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# When Your Toaster is a Client, how do you design? Going Beyond Human Centred Design

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**Abstract:** This paper does not argue that artificial intelligence will make objects truly intelligent but it does make the case that within the sphere if the Internet of Things (IoT) objects will increasingly have *agency*, be making their own decisions responding to data they have collected beyond the direct control of humans. As such these networks and objects can be regarded as actors or stakeholders. There has been an assumption that humans should be at the centre of the creative process since Normans seminal texts , ‘User-Centred System Design: New Perspectives on Human-Computer Interaction’ (Norman & Draper, 1986) and ‘The Psychology Of Everyday Things’ (Norman, 1988). Here he maps out a new direction for good design that has been incorporated into the design mainstream (Sanders and Stappers 2008, Markopoloulos et al. 2016, Coleman and Clarkson 2016).

In an age of automated Bots and IBM’s Watson (Baker 2011) the bedrock of this assumption is being eroded daily. Kortuem et all define the Internet of Things as ‘*a loosely coupled, decentralized system of smart objects — that is, autonomous physical/digital objects augmented with sensing, processing, and network capabilities*’ (Kortuem et al 2010). They draw a distinction between sophisticated but ‘dumb’ systems that for example track the movement of goods through warehouses and systems that use ‘smart objects’ that have a level of understanding built into them. Its these smart objects that characterize a move to the true Internet of Things. Kortuem et al define smart objects as having the capacity to ‘*sense, log, and interpret what’s occurring within themselves and the world, act on their own, intercommunicate with each other, and exchange information with people*’ (Kortuem et al 2010). In this paper we argue that rather than trying to humanise technology considering everyone as a ‘smart object’ offers some interesting and provocative challenges to design that help get beyond human centred approaches.

There is an extensive body of literature examining the idea that everything (including us, ideas, smells...*everything*) can be classified as an object or a thing. With a few notable exceptions, for example Ian Bogost’s *Alien Phenomenology, or, what it’s like to be a thing* (2012) and Levi Bryant’s, *Onto-cartography* (2014) the connections between this area of philosophy and design are not well developed. In

this paper we use this materialist or Object Orientated Ontological (OOO) perspective to explore the implications for design practice. Specifically we look at the fundamental principles of Human Centred Design as laid out by Norman (1988), for example '*Use both knowledge in the world and knowledge in the head. By building conceptual models, write manuals that are easily understood and that are written before the design is implemented*'. We apply an OOO perspective to this, challenging notions of knowledge, the average user, the visibility or explanation of actions and designing for error.

**Keywords:** Internet of Things, Design, New Materialisms, Object Oriented Ontology, Capitalocene

## 1. Introduction

Used Centred Design codified a way for designers to conceive of their relationships with the people that will use their designs. This recognised that the user (or 'human') matters in design processes. Understanding the needs, abilities and perspectives will improve the likelihood of a design being effective. From the genesis of UCD in the 1980s the principles developed then are almost universally applied and adopted. These principles are now part of the foundation of modern design to the point that it seems obvious that the people who will use a product or service should have an input in its design. Here we are seeking to go beyond, and in the process challenge some of the assumptions that underpin UCD.

Increasingly we are seeing decisions being made in the world autonomously, without human control or knowledge. In our everyday lives softwear will decide on the best way to get form A to B avoiding traffic, systems will create lists of music that we will like to listen to, increasingly we will be driven around in vehicles that are making their own decisions about navigating through our road networks. This trend of 'smart objects' making decisions for us is likely to increase and the decisions they make for us will have a greater and greater effect on us. For design this means the decisions smart objects make will start to have a bearing on the success of design projects and how products and services function.

This paper explores the implications of having non-humans with agency or acting as 'users' in the design process. It seeks to energise a debate in this area, prompting new design theory, practice and ultimately a new 'smart object' inclusive design approach.

## 2. Human Centred Design in Context

Human Centred Design (HCD) is an approach to design that places the end users or recipients of design outcomes as a central focus in the design process. Here we are using HCD as an umbrella term for an overlapping collection of classifications of design practices including; people-centred design, user-centred design, person-centred design and user/client-oriented design. While there are distinctions made between these approaches (Zanga and Dong 2008, Steen et al 2004) they all have their roots in the seminal work of Donald Norman in the 1980's. His two books, 'User-Centred System Design: New Perspectives on Human-Computer Interaction' (Norman & Draper, 1986) and 'The Psychology Of Everyday Things' (Norman, 1988) mapped out a new direction for good design. This message based on '*A philosophy based on the needs and interests of the user, with an emphasis on making products usable and understandable*' Norman (1988) is a mainstay of contemporary design education and is widely recognised in professional practice (Sanders and Stappers 2008,

Markopoloulos et al. 2016, Coleman and Clarkson 2016). Later in this paper we will be discussing design processes that go far beyond just inviting people into the designer's process, these approaches such as open design and democratized innovation have citizens (people) leading design processes often without feeling the need to involve designers at all.

The fundamental principles for HCD remain in essence those laid out by Norman in the 1980s, these are

- *Make it easy to determine what actions are possible at any moