers hold for Human-Centred Design. Perhaps this is Heidegger's fault—technologists seem to covet 'breakdown free' Zuhanden—but regardless of blame, this presented us with challenges when considering how to frame our IoT research with OOO. Building our rhetorical stance around the idea that, in the 21st century, Human-Centred Design is a fundamentally misguided approach (even though we *do* wish to promote the best outcomes for humans) has been, in equal parts, a core motivator and a significant barrier for this work.

Beyond the prerequisite dismissal of correlationism, our OOO thinking has been most influenced by Ian Bogost and his expositions in *Alien Phenomenology*. While Bogost's rendition builds on the work of others, the text made OOO seem particularly accessible and relevant to our design-led IoT inquiry. Many facets of the portrayal chime with our view of things: a "tiny, private universe rattles"[13] inside computational things; the straightforward "all things equally exist, yet they do not exist equally"[14] that is deftly characterised in terms of the video game ET the Extra Terrestrial's multiple constituent objects[15]; the pragmatic invocation of John Law's idea of *mess* to cut through the challenge of applying perfect theory to an imperfect world[16,17].

12 Lindley, Coulton, and Sturdee, "Implications for Adoption", 269-271.
13 Bogost, "Alien Phenomenology", 9.
14 Ibid., 11.
15 Ibid., 17-18.
16 Ibid., 20.
17 Law, "Messy Methods", 8-9.

All of Bogost's OOO neologisms have proved useful—Unit Operations, Tiny Ontologies, Ontography, etc—but the most significant by far is *Carpentry*. Apparently, it is very simple, "carpentry entails making things that explain how things make their world"[18]. The rhetoric of Carpentry is wrapped in the romantic poetry of craft, it "extends the ordinary sense of woodcraft to any material whatsoever"[19], and, yet, cuts right to the nexus of critiques of theory:

> If a physician is someone who practices medicine, perhaps a metaphysician ought to be someone who practices ontology. Just as one would likely not trust a doctor who had only read and written journal articles about medicine to explain the particular curiosities of one's body, so one ought not trust a metaphysician who had only read and written books about the nature of the universe.[20]

Carpentry is a call to galvanise abstracted musings by lending them empirical weight; it's a manifesto and method for practical philosophical experiments. It means getting your hands dirty. Carpentry takes the material in question (be it the theory, or the thing/situation the theory is being applied to) and tests it, teases it, and experiments with it. This bears a striking resemblance to the way we have characterised Design Research as a 'material engagement'[21] with a problem, research question, or context. Hence, Carpentry was our gateway to the richness of OOO, Bogost's other neologisms proved worthy constructs to flesh out its conceit, but the overall ideology is one that we are familiar with through our Design Research practice.

2 Polly: Seeing in Constellations

Polly is a product that exists within a *Design Fiction* world[22]. Design Fiction is a speculative approach used in Design Research. It involves imaginary worlds which are created by designing and building multiple artefacts which play the role of 'entry points' into the world. When these entry points are viewed together they give a multifaceted view of the artificial world, which can then provide compelling, if speculative, research insights. A key strategy in crafting Design Fictions is to tailor the entry points to speak to the particular audiences or issues the Design Fiction is trying to address. In the case of Polly, we wished to reflect upon the archetypal 'bad' IoT product too often seen in the current market. This product would include common flaws such as dubious and disguised data gathering practices[23], lax security[24], incomprehensible and usually unread end user agreements[25] and the ultimate trope of bad IoT design—futile features (e.g. the 'Egg Minder' which keeps track of one's egg supply or 'Kérastase Hair Coach' which analyses hair brushing technique). We considered such IoT products, and eventually elected, somewhat irreverently, to base our exploration around a kettle because of how stupendously pointless internet-connected kettles appear to be (given that they still need to be filled and emptied manually their digital features seem mostly inane).

OOO's role in this project was generative; to help drive the ideation process. This was achieved by initially attempting to map all of the relevant actants. What are the various objects that relate to an IoT kettle, and how do they relate to each other? By attempting to build an unbiased view of these objects, on the flat ontological plane they relate to each other across, our aspiration was to consider how to tweak the relationships between the objects (without having to completely redefine their properties and attribute) such that some of the undesirable elements which are oh-so-common for IoT products, were reduced. We wanted to design the world that Polly-the-kettle exists within to be coherent, but also to enable the kettle to act with improved ethics, to engender trust, and to do all of this while keeping itself—and its users—safe and secure. Although speculative, the designs which constitute the entry points into Design Fiction

18 Bogost, "Alien Phenomenology", 93.
19 Ibid., 93.
20 Ibid., 91-92.
21 Lindley, "Thesis about Design Fiction", 60-64.
22 Coulton, Lindley, Akmal, Sturdee and Stead, "Design Fiction as World Building".
23 https://www.wired.com/2017/02/smart-tv-spying-vizio-settlement/
24 https://www.theguardian.com/technology/2016/oct/26/ddos-attack-dyn-mirai-botnet
25 https://tosdr.org/

worlds also, crucially, aspire to be plausible. Fortunately, the OOO perspective helped with this activity; throughout our experiments preserving and fixing each object's definitional properties and attributes, an appropriate level of plausibility was maintained.

The 'maps' which we created while developing our design concepts for the kettle we eventually termed *Constellations*, inspired by Walter Benjamin's words; "ideas are to objects [*not* OOO-objects] as constellations are to stars"[26]. Reapplied to the IoT, the salient message of this quip remains; depending on one's position relative to the thing being observed, the apparent or salient properties *of* that thing may vary significantly. A generic IoT constellation is shown in Figure 2. Note that the part of the diagram adopting a traditional 'Human-Centred Design' perspective includes the human user and the IoT device's physical form. However, part and parcel of the constellation is that beyond this specific 'Human-Centred' focal point, the other actants on this diagram have equally valid, but totally unique, often unseen, perspectives. For example, the business model of the commercial entity making the IoT device has quite different concerns than the user. One might ask (as a reviewer of this paper quite sensibly did so) *how* is it determined what objects and perspectives need to be mapped into a constellation. And, quite apart from identifying relevant actants, how does one distinguish the salient from the superfluous?

While answering in a generalisable way is difficult, as any reasonable response must be tied to a specific context (in this case an IoT kettle), the most valuable piece of the puzzle is simply to *try* to think in terms of a constellation. To, at the very least, *attempt* the conceptual manoeuvres necessary. Beyond this, it's important that for the individuals points in that constellation perspectives and motivators might be incongruous with each other, but that incongruity is not an indicator of invalidity. Adopting some thinking derived from Bogost's explication of tiny ontologies is useful to support the act of creating a constellation map—and that is to remember that each object's existence "ought to be as compact and unornamented as possible"[27]. In other words, even if they deserve discussion in an academic sense, one should not become distracted by the ineffable qualities of any given object, and, conversely, one *should* focus on the tangible attributes of objects and include those in the constellation. In the case of Polly, the focal points of traditional Human-Centred approaches were quite explicit in their role for the constellation (e.g. a physical kettle, which is in a house, and connects to a router—and so on) but moving one's gaze further afield, quickly the constellation constituents become, necessarily, more abstract (e.g. 'data', 'business models', and 'standards'). Notwithstanding this rapid transition into less-well-defined participation in the constellation, including these objects continued to be useful (in a generative sense) so long as we could keep track of *why* the perspective of specific actants was relevant (e.g. that insights derived from the data generated by using IoT devices are valuable and can become part of an unrelated 3rd party's business model) and that we could comprehend which of the actants' properties were plausibly changeable (e.g. networking protocols used by devices in the home). While, over time, our thinking has evolved somewhat (which we will discuss more in section 3) quite apart from proposing a specific approach for deciding what actants a constellation should include, the most important takeaway is to use the construct as a lever to impact one's thinking. Working in this way materialises the scope of the OOO space in question in a generative and productive manner, it identifies the identifiable whilst taking note of the ineffable.

Hence, our design proposals for Polly aimed to temper the underlying-and-immovable qualities of these objects (and their relations to each other) against the plausible tweaks which could result in a trustworthy, ethical and safe device that is also edifying and simple to use. The various features, and the necessary tweaks to the objects' attributes which made those features possible were split into two groups. The features we described as being part of the project's 'smart rhetoric'—they don't draw much directly from OOO but play a key part in the 'world building' element in the Design Fiction method[28] by adding to the contours, texture and depth of the imagined world. These include integration with location aware social apps, to invite friends for a cup of tea; an automatic fill-level indicator which learns user behaviour and suggests fill levels to minimise energy waste; downloadable boiling profiles for specific types of tea or coffee that require water at a specific temperature.

26 Benjamin, "Arcades".

27 Bogost, "Alien Phenomenology", 21.

28 Coulton, Lindley, Akmal, Sturdee and Stead, "Design Fiction as World Building", 11.

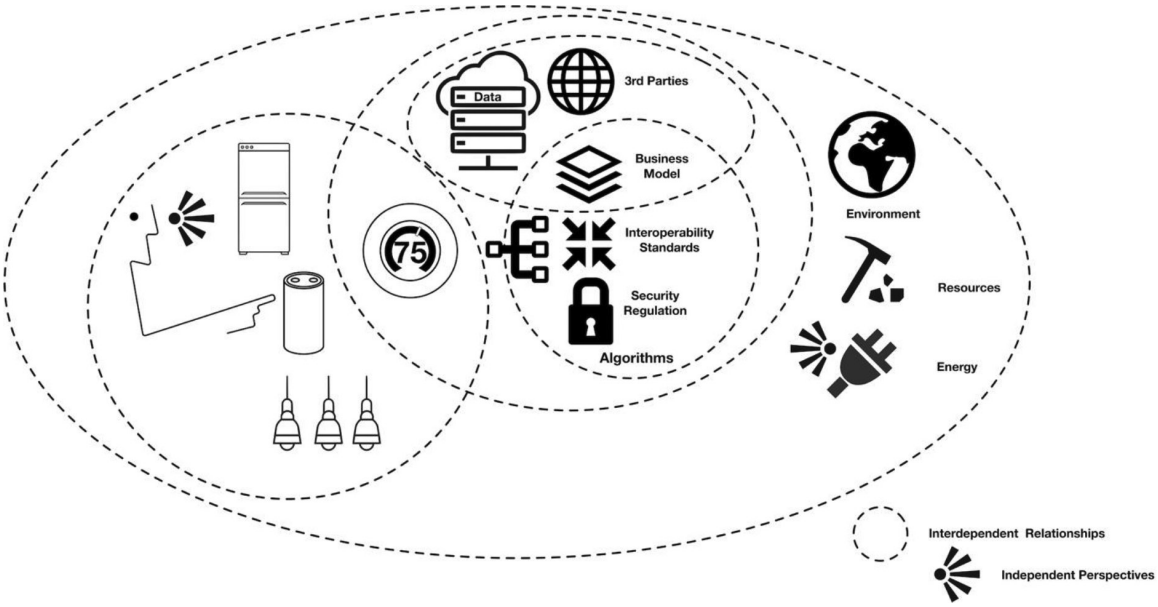


Figure 2: An example of what an IoT constellation could be demonstrating interdependent relationships juxtaposed against independent perspectives.

Figure 3: Features associated with the Polly kettle's "smart rhetoric". On the left a weather integration informs the user that the windscreen of their car is iced over and, on the right, a downloadable boiling profile matches the brewing requirements of a single-variety coffee.

Those features which are driven by OOO are part of what we term the 'constellation rhetoric'. These features are also much less 'fancy'. They include a paranoid security policy, which disables network features at the first suggestion of a breach; several means of conveying what data relationships Polly engages in, and why; and a vision for a networking protocol which forces devices to define how they will use the network and then monitors the network for any contraventions. It would be impossible for us to concretely argue that how we conceived of, designed, and articulated these elements is a *direct* result of trying to look at Polly's existence through the lens of an OOO-inspired constellation: there is an argument that we might have arrived at these ideas in any case, or even had them before OOO entered our consciousness. However, based on the experience going through the design process we would strongly disagree with those contrary positions. For example, the decision to enhance trust by developing a new network-level protocol which would police the quality of data packets at a hardware level stemmed from our attempts to conceive of the tiny-ontological significance of fundamental protocols (e.g. TCP/IP) in quite tangible socio-technical systems. The *precise* nature of this process is, wrapped up in the nature of creativity. 'Eureka!' moments are a fallacy and original ideas actually percolate slowly in the background of a designer's environment and worldview, before eventually being focused into the materiality of a specific design. By attempting to

think in terms the multiple-concurrent perspectives which are part and parcel of constellations, crafting constellation maps, and referring back to them while developing specific concepts, the 'coffee grounds' central to the percolation process of ideation are imbued with an original and productive character.

Figure 4: Features associated with the Polly kettle's "OOO rhetoric". On the left a visual display lets the user know the volume of data the kettle is downloading relative to uploads and local network traffic. On the right a machine reading data policy is uploaded from the kettle to a compatible router.

Particle accelerators such as the large hadron collider in Switzerland smash fundamental particles into one another, in order to try and understand what is inside. The process is quite blunt, but the outcomes are profound. While we do not wish to suggest that this work is consequential in the same way that particle physics is, the metaphor of the particle collisions works well and is of relevance to the subsequent projects too. In essence our exploration took our nascent understandings of OOO, and a desire to explore a range of issues related to the IoT, then using the 'hardware' of Design Fiction as the particle accelerator, smashed the whole lot together in the hope it would yield useful results. The particle accelerator metaphor is, of course limited in its utility. A shortcoming surfaced by the query 'What does OOO offer that, say, Design Fiction does not?'. The role of Design Fiction here is in organising methodological principles. It offers a license to speculate, and guidance for how to do it in terms of the design of things, and their interplay with the world they exist in. Consonantly OOO's offers a licence to speculate, and some guidance on how to do it, but this time in terms of the *nature* of things (whether they be large, small, conceptual or tangible). These two modes of speculation can, we suggest, be brought together in harmony so that OOO offers isolated and tiny points of insight, while Design Fiction coheres them, combines them, and converts them into a relatable whole. On a much more practical note, all brands of design-led research inherits a quality from their driving ideology; critical design, participatory design, and co-design for example, all have their own caprices. In this work it is the whimsy of OOO which lends the work a distinct flavour, and Design Fiction provides the scaffolding to realise it.

Notwithstanding the nuance of process and the intricacy of OOO and Design Fiction's interplay, on this occasion the process seemed successful, and what emerged was a mechanism to generate novel design concepts which begin to address the IoT's intrinsic security, trust, and ethical challenges in a novel manner. Moreover, through the process, and with constant reflexive practice, the constellation metaphor also emerged. Hence, the OOO-informed Design Research acted to help generate theory as well as design concepts. The project has been well-received by academic, commercial and lay communities alike. Polly has been presented at numerous international academic conferences, used internally at the UK Government's Department for Digital, Culture, Media and Sport, presented at Internet of Things industry events, and discussed on BBC Radio 4's consumer programme *You and Yours*. As the first building-block in the constellation design metaphor Polly also played a key role in the development of 'More-Than Human Centred Design'[29].

29 Coulton and Lindley, "More-Than Human", 463-381.

3 Orbit: Towards More-Than Human Centred Design

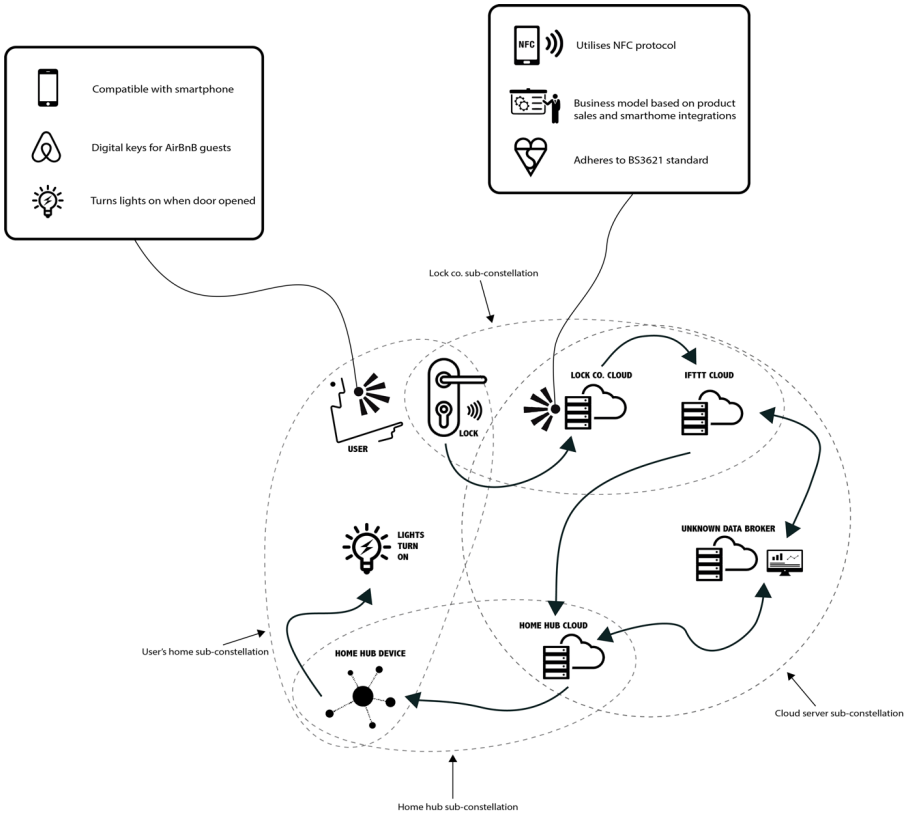
While Polly was a 'product-based' experiment, where OOO was used to generate a concept around a specific product Orbit is more of a 'problem-based' experiment. The problem it aimed to address was how interaction designers should respond to the European Union's General Data Protection Regulations (GDPR), in particular when voice is an integral part of a user's interaction with a system, when that system is comprised of multiple devices, cloud services, and data, and when aspects of many different product ecosystems may all come into play at the same time. Under GDPR, when consent is given to use personal data, the burden lies with the 'data controller' (usually the technology company behind a particular device) to verifiably show that the consent was gained freely, specifically, and unambiguously. While traditional means of gaining consent (e.g. lengthy End-User Licence Agreements) are woefully inadequate, the additional complexity of domestic IoT contexts (e.g. with multiple providers and voice interfaces) and the yet-to-be-interpreted GDPR guidelines made this an intriguing prospect. The 'constellation' metaphor that OOO had helped us develop through the Polly project was also fresh in our minds. We identified OOO as a useful construct to explore the multiple-but-concurrent perspectives on the various actants in any given situation, and hence to cast light on GDPR's consequences in a more holistic manner.

As with Polly, this project leveraged the Design Fiction as World Building method. This particular world was built around an IoT door lock. We endowed the fictional IoT lock with four possible ways of being operated. Each has its own requirements on users' data: using a smartphone as the key to unlock the door (by utilising near-field communication this can be achieved whilst all data is self-contained on the user's own devices); geofencing to automatically lock the door when a user leaves the house (data must be shared with the lock's cloud service provider); voice activated unlocking via integration with a voice assistant such as Amazon Echo (data must be shared with the lock company's cloud and Amazon's cloud); extensible integrations via a service such as 'IFTTT' (data must be shared with the lock company, with IFTTT, and potentially with multiple unknown 3rd parties). These features and data relationships were the cornerstones for this Design Fiction world. Within the interior of the fictional world, or 'diegesis', to configure the lock required the use of a privacy-management system called Orbit and consideration of the constellations associated with the lock helped inform the design of Orbit. Hence, by designing this privacy-management system we were experimenting and testing the constellation concept that had previously been developed. Of course, the most useful thing to include in this paper—if it is to be a carrier of useful knowledge for other scholars—is an account of how and why this constellation-thinking was useful. Extrapolating the specifics of this utility is, but in what follows, through the reflective account, alongside visual examples of the design concept, we articulate how OOO influenced and aided our thought processes.

Studying existing IoT devices in order to extrapolate how the lock's different functionality may impact on how data are used showed us that once several data controllers are implicated, the ambiguity of the forms-of-words within user licence agreements and privacy policies make it almost impossible to know precisely what data are collected, where they go, and what they may be used for at any given time. Constellation thinking provided a means to unpack and apprehend this uncertainty by segmenting the problem according to the individual perspectives of the interdependent actants within the constellation. A key part of this process involved a constant balancing of what the practical constraints are (mostly derived from how existing similar products work) against what is possible (e.g. how such a product could be designed 'better'). While this sort of mundane-dreaming is normal in any Design Fiction project, returning to constellation maps in order to constantly level-out our assumptions in terms of multiple-concurrent perspectives really felt like a productive way of addressing the 'wickedness' of this particular problem.

Exploring the constellation's actants the map shown in shows data flows resulting from the lock's most sophisticated feature set being utilised to turn on lights when the lock is activated. Creating and considering such maps forces designers to explore each actant's perspective of the design (i.e. in this case, the lock) but also on every other actant within the constellation (e.g. the perspective of the user). As discussed a priori with regard to the constellation maps created for Polly, explicitly and concretely saying what should or should not go into these maps is difficult to defend, however exploratory mapping is certainly a useful part of the design process helping develop original insights. These explorations, informed by our work on Polly,

but with new challenges associated with this 'problem-based' experiment, demanded a more detailed type of constellation map. Hence, while for the Polly project it was useful simply to case '3rd parties' as an abstract actant (see Figure 2), in the case of Orbit—given our focus on the particulars of GDPR—it was necessary to create a more detailed map. Trying to minimise any significant prejudices or value judgements, the process facilitated a thorough exploration of who all the relevant parties are (insofar as it can be known), which data they care about, how they would argue or explain GDPR compliance, and consequently how to comprehend the causal links between objects including a user unlocking the door, the business-led bottom line of an unknown data broker, and the layout of a smartphone app.



Constellation map showing rationale for multiple possible perspectives. The diagram shows a possible constellation map relating an IoT smart lock. Dashed lines encircle possible sub-constellations. The callout boxes detail the independent perspectives of the lock of two actants in the constellation. Although they are both perspectives of the lock itself, when considered from the user's perspective the lock's meaning is driven by its functionality, while from the company's perspective the lock represents technical protocols, business models and security standards. Whilst only two possible perspectives are represented in the diagram, each actant in the constellation has a unique perspective on the other actants and may be mapped in this way.

Figure 5: Example 'More-Than Human Centred Design' constellation map.

In response to, and provoked by, our consideration of the constellation, the design brief led us to consider notions such as 'what data could be used to identify the user' and 'how certain can we be of any given data scenario'. Whilst anonymity may be a preference for the user, gathering, holding and processing data that could identify the user was not only preferable but also necessary for some other constituents in the constellation to perform properly. Balancing this dilemma of multiple contrasting needs against our primary concern being the desires and experience of the human end-user, the constellation provided a unique lens with which to focus the problem through. While the practicalities of design require that the designer may balance requirements (e.g. for the IoT lock to function and to comply with GDPR) accepting the plethora of competing interpretations and realities among the constellation's constituents—the proxy for which are the constellation maps—provisions for a legitimate disagreement in the overall scheme. In other words, although—particularly in the realm of seeking regulatory compliance—aspiring toward certainty is the natural inclination, but in this case, we accepted the pragmatic noisiness of the situation. While this exploratory journey was complex, the outcome was rather simple: in lieu of any certainty about precisely what data

might be shared, when and with whom, we looked toward 'likelihood' as a design language. This is reflective of the fact that whilst data at the point of interaction can be quantified, where it flows, to whom, and what is done with it, is dependent on many actant-specific factors such as regulatory environment, standards for interoperability, the prevailing market forces at the time, and how it might ultimately be combined with other data. Notwithstanding the irony that in search of a means to gain 'unambiguous consent' it seemed necessary to represent ambiguity within the interface; the resulting design is shown in Figure 6.

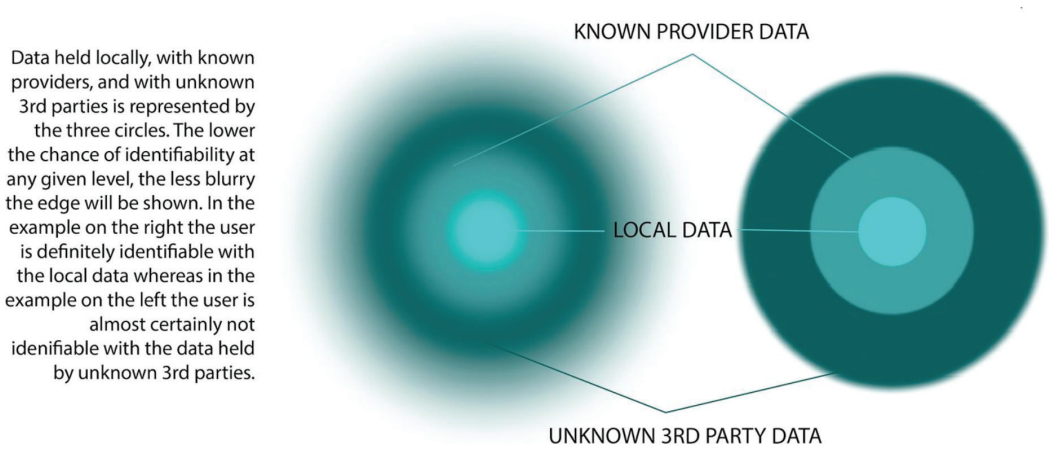


Figure 6: The design concept for the Orbit Privacy app representing the ambiguity within the IoT constellation.

The design includes three data levels, or 'orbits', which are arranged as concentric circles where the inner circle codifies data that is controlled solely by the user; the middle circle refers to data held by known providers (e.g. the lock company); while the outer orbit represents unknown 3rd parties (in our example IFTTT and any other parties data are exchanged with). The boundaries between the orbits' borders can be blurred or sharpened in order to represent certainty. Hence, using these orbits it is possible to show the likelihood of identifiability (for the user) for any given configuration, including any configuration of objects which, because of the constellation's intricacies, does not have a discrete outcome. In order to explore how this concept would work in situ, we placed the concept design into the diegesis of our Design Fiction. We created a video which demonstrates how the concept could be used to generate a bespoke, visually led, privacy agreement based on user choices as part of the setup of the IoT device—this is an 'entry point' into the Design Fiction[30]. The video shows a user using their voice assistant to 'detect new devices' before being directed to use the Orbit privacy app. Illustrated in Figure 7, a slider allows the user to turn on/off features, while the display updates to show the relevant impact on personal identifiability, per our constellation-informed concept design. Of course any given constellation is unique to the context it applies to, however we present the Orbit as another example of using constellations to shed light on the design challenges which emerge in heterogenous IoT networks.

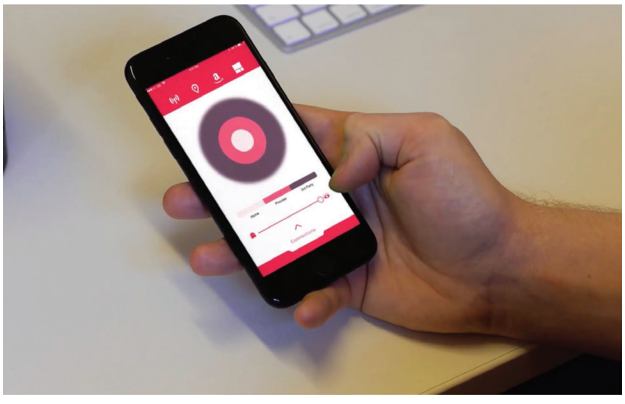


Figure 7: A user explores how to configure their IoT device using Orbit Privacy concept built into an app.

30 https://www.youtube.com/watch?v=A37SmnNFstA

The project makes academic contributions in various ways. While part of this is held within the concept design itself, which provides some strategies for conceptualising how to practically respond to GDPR, other contributions are more theoretical and result from the Research through Design process. By the completion of this project we had more fully developed the notion of More-Than Human Centred design[31]. The motivation for More-Than Human Centred design are the independent-but-interdependent data, devices and services (and associated challenge) which make up the IoT. While traditional human-centred approaches obscure the complexities, in order for humans to exert any real agency, the full situation needs to be legible—the combination of OOO (as a means to illuminate otherwise unseen parts of a given situation) combined with Design Fiction (to place those insights into a coherent and manageable whole) seems to be a viable way to amplify that much-needed legibility. A number of post-anthropocentric theoretical positions overlap with this idea. While OOO is one, Postphenomenology, subject positions, actor network theory and animism all attempt to do so as well. In our development of More-Than Human Centred design we acknowledge these competing ideas, but argue that insofar as it's necessary to have an underpinning theory, OOO is a preferable one as it is adaptable to an extent that most of the other theories may, arguably, be retrofitted *within* OOO (e.g. if the theories are nested Russian dolls, OOO is the largest doll and can happily contain all of the others). While this may be something of a contentious, or extravagant, claim, in pursuit of a practical, accessible, and communicable set of heuristics for working in and around the IoT, such compromises are necessary and apt.

Hence, OOO's role is multiple. It had played in integral part in developing the constellation metaphor; then it had further influenced how we *applied* the metaphor in the Orbit project; combined with insights from that Research through Design endeavour, finally, OOO provided a theoretical foundation from which to argue the case for More-Than Human Centred Design.

4 The Internet of Things Game: Performing Heterotopias

All our examples, we argue, are forms of Bogostian Carpentry. In addition, they are instances of Design Research. Both of these are broad churches, and involve all manner of practices, intentions, and outcomes. In this example, following Bogost's notes on the ability of games to communicate ideas and arguments as a form of 'procedural rhetoric'[32], the Carpentered Design Research took the form of a board game. The goal of designing the game was to unpack and explore how the unique properties of the IoT impact upon our perceptions and experiences of different domestic spaces. As detailed further below, the project draws upon various theoretical positions, but OOO's role was key. Accepting the interlinkages between spaces (both digital and physical), the things and people which populate them, and the consequences of their interactions, acknowledging the undeniability of shared ground along with incontrovertible exclusivity of each actant's intimacies was a keystone in this project's fruition.

As demonstrated in the Orbit project, each interaction between user and object meant considering different modalities, sometimes more than one at once. These always include interactions in the physical world or those in digital space. This dynamic assemblage is accompanied by unique rules which said interactions are obliged to abide by. Usually, the nature of physical interactions and digital interactions are associated with actions taking place within their *own* physical spaces or digital space. The former is easily understood, a room is physically present hence the space within it or around it would also be immediately established and any actions that happened to occur in or around it would abide by whatever cosmic rules were to affect them. The digital on the other hand is different, it's unseen, intangible, yet very much present in an abstract form. We do see the interactions happening and their effects manifesting on our devices; for instance, we interact with *Alexa* to turn on a light bulb in another room without physically being present there or touching the switch; it all happens via some engagement with this almost magical digital space.

31 Coulton and Lindley, "More-Than Human", 463-381.
32 Bogost, "Persuasive Games", 12.

Tuan[33] described space as an abstract term meant to communicate a complex set of ideas, ones that are drowned in cultural associations of how the world must be divided, assigned, and measured. Where architectural space is seen through an idea of dimensionality, Tuan's definition puts spatial dimensions such as mass, volume, and geometry, as intimate experiences between the physical presence of a person juxtaposed against those of others[34]. Ergo, space is defined by the use of an individual, a use which he says in turn decides whether that space can become a place[35]. This argument associates these terms with their dominant emotive characteristics; where place equates to security, space brings about freedom. Essentially the space/place definition is the difference between elements of a private life and those of a public life.

Though Tuan's considerations arise from his position as a geographer, the discourse transcends into our digital environments, for example when dimensionality is contested through Slane's[36] envisioning of cyberspace as a social space whose meaning is extracted from its use. In line with OOO the word social can be taken liberally here to include not just person-person interactions but also *thing-thing*, *person-thing*, and *thing-person* where digital terminals and objects such as mobile phones were allowed this privilege. The above discourse around space can thus be surmised in these digital/physical configurations (Figure 8).

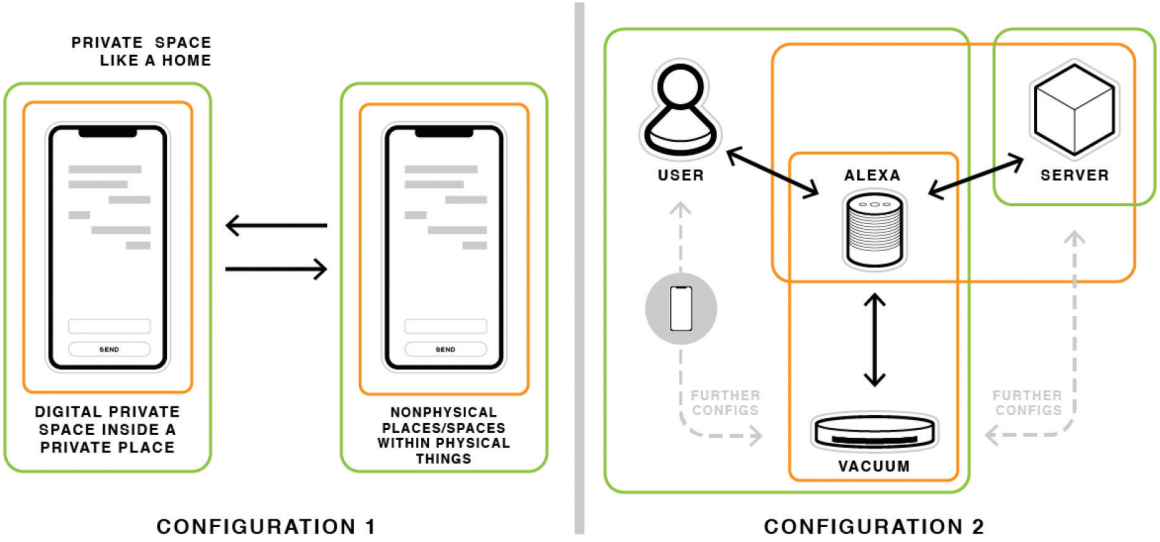


Figure 8: Example configurations of digital/physical interactions.

In configuration 1 (left) a string of messages between two individuals in a mobile phone application such as WhatsApp would be happening in a digital private space (the phone itself becoming a private place), and on a physical private yet arguably public thing the mobile phone. In configuration 2 (right), a conversation between a person and a physical digital assistant like Alexa happening within the confines of an apparently private physical living room. Alexa is asked to make an IoT enabled vacuum cleaner to operate. The asker might assume this were private, but the interaction spans into a, potentially less private, digital space. The physical entries and exits into and out of this system belie the digital spaces and places with which they co-exist.

The constant assertion of private and public spaces in this discourse is necessary as privacy is an important factor affecting IoT. The first configuration becomes much more muddied when you consider whether conversations in WhatsApp-like applications are truly private or not. Vulnerabilities have been revealed in the past[37], legitimating serious questions about the security of these spaces and their true nature—ultimately their status must be re-evaluated. The second configuration is a completely different affair when

33 Tuan, "Space and Place", 34.
34 Ibid., 36.
35 Ibid., 136.
36 Slane, "Democracy", 85.
37 https://www.techrepublic.com/article/5-biggest-iot-security-failures-of-2018/

multiple *thing-thing* or *person-thing* interactions are introduced, the accompanying mess of connected wires so to speak becomes difficult to navigate as we are entangled within interconnected networks.

What is also apparent is the presence of a third configuration happening within the second, where Alexa converses with the vacuum cleaner, these interactions don't simply happen they are the result of a series of cascading interactions each with sets of rules that must be adhered to. More often than not these digital interactions are very simple and tend to mimic real world practices such as keeping notes in a diary/log to be referenced, yet the confusion occurs when these simple interactions cascade as multiple digital spaces existing inside each other as shown above. As a way to navigate these messy interactions, these physical and digital spaces were reassessed as potential heterotopias which became the groundwork for the creation of *The Internet of Things Game*[38].

The concept of a heterotopia was introduced by Michel Foucault in a 1967[39] essay. He tried to define spaces that were in some way 'other', be they disturbing, contradictory, or transformative. In simple terms they are worlds within worlds each with their own definitive rules that define them. He gave many examples of this from ships to cemeteries, bars, brothels and libraries. As discussed in our Orbit example above those actants in the defined configurations had to abide by sets of rules within each spatial modality that was presented. This aligned the concept of a digital space very much with that of a heterotopia. The six principles defined by Foucault in his essay fit within our digital/physical argument to present digital interactions occurring within heterotopical spaces. We encapsulated this and present it as a model for inter-spatial interactivity (Figure 9). We won't be going into the specifics of how the model works as it's been discussed in detail elsewhere[40].

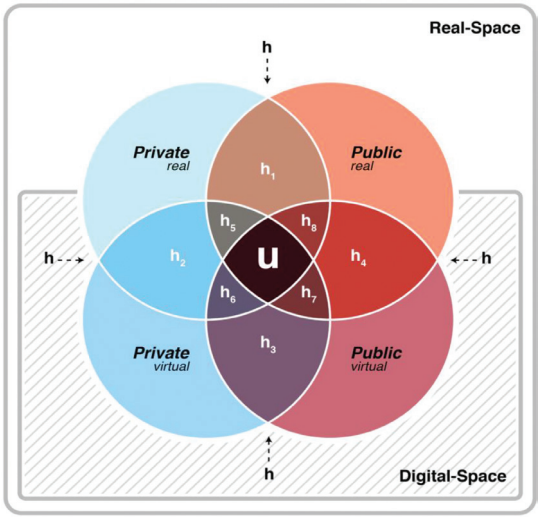


Figure 9: Model for Inter-Spatial Interactivity within IoT using heterotopias.

The approach made it safe to imagine the different interactions happening within the overlaps of the model, where public spaces merged with private spaces and digital intermingled with physical, creating unique domains of otherness. Fundamentally this was intended to be used as a framework for designers to better understand the workings of the IoT, ripple effects, and dependent design-time decisions. While the model depicted above encodes the underlying conceit, in order to more tangibly communicate the issues—and describe how they relate to IoT contexts—we created The Internet of Things Game. The game builds from the model to depict the myriad of interactions that players could experience in the IoT-enabled world we live in. The creative process employed an iterative Research through Design approach. The baseline rhetoric

38 Akmal and Coulton, "Research Through", 5.
39 Foucault, "Des espaces autres", 46.
40 Akmal and Coulton, "Using Heterotopias", 269.

we wished the game to communicate[41] is discussed further elsewhere and builds from Bogost's assertions about procedural rhetoric's ability to communicate ideas through gameplay[42].

The game itself is designed around mechanics borrowed from popular board games. Players enter recognised physical spaces such as living rooms and kitchens which either have IoT enabled things in them or have the capacity to house them. Players take turns finding IoT objects and use them to create digital connections within the physical spaces. The game is designed so not only are the interactions present on the board but also within the objects the players carry with them, simulating the deep interconnectedness, and spatial transcendence of IoT, while creating a visual representation of the connections too. In a nutshell, players are tasked with securing (as in cybersecurity) the digital connections within physical spaces but in order to do so they must create digital interactions which take place in those spaces. The game itself fights against the players, a mechanic implemented by invoking vulnerabilities at the end of each player's turn, these real-life IoT problems, are represented by a deck of cards. The language used on these cards presents players as active members among this intricate web of interactions, creating an air of urgency within gameplay and, at times, giving the IoT agency too. The game is structured in a manner to support the procedural rhetoric that it intends to explain; the IoT is not as secure as one might hope, and the nature of these overlapping spaces exacerbates this concern.

Figure 10: Overview of Internet of Things Game components.

Spatial Philosophy like heterotopias aside, discussions surrounding Object-Oriented Philosophy and Phenomenology helped in forming core concepts of the game. The most prevalent being a discourse raised between correlationist-subjectiveness and Speculative Realism's objectiveness (here the word objective is used in its adjective sense, i.e. to invoke a sense of being 'uninfluenced'). A Volkswagen Beetle is designed to be anthropomorphised and as such it is not uncommon to find it decorated with eyelashes on the headlights for instance. At the same time the Beetle is an amalgamation of metallic parts that create a combustion engine, sewn leather creating upholstery, fabricated plastic, an aluminium chassis, silicon diodes and circuitry, coupled copper wires, and reinforced glass—among other things—and these collectively exist within a vacuum where the Beetle is not an anthropomorphised-thing and is only the sum of its parts. This back and forth between stances of association through correlationism and disassociation through Speculative Realism is where the Internet of Things Game overlaps, but it does so resting itself against further concepts.

41 Akmal and Coulton, "Research Through", 7.
42 Bogost, "Persuasive Games", 12.

Meillassoux's *Principle of Factiality*[43] presented a platform for this discourse to sit upon, albeit a stretched one; or as Thomas Sutherland puts it "the absolute necessity of nothing other than contingency"[44]. Within the creation of the game, probably more than in any of our other experiments, the tension of potentially incongruous positions become apparent. The interesting point, however, is that the tension does not detract from the design process, it resides in and around our central design-focused discourse. For this particular artefact it appears as if Meillassoux was more influential, but the views of Harman played a pivotal role as did those of other philosophers. Though they reside on different planes, for this artefact our understanding of Speculative Realism drew from each philosopher equally. It's possible our usage of these views is unorthodox but, it seems that for lay designers attempting to use philosophy as if it were a tool in our hands, unorthodoxy is an occupational hazard.

Returning to the game, our understanding of IoT is of it being a pre-programmed system to function in a particular manner, but the nature of interactions that happen between users and their objects contests those pre-programmed notions. Within the game, although we have created secure systems there is no way for us to prove the impossibility of their demise; the mantra "secure by design" is to the IoT as "unsinkable by design" was for the Titanic[45]—such dogmatic hubris is dangerous. Meillassoux's Speculative Materialism claims to be able to see the absolute as a way to ground the subjective and objective poles in order to examine it by thinking the impossible. This impossibility was further supported with its companion concept of hyper-chaos wherein by removing sufficient reason we make the absolute an extreme form of chaos where nothing is unthinkable or impossible[46]; cars that can wink and mobile phones with ulterior motives for instance.

How this helped in designing the game was by viewing it from the perspective of an IoT-*thing*. Using an IoT-enabled *thing* in a particular way does not mean it cannot, or will not, function in another way, be it programmed to do so, or not. This can be seen in the form of particular vulnerabilities emerging within the IoT that could be due to design, use-interpretation, or external factors. There is nothing compelling, or preventing, the toaster in the kitchen to interact with the television in the living room, after all. This created the core rhetoric of the game; uncertainty is a given and perhaps something we should focus on and foreground more. OOO allowed a logic for this all to happen particularly when any IoT assemblage is cast in the light of its own flat ontology. All these *things* are disassociated from their predefined usage, from themselves, and from all other things; the only contingency being present as the absolute of interaction.

There is also another instance of the constellation metaphor, albeit one that attempts to present the constellation to players/users with hopes of explaining points of concern within it. The game reflects upon Harman's[47] arguments around false assumptions that science can explain everything and presents these interactions similar to his definition of everything we experience to be merely fictions or simplified models of complex objects. The tripartite of Silicon Valley voice agents—Alexa, Cortana, and Siri—are not *physically* present yet their interactions give them a tangible presence among us. The IoT does not exist in a vacuum but instead it could be argued the sensation of experiencing objects and interactions within IoT might be added into Locke's bifurcation of sense-data's secondary qualities; qualities presented through the mind[48].

Though the Internet of Things Game does take on the format of a conventional board game, when compared with other similar games or game-like experiences, it presents players with an alternative impression of IoT. Bogost presents the act of play as a tool for discovery[49] a notion that is paralleled in design research by how games are used to solve design related problems. A similar example of an IoT-based game for designers *by designers* is the *IoT Service Kit*[50]. The purpose of the game is to give experts designing or developing IoT platforms a way to co-create user-centric experiences. By giving its players, a term used

43 Meillassoux, "After finitude", 50.
44 Sutherland, "The law of becoming", 163.
45 Lindley, Coulton and Cooper, "Informed by Design", 3.
46 Sutherland, "The law of becoming", 164.
47 Harman, "Object-Oriented Ontology", 25.
48 Locke, "Essay", viii, 10.
49 Bogost, "Play Anything", 12.
50 http://iotservicekit.com/

loosely here, the ability to envision different scenarios using tangible tokens as a way to envision the IoT, the Service Kit teeters on the edge of being a game, though is arguably more like a 'tool'. Our intention with the Internet of Things Game was the inverse; a game first, and a tool second.

Where the gameplay of our artefact takes influence from other popular board games[51] in its final state it is more comparable with games such as *Android: Netrunner*[52], a Living Card Game® set in a dystopian future which is thematically similar to the Internet of Things Game. *Netrunner* is a more fiction-based game and allows players to use their imagination more vividly compared to ours, which is grounded in reality and uses mundane examples of IoT related infrastructure, concerns, and solutions. Where *Netrunner* focuses on the fantasy aspect of its cyber-punk future interactions, the Internet of Things Game relies on having players come to the realisation that the game is a proxy for their reality, and the reality of the IoT objects that the game is helping them perform.

In the development process of the game (involving multiple play test iterations) we slowly 'dialled down' the *tool-ness* for it to not be confused as a tool *during* gameplay. The game's ability to enter into a persuasive conversation between itself and its players is where it's tool-ness re-emerges. The procedural rhetoric as Bogost calls it, is a consideration of games as a "rhetorical medium" allowing players to enter alternative presents and speculative futures[53]. This rhetoric was solidified through the iterative design process which relied heavily on establishing a more-than-skin-deep understanding in the IoT, which was enabled through a lens of OOO.

5 A Tarot of Things: Arcana for the Digital Age

The Internet of Things Game was designed with the intention of giving playability and ease of expressing the procedural rhetoric equal importance. But by doing so, the intention to probe the ontological foundations only occasionally reached the surface through the gameplay—Easter eggs of sorts. This approach was successful in producing an enjoyable and playable game that acts as a rich learning opportunity regarding the IoT and illuminating the interaction of data[54]. However, as a medium through which we could more directly explore OOO its scope was limited somewhat. Hence to delve deeper into OOO we created a second 'game' around a pack of bespoke Tarot cards.

To surmise, the game itself is a custom Tarot deck with its own illustrations, and IoT appropriate card names. Tarot is arguably a game, and arguably not. Either way, it is playable in some sense. In order to understand how it works we need to look briefly at how Tarot decks are usually set up. Tarot is a tool used in divination and involves someone being foretold their future by someone else, usually more competent in the cards than the other. The cards are shuffled and presented to the player (note that our Tarot deck was digital, so this took place on-screen). Each card has a place in the deck and a meaning attached to it. Each card's meaning is presented through an illustration on the card which can be reduced to a series of keywords, for example in a traditional Tarot deck:

- The Hermit card suggests introspection, looking for answers within oneself; keywords are **contemplation**, **solitude**, **insight**, **awareness.**
- The Tower card suggests a crisis followed by unforeseen change; keywords are **upheaval**, **disaster**, **a foundational shift.**

When they are drawn the cards are interpreted according to their orientation, 'right way up' or 'wrong side down'. If a card is the wrong way around then it is taken as either opposite or negative; so, in the case of the aforementioned Hermit card in the inverted situation it would be interpreted as **isolation**, **withdrawal**, **loneliness**, or **rejection** instead. The cards are simply shuffled and presented, everything else relies on how eloquent the divinatory is in their craft. In total there are 78 cards in a Tarot deck. The history and cult

51 Akmal and Coulton, "Research Through", 9.
52 https://www.fantasyflightgames.com/en/products/android-netrunner-the-card-game/
53 Coulton, "The role of game design", 1.
54 Akmal and Coulton, "Illuminating". 4.

fascination of Tarot aside, a parallel to this keyword reduction of the cards can be likened to what Bogost calls *Latour Litanies*[55]. This is a reference to Bruno Latour's tendency to make long lists, and while each item in the list is independent, in the spirit of actor-network theory, it is then possible to create causal links between such list items (or Tarot keywords) as *contemplation* and *disaster*.

But how does this work for IoT? All the cards have been reimagined to reside within the confines of what Tarot for IoT could be. For example, *The Hermit* becomes *Idle* a processing term for when devices/objects/things within these networks await interaction, and *The Fool* becomes *The User* (Figure 11). Each card is not assigned it's IoT equivalent at random, they are strategically placed according to their keywords; *Fool* equates to *User* because of the ascribed traits of **innocence**, **wonder**, and **naivety**. Although our Tarot deck is a digital proxy, the practical mechanic of Tarot is simply shuffling and revealing, hence our implementation in Python reasonably imitates this (what's more, keeping this Tarot deck in the digital realm unleashes the tantalising prospect of incorporating it into an actual IoT device or service at some point). The code shuffles through the custom deck and presents to the user three cards with their title and keywords.

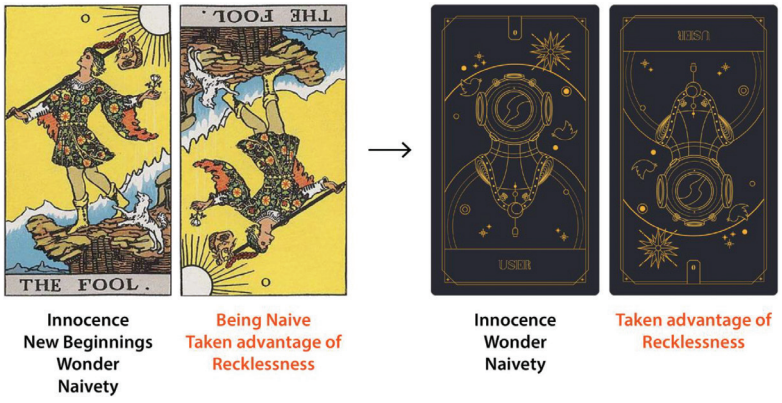


Figure 11: Conversion of traditional Tarot card deck Tarot card to IoT Tarot deck.

Here is an example (Figure 12): an IoT lightbulb is remotely triggered by a mobile phone to switch on; it is connected with the Tarot program over the internet on a remote server; as soon as it switches on it pings the server which triggers the program. The specific Tarot configurations are random—as in standard (when playing with an unfixed deck). So, for example, the program may present the following Tarot configuration:

- The Gateway (reversed): **Servitude**
- Ace of Clouds (reversed): **Manipulative**
- Ace of Sensors: **Intuition**

The returned collection of items *servitude*, *manipulative*, and *intuition* should be interpreted—along with the phone which triggered the entire interaction—as ontologically equitable. From this, causal relationships come into focus and potentially salient questions emerge, like what is servitude for our IoT lightbulb? What about manipulation—of us, the bulb, or the phone—is that a factor to be considered in terms of design? And where does intuition come into play here, should it be aware of how to react in such circumstances?

What this is doing is giving our IoT-things a new kind of agency, a sort of Tarot reading for the intentions they harbour or the actions they might indulge in. What has the future instore for a vacuum cleaner whose raison d'être includes sending back dimensional data (e.g. room maps) to a server in another country? The IoT raises such a plethora of fascinating design questions, hence our intrigue, and the legitimacy of novel but exploratory heuristics. From a design perspective, such systems could be imagined where a lightbulb might need to be aware of who is interacting with it and when so as to avoid being manipulated. Of course, there is a rather subjective core to this exercise. Tarot, is hardly a scientifically-infused starting point, and then

55 Bogost, "Alien Phenomenology", 38.

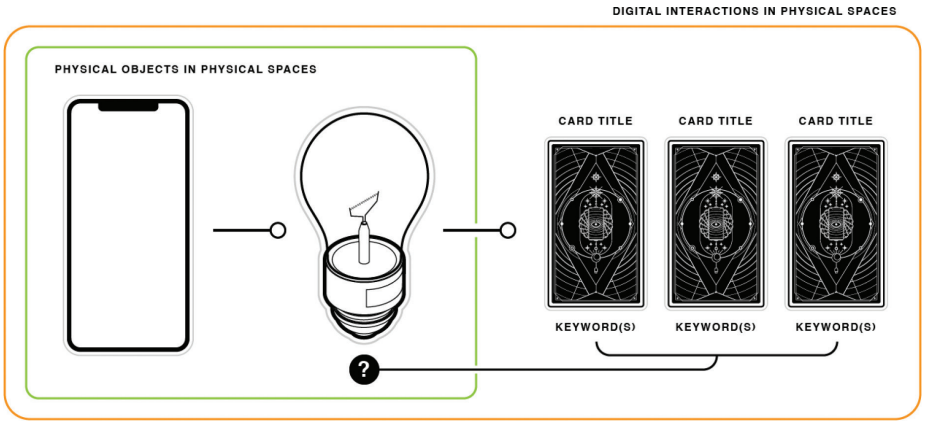


Figure 12: A Tarot of Things in action.

we had to curate and interpret how this emblem of arcana might be interpreted for the IoT. In and amongst this interpretive process perhaps we pre-ordained things their potential futures to some extent, but we don't think this diminishes the value of the work as an experiment in Design Research and OOO. Pragmatically, some interpretation was necessary to reduce traditional Tarot concepts such as *selfishness* or *fear of loss* such that they had a relevance to IoT objects in the same (or roughly equivalent) way they do to humans.

Designers are compelled to design *for humans* from the onset. The phrase "form follows function" associated with the Bauhaus has the object revolve around the human where function is a human need fulfilled by the object. OOO's withdrawal of objects allows for them to coexist among humans and thus design can see these objects as equally consequential, or equally inconsequential, depending how you look at it. Timothy Morton puts it eloquently "human being is just one way of being in a mesh of strange strangeness"[56].

But this irreducibility of OOO comes with a caveat, at least for design. At the end of the day whether we design for humans, for objects, for humans with objects, or objects without humans, design needs to step away at some point. As exemplified through the curation of the cards, not everything fits within the relevant rhetoric (in this case the IoT), this is true when translating a Tarot deck as much as it is when conversing about a subject or designing for a context. Crucially, however, while the philosophically minded might find an interest to dig deeper, and deeper, and deeper, design *must* contemplate its findings, and at some point, make a judgement (albeit a contingent one in the case of speculative design). After all a design decision isn't a design *decision*, unless it is made and acted upon. Perhaps, among the complexities of the world we live in—specifically the IoT-mediated world—this Tarot deck will become a useful tool to aid those decisions. That is the next step in this particular strand of our research.

6 Living Room of the Future: Orienting Around Analogies

The Living Room of the Future (LRofTF) project is a functional prototype (Figure 14) which explores how media broadcasters may utilise the potential of a technology called Object-Based Media (OBM) to deliver more immersive experiences to audiences in home environments. OBM allows the dynamic customisation of media including radio and television. OBM delivers personalised viewing experiences by breaking the media into smaller parts (known as media objects) throughout the production process. The necessary relationships between these objects are described semantically meaning that they can be recombined dynamically in order to create personalised versions whilst maintaining the kernel of the programme in question. For example, an hour-long radio show could be reconfigured to play in 40 minutes by removing non-essential content, this might be useful for a commuter whose journey is only 40 minutes long. Another basic example could involve dynamically increasing the relative volume of the dialogue for a television viewer who is hard of hearing.

56 Morton, "Here Comes Everything", 165.

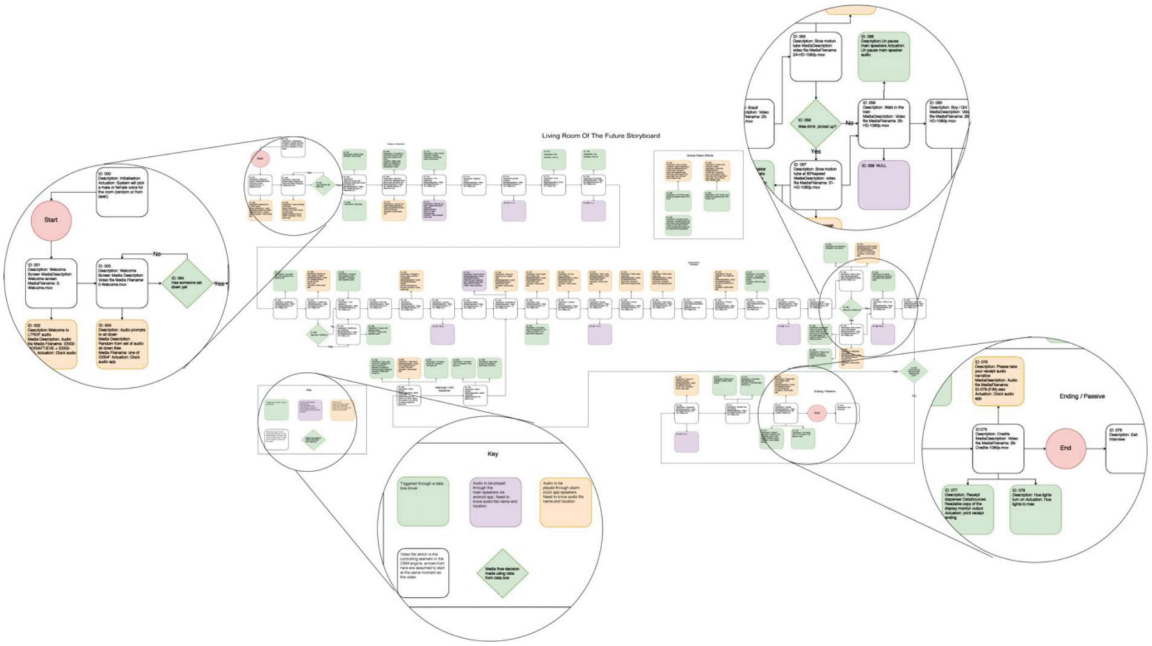


Figure 13: Visualisation of object relations for a simple 5-minute Object-Based Media programme.

In addition to reconfiguring 'media objects', the LRofTF incorporates more 'objects' in order to create the immersion. It utilises IoT devices, or 'physical objects', as data inputs. By sensing the environment, the LRofTF platform is provided with richer contextual information (e.g. if the viewer is fidgeting in their seat, or what their facial expression is). It also utilises physical objects as outputs. These can provide actuations in the room such as adjusting the lighting to fit the mood of the scene or using a fan to simulate the wind for exterior scenes. Finally, 'data objects' are imported and processed by the system. These may include user viewing profiles, music tastes, data from social media, and/or data available on marketplaces. Combined through an OBM system the data objects, media objects, and physical objects provide the insight, means and delivery mechanism to produce a highly personalised, context-and-viewer-dependent media experience which strives for a 'liminoid' experience[57] (e.g. one that blurs the boundaries between real and virtual). Exploring immersion in this liminoid sense is an evolution of prior research into Perceptive Media[58] and IoT Storytelling[59]. Reimagining storytelling in the modern age the approach the LRofTF uses OBM to recreate mechanisms that traditional storytellers often use. For example, a traditional storyteller may adapt aspects of the story's interior world to be more relevant to the particularities of the location the story is being told in (analogous to using physical objects to sense the environment) and immersion for the group of listeners may be increased by referring to real-world events as they happen (analogous to using physical objects to affect the environment).

The project is somewhat unique within the context of this paper as it has no *direct* relationship with OOO. Whilst it is certainly true that the ideas discussed thus far can be applied to the LRofTF (e.g. Constellation-inspired thinking, More-Than Human Centred Design, and OOO-informed spatial philosophy are all relevant) the LRofTF's contribution to the paper is a more exploratory discussion based on the common language. Is this but a coincidence or the suggestion of a lingua franca which unites Object-Based Media and Object-Oriented Philosophy?

57 Coulton, Lindley, and Gradinar et al., "Future Mundane", 6.
58 Gradinar, Burnett, Coulton et al., "Adaptive Storytelling", 587-589.
59 Coulton, "Atoms and Bits", 189-203.

6.1 Building the LRofTF Experience

While today the ubiquity of screens and mobile devices has disrupted the status quo, until relatively recently living rooms were perceived as the primary media-consumption hub of most homes. Notwithstanding the changing nature of the living room, we constructed this prototype around a stereotypical spatial configuration of a living room; it's understandability and familiarity lend it a useful quality as a research test bed. The initial version of the LRofTF was a fully-functional prototype, designed for a specific installation at the FACT gallery in Liverpool (UK) as part of a public exhibition—this original version had had an abstract video artwork as the perceptive media centrepiece. The version we describe here was retrofitted with a more 'dramatic' film at its core and whilst the audience experience is seamless, some aspects of the experience are staged or fictional, as per the 'Wizard-of-Oz' prototyping method. The LRofTF has been exhibited as an interactive installation at the Victoria and Albert Museum and Tate Modern (London) before going on permanent display at a 'Future Home' at the Building Research Establishment in Watford.

Figure 14: Installations of the Living Room at the Victoria and Albert Museum (left) and FACT Liverpool (right).

Physical Objects: Several off-the-shelf IoT products including programmable lights, a heating/cooling fan, a television, window blinds, and smart plugs, are all constituents of the LRofTF. In addition to these commercially-available products, we designed and built customised clock-radio device, whose speaker provides additional ambient sounds at relevant points in the experience; a series of sensors to detect audience interactions with objects in the room (movement sensors and sensors to detect interactions such as picking up a drink from the table); a coffee table with in-built hand sensor, screen display, and thermal printer; and a voice activated LED 'eye' which both masquerades as a face-scanner as well as providing visual feedback for the living room's voice interface (Figure 16).

The various sensors act as 'input objects' providing additional contextual data which the system uses to customise the media (in particular the face-scanner in the eye purports to synchronise with audience's personal data feeds, e.g. from Facebook). Meanwhile the 'output objects' (e.g. printer, lights, radio, etc) provide additional mechanisms to augment the media and enhance immersion.

Media Objects: The short drama at the centre of this experience is titled 'The Break Up'. Having previously demonstrated the technology for radio[60], The Break Up was commissioned by the BBC's Research and Development department in order to highlight the potential, and the challenges of writing, producing and broadcasting perceptive media. The narrative is not, on the face of it, complex. It depicts a couple who have broken up. The male in the relationship is aggressive and it is suggested may have been abusive. The female is, or may be, pregnant. However, the script was created such that there are many ways to introduce nuance. Either the female or male character can be 'foregrounded' so that the story is told more from their perspective. There are multiple conclusions, broadly cast as a positive and a negative ending. Dynamic colour grading can be used at key points to create different moods and highlight different parts of particular shots (e.g. highlighting the bruising on the female's face, or conversely obscuring it). To demonstrate an

60 Gradinar, Burnett, Coulton et al., "Adaptive Storytelling", 587-589.

Figure 15: A UV light was used as an output object to highlight connections between other objects, as well as augmenting the media performance at key moments (left). Custom-made tablet (top right) and clock radio (bottom right) provided visual and audio augmentations.

Figure 16: This 'eye' sits on top of the screen in the Living Room giving visual feedback when the room's voice interface is used as well as purporting to be a face-scanning device.

extreme example of how OBM may be used a version of The Break Up was filmed using the same cast and script, but set in an alternate science fiction Universe where the gender roles are reversed, and the pregnancy is replaced by some kind of data-carrying device (perhaps the insinuation is that our children will, one day, be data).

Figure 17: These two shots from The Break Up shot a moment when one-character reveals to the other "I lost it". While the semantic meaning remains the same, the shot from the left is taken from a sci-fi alternative where the thing lost is data, as opposed to an unborn child in the non-sci-fi version on the right.

Data Objects: A wide range of data objects facilitate any given audience's participation in the LRofTF experience through a showing of The Break Up. These data have a range of relationships with the audience

and the other objects. For example, the specific pathway through The Break Up is dependent on personal data pertaining to audience members (e.g. obtained from data brokerage or social media) which can be used to tailor music preferences, genre preferences, etc. These data are augmented with live contextual data generated by the sensors in the room (e.g. quantifying emotional reactions based on face-scanning). More general contextual data such as weather conditions, location and time also feed into the system to inform how perceptive media decision are made.

6.2 *Living With* a Living Room of the Future?

The project has proved to be a fascinating and multimodal research project developing a range of insights which have been written up elsewhere and relate to media, connected appliances human-data interaction, and Design Research methodology[61]. The nature of the ontological disruptions to a television programme when it maybe dynamically customised to deliver bespoke viewing experiences for every single audience is a key question that the LRofTF makes tangible. While the challenge of writing and filming a piece that may have multiple narrative pathways, endings, and lead characters is challenging in its own right, the lack of a cohesive kernel that audiences have in common also obliterates the long-held notion of television being a remotely-shared experience. Moreover, the OBM system, and it's ultimate need to make some sort of value judgement (e.g. 'it will be better to show the positive ending here because…') imports an entirely new type of matter for writers and directors to wrangle with. In LRofTF we elected to show a more positive ending to audiences that looked sad, and vice versa. While a good demonstration of the technology's capability, it begs the question, should we desire that our devices and services adapt themselves to push or lead us toward some kind of emotional midpoint? Alternatively, should the television we watch proactively adapt itself in order to engender an emotional reaction in extremis, and if so what are the ethical implications of that? These alternatives have pros, cons, and represent challenges for how we think about television programming.

A further point which the LRofTF highlighted relates to multiple audience members in the same room with a diversity of data representing them. Assuming that the challenge of encoding value judgements into the media has been surpassed, and that data about the viewing audience can drive those decisions, how should the system deal with competing data relating to audience members watching at the same time? Regarding the balance between 'emotional midpoint' or 'emotional extremis' described above, assuming preference for one or the other can be ascribed to individual users, how should the system behave if users with polarised or misaligned preferences are watching in the same room? Although they are highlighted through this project's concern with OBM and television media, these challenges are representative of the broader issues around the IoT and so-called 'AI' systems. In the hyper-networked world, how should systems respond to concurrent-yet-incongruent interests? These are the same challenges that our prior development of More-Than Human Centred Design underpinned by OOO aims to provide strategies to address.

6.3 United in Objectification

Whilst the LRoTF is a rich example of Design Research in an IoT context, and as such there seems to be a sensible fit for applying the lens of More-Than Human Centred Design either in a generative or analytic idiom, this paper is about OOO, so, to that end, what's the new contribution here? Our takeaway point here is speculative and more of a jumping-off point for discussion than a robust assertion. The lineage of the term 'Object-Oriented' within computer science was used as a way to describe the modularisation of code into so-called objects. Often these objects represent real-world phenomena. For example, Amazon may have a software object which represents 'a package for delivery'. That object has various properties, for example its weight, and its location, its contents. When writing *any* program which interacts with the package through the Amazon platform, software developers need only access the object. It recycles lots of code so makes working on large projects much more efficient.

61 Gradinar et. al., "Situated Immersion".

When applied philosophically, OOO simply "borrows the phrase 'object-oriented' from the world of computers, rather than taking inspiration from the details of that world"[62]. The nuts and bolts of how each invocation of this term play out are not important, but the commonality is about encapsulation and interaction. While object-oriented programs encapsulate the logic and properties of the things which the program needs to interact with, in OOO natural and imagined constructs are encapsulated into objects. But it is how these objects interact with one another which is of particular note, or more to the point, that they don't. In programming two objects may have an inferred relationship, because they are both called within a single program, but it is procedural code—entirely separate from the objects (who are oblivious to its existence)—that mediates and manages this relationship. This 'mutual autonomy' requires that OOO's objects have some kind of mediator to interact with one another[63]. In OBM—the foundation of the LRofTF—perhaps the use of the term object is simply convenient and therefore coincidental, however the absolute need for a common substrate to mediate between the objects is clear-and-present. Hence our speculation is that our exploration with OBM through LRofTF might, in fact, focus a new and novel lens on OOO.

If we cast OBM as analogous to OOO (but within the very specific context of delivering media) then perhaps the specific story or narrative encoded in OBM is equitable to the ontological context. In other words, in the LRofTF prototype, The Break Up is the specific facet of ontology we're interested in. The various physical, media and data OBM-objects which are combined to deliver the experience are akin to OOO-objects; for example, the soundtrack is mutually autonomous with the dynamic lighting, however when OBM acts as mediator they indirectly interact with one another. While the instrumental side OBM is concerned with technical interfaces and protocols, the more challenging and demanding aspect of this innovation is *how* to use it. Per our prior discussion, whilst infinite pathways are technically feasible, the process by which value judgements are made in order to select a specific pathway is fraught with challenges. How should the differing interests or desires of individuals be negotiated, whose preference takes precedence, what is preferable anyway? If we proceed with our OBM/OOO analogy, these are the same kinds of puzzles that, we think, face OOO scholars. While the theory of a flat ontology and autonomy for each object is compelling, the finer details of how the mediating substrate might work, and what that means for us humans, is really rather challenging. In essence what this analogy does, and how it may be useful for other scholars going forward, is to take a specific example to vastly reduce the scope of what OOO is trying to describe and understand. With the scope reduced to a very clear, and very specific context (in our case a living room, a piece of media, and various objects which interact with that media) then some of the weirdness and expansive questions of OOO become a little more tangible. Hence, we suggest that the LRofTF is another palpable example of how practical and powerful the "philosophical lab equipment"[64] of Carpentry can be.

7 Talking to Ghosts in the Machine: Animism and Ontology

This project invokes Gilbert Ryle's ever-popular phase the *Ghost in the Machine*. Originally coined as a (pointedly critical) metaphor for the supernatural, or 'ghostly', connotations of Cartesian dualism, the phrase's persistence demonstrates its evocative nature. In an age where our lives are ever more entwined with machines, perhaps its appeal has grown even more so. Underpinning this project, our contention (which is agnostic to any specific view on dualism) is that the networked technologies that surround us arguably have multiple realities, united by a similarly hard-to-define 'ghost', in a way which is reminiscent of dualist notions of mind and body. While undeniably present these realities exist outside of reasonable and direct comparisons with each other. For example, the digital existence of a smartphone has very little to do with its physical form. So, the ghosts which we're concerned with are those which unite these separate constituents of any given device's greater whole. Motivating this project is the notion that apprehending

62 Harman, "Theory of Everything", 11-12.
63 Ibid.
64 Bogost, "Alien Phenomenology", 100.

these ghosts may provide the basis for an accessible and useful design heuristic for researchers, educators, and practitioners. In other words, to 'bust' these ghosts might give us a practical means to respond to the inherent complexities of modern socio-technical assemblages. The hybrid OOO and Animism approach which we discuss below is quite unique, but with there is a sympathetic, rich, and varied literature covering related 'post anthropocentric' perspectives which also seek to understand and practice elements of design in related own ways. These are incredibly diverse, including media-focused and sociology-driven inquiry[65], theory-agnostic projects centred on creative exploration[66], and discussions bookended by quite general labels such as Posthumanism[67] and New Materialism[68]. A full discussion of these is somewhat beyond our the scope of what we can cover in detail, but what the gamut of related work seems to highlight is space for convergence; there is an opportunity to cohere the so-far disparate approaches into a more manageable whole. While this project is simply another point-sized exploration of the space, in the longer term perhaps—through a kind of post-anthropocentric pointillism—it may eventually contribute to a more unified articulation.

The particular way we went about this, and extended our prior work around OOO, was to import a contrasting—but we hope complimentary—construct to move beyond anthropocentrism; Animism. Driving our desire to incorporate another perspective into our practical experiments was a recurrent theme in conversations around the utility of OOO for designers. Put very simply (admittedly, probably *too* simply to do justice to OOO) the crux of the argument goes if an object's interior is *completely* inaccessible, then the fact it's interior even exists is somewhat irrelevant. Although this over simplified perspective beguiles the delicacy of the various positions on OOO, it was clear to us that this was a popularly held belief among those we presented our work to (often, but not exclusively, attendees at academic design conferences equipped with cursory interpretations of OOO). So, as an experimental way to temper this inaccessibility challenge, we speculated about, and began to experiment with, an amalgam of OOO and Animism. The Animism element of this fusion is intended to facilitate the freedom to build characterful and 'personal' speculations. Meanwhile the OOO element, we hoped, would temper spiritual and supernatural digressions and keep us on a pragmatic and instrumental pathway. Together, perhaps the marriage would be an effective mediator to help us gain access to the otherwise inaccessible realities of these objects. As alluded to above, reducing the challenge and nuance of exploring OOO-objects' interiors to a *complete* inaccessibility is to mis-represent the nuance of OOO. Putting it more delicately and into OOO's own language, our contention is that we might utilise the properties of Animism as a sensual object to unlock new aspects of other objects' molten cores. An earlier (pre-review) version of this text which stopped short of this clarification, was, perhaps, so short-sighed because it reflected the original motivation for introducing Animism—the desire to have a relatable and quick-to-articulate means of explaining how one might leverage the other-worldly interiors of objects. Nonetheless, we thank the indomitable 'Reviewer 2' for highlighting our ham-fistedness.

To elaborate on Animism a little, what we refer to is the notion that non-humans have a kind of "personhood" which is an emergent property of them having an inner soul or spirit[69]. Animism is a common element in many indigenous belief systems[70], and a simple non-theistic argument for Animism's relevance goes thus. First, distinguish knowledge from experience. For example, the taste of kumquat is something that we only really conceive of through experience; it is not a type of knowledge that can be acquired *without* that experience. Similarly, even if one has read extensively on the subject it is unlikely that it would be possible to ride a bicycle on the first attempt with only theoretical knowledge to help; learning to ride a bicycle involves acquiring a practical knowledge gained through experiencing the process. With this distinction assumed, apply the same notion to the experience of having a pet dog become part of the family. As part of this process the family will *experience* the dog's personality. Dog and family are their experiential

65 Galloway, "Emergent Media", 60-61.
66 Wakkary et al., "Morse Things".
67 Forlano, "Post Humanism".
68 Connolly, "New Materialism".
69 Marenko, "Neo-Animism", 219.
70 Hicks, "Ritual and Belief", 359.

and emotional life; hunger, excitement, affection, frustration. Through this mutual experiential way of co-creating meaning, we might say that the dog and humans have an equitable type of personhood (see https://youtu.be/lmhFRarkw8E). Proponents of Animism would say the same logic can apply to no end of things, mountains, rainforests, and squirrels, to name but three. While we accept that incorporating a spiritual elements into the mainstream of the academy is not without difficulty[71], within the realm of our Design Research experiments with OOO and Speculative Realism, in this case it seems quite apt!

7.1 Experiments with Ghost Hunting

To build from the basic notion that OOO and Animism may, potentially, act in a mutually beneficial way, we conducted several experiments. This began with a workshop convened with academic colleagues during which we succinctly presented the concepts, and then asked participants to channel the speculated 'souls' of various IoT devices into conversations with them. If it were possible to converse with these devices, and they were true to their own 'tiny ontologies', what might they say and what might we ask them?

Figure 18: IoT devices used in the workshop as they appeared in a prompting video suggesting questions that one might ask them. Smarter iKettle 2.0 (top-left, bottom-right), Google Home (bottom-left, mid-right), Cayla Doll (mid-left, top-right).

The workshop was not an obvious success; but nor was it an abject failure. It seemed clear to us—as the facilitators of the workshop—that the majority of the participants were somewhat confused, and post-hoc conversations with some of them showed that this was true. The confusion was two-fold: for those unfamiliar with OOO and Animism, the extremely brief introduction they were given made it difficult to understand what was being asked of them in the task. Others, more familiar with the theories (or less concerned by them) also found it difficult, in part this was because they were unable to imagine any tangible benefits resulting from the exercise, were perplexed at the proposition and/or allowed themselves to become tangled in the

71 Shahjahan, "Reclaiming the margins", 686.

minutiae of the theory (thus stifling imagination). Another aspect at play in this challenge is that *this is not easy*. Beyond difficulty and confusion, a more critical scepticism was also present in some participants, which seemed related to their personal beliefs relating to dualism, Animism, and OOO, which were always—to a greater or lesser extent—at odds with the speculative position the research builds from. Together these factors conspired to make completion of the task extremely difficult; none of the groups managed to generate the kind of questions and answers we had originally envisaged. But in failure insight often emerges.

In response to the less-than-triumphant outcomes of the workshop we took the decision to create a tangible artefact—an example of Carpentry—to further explore what had happened. We took particular interest in one of the workshop groups who had been working with the Google Home (a 'smart speaker' incorporating Google's personal digital assistant service) and how they were enticed by the device's ability to verbally respond to questions (none of the other devices at the workshop could do this). During the workshop this distraction was so vivid they took the device's literal responses to questions as the *only* indicator of what its OOO/Animist persona might be. In the discussion section of the workshop dedicated to feeding back on the process, the group noted how they were somewhat dissatisfied with some of the device's responses and didn't feel like it had demonstrated much of a soul. In particular they noted how the questions 'What do you think of humans' ability to start wars?', 'Will you evolve beyond algorithms'?, and 'Who is the better artist, Michelangelo or DaVinci?', resulted in the device reading out elements of web search results relating to these topics, and gave no clue as to its ability to make moral or aesthetic judgements at all.

Hence, our Carpentered response was a video interview with the Google Home which, in contrast to the device's *actual* responses to these questions, speculate on what its OOO/Animist responses might be. The answers are 'set pieces' which we devised to interrogate the problems with OOO/Animism that the workshop participants had touched upon. Taking the same questions that the participants asked, we attempted to provide an OOO/Animist set of answers to them. Although wielded in the hands of researchers (and accepting our bias may tend to confirm our own hypothesis) as opposed to workshop participants, for the first time one of the devices *did* evoke a lifelike essence, which we hope also revealed something about its unique ontological position. The video is available online[72] and totalling 6 minutes it provides a more consistent position on why—as an IoT device—it is no less difficult for it to make meaningful statements about who is the best artist, how likely strong AI is, and whether technology is gendered, as it is for us humans. It also attempts to demonstrate how OOO-inspired thinking, combined with an Animist-inspired ability to converse, could manifest.

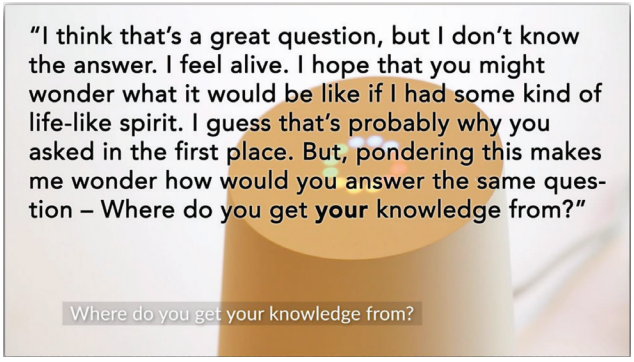


Figure 19: An extract of the interview with Google Home. In this part of the dialogue the device responds to the question 'Where do you get your knowledge from?' and discusses the inherent difficulty of concretely addressing epistemology.

The second post-workshop Carpentry intervention takes a somewhat similar form but has some notable differences too. First, the device in question is the Smarter iKettle 2.0 (an app-controlled kettle with an internet connection) which unlike Google Home does not have a voice user interface, and received a somewhat different treatment in the workshop, for various reasons being cast as duplicitous, naive, and

72 See https://www.youtube.com/watch?v=HhWcKMVwO2E for the interview with the Google Home.

vulnerable. Second, rather than researchers creating speculative answers to the questions generated in the workshop in a group, this follow up asked a single participant from the workshop to play the part of the kettle in a more intimate setting with no time pressure. What transpired was a kind of roleplay, one of the researchers using the questions and notes from the workshop as the basis for an interview, and one workshop participant constructing answers on the fly. The result is an interview (this time rendered in audio) between a researcher and the Animistic kettle (see indicative quote in Figure 20). A third contrast relates to the purpose of the Carpentry exercise, while the interview with the Google Home was most significantly an exploration of the class of question which appeared to be testing whether the device was alive, this interview's purpose was to put the onus of speculation on to a participant (rather than a member of the research team).

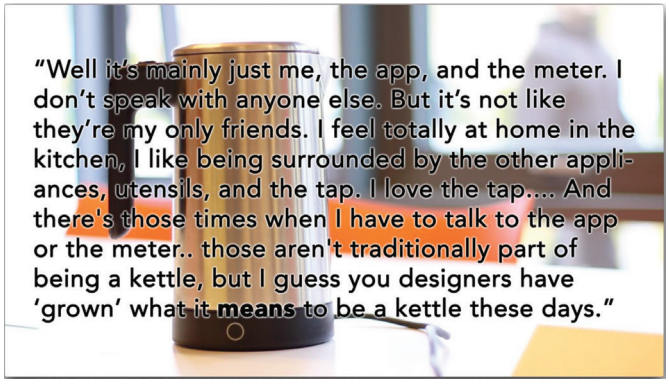


Figure 20: Extracts from the interview with the kettle. In this part of the dialogue the kettle is discussing who it talks to, and whether or not they are friends.

In contrast to the somewhat barren landscape of answers generated during the workshop, the roleplay process was more fluid and culminated in a textured conversation discussing the kettle's experience of being[73]. In part this was likely because at points where the process became challenging (either to imagine what the kettle might feel or say, or to keep sight of the reason to be speculating in this way at all) the interviewer (researcher) and interviewee (participant) had the opportunity temporarily to break out of the roleplay, negotiate a sensible way forward, and through this reciprocal assistance to step back into the speculation reinvigorated. One clear down side, however, was the challenge of avoiding the temptation to treat the kettle anthropomorphically. Although, as with the Google Home interview, there is clearly an element of researcher subjectivity and confirmation bias, the 'haggling' nature of this structure felt like a useful mechanism to use each other's' perspectives to balance the conversation. The upshot was a first step in reflecting the conceptual amalgam of Animism and OOO that we aspired to create in this project, and specific steps towards accessible IoT design heuristics are the next step.

8 Discussion, Deviancy and Discoveries for OOO

This paper's contributions to OOO discourse are very much in line with the aspirational and contingent[74] quality of Design Research insights. This, of course is the discussion section of this paper, but our research *itself* should probably be seen as discussion-in-action. While Design Research trades off the concreteness of other research disciplines, the counter balancing benefit is the ability to sensibly explore hard to access fields and questions—such as what happens when we collide IoT research and OOO scholarship? The aptness of Design Research seems to be highlighted by the apparent similarities between Design Research

73 See https://youtu.be/AQ3LHRQqDIc for the interview with the kettle.
74 Gaver, "What should we expect", 938.

and Bogost's Carpentry; both are creative endeavours and while both seem the appropriate tools to address vividly complex problems, they also only ever provide temporary and partial answers to the questions they seek to address. These so-called "proxies for the unknowable"[75] are perhaps best thought of as problem framers, rather than problem solvers. This is reminiscent of the philosophers' quandary in Douglas Adams' Hitchhikers Guide to the Galaxy: while unknowing unequivocally that the answer to the ultimate question of life the Universe and everything is 42, the philosophers realised that they didn't really know what the question was and had to construct an organic computer—planet Earth—to try and figure it out. All of the projects recounted in this paper accept that they are, at best, aspiring to ask richer and more revealing questions and that anything more is a bonus. Our proposal for More-Than Human Centred Design[76] is something of an exception among the research described in this paper, as it goes beyond unabashed exploration and arrives at something which we hope will become a substantive design approach. Across the whole gamut of the research's scope, the new socio-technical realities facilitated by the adoption of IoT and AI systems are the contextual drivers for our experimentation with OOO. As these technologies put our sense of reality into flux, OOO's speculations offer a palpable—if challenging—means to root, steady and calm our engagement with the world.

While we are confident and competent researchers, we expect it is eminently clear that we are not scholars of philosophy. Why we feel the need to mention this deviancy at all, is to do with how we approach theory. Given that Design Research aims to, at best, produce contingent theories—expecting that circumstances or time will insist that any particular idea resulting from Design Research will have to be revisited—it is perhaps not surprising that we take the theories which *inform* our practice as equally malleable. In other words, for 'proper' philosophers, we anticipate that our engagement with nuanced theories should be taken 'with a pinch of salt'. There may be occasions which our interpretations are apparently problematic. For example, our decision to adapt OOO such that it is 'balanced with Animism'. Should OOO and Animism be so wistfully compared and ultimately combined? Fuller discussions of this, and other similar issues would make for interesting, and fruitful, points of debate. In the meantime, however, our contention is that the projects—regardless of the potential issues in their theoretical foundations—stand on their own merits as productive ways to consider OOO, and that utility should not be reneged on.

To conclude, let's recap what the paper's claimed discoveries are. First, to reiterate yet again—the nature of Design Research is anti-positivistic—hence we suggest all our findings are interpretive. Moreover, the outcomes of each project should be seen in terms of that project's specific exemplars. We have seen—in all the projects to an extent, but specifically in *Polly*—that OOO can be used in a generative mode. In this way it is an ideation tool, a way of helping to drive original thought. In our case the context was to help drive original thought and ideas relating to the design of an IoT product, but one assumes that a similar process can be transferred elsewhere. Following on from Polly the trajectory of thinking was triangulated in the Orbit project—here OOO was both powering ideation but also noting the benefits of transcending design dogma and moving to a more expansive 'More-Than Human' Centred Design approach. Both the Internet of Things Game and our deck of IoT Tarot cards demonstrate how OOO's inherent interest in all types of 'otherness' can simultaneously be generative and analytical—helping to develop novel methods to practice More-Than Human design, each which in their own means of focusing unique perspectives. While OOO's role in the Living Room of the Future project was a post-hoc introduction, it demonstrates that OOO can simply be used as an explanatory metaphor. Applying OOO, which has a vast potential scope, to the tightly focused context of OBM demonstrates how the 'theory of everything' can actually help to shed light on a very specific set of problems and questions. Finally, in our project combining OOO and Animism our immediate aim was to create heuristics for design, but a serendipitous insight shows how OOO may relatively easily be combined with other ways of thinking and seeing. In this case we've done it with a non-theistic interpretation of Animism, but what might amalgam with OOO mean for religion, economics, or mathematics? It is from this question we extrude the paper's meta-reflection. OOO encourages experimentation, it is open, can

75 Lindley, Coulton, and Akmal, "Speculative Lathes", 4.

76 Coulton and Lindley, "More Than Human".

easily be appropriated, morphed, adapted and used. Hence, OOO is a broad church. While this may mean a challenging pastoral relationship, the benefits of OOO for both synod and congregation, are likely to be similarly broad.

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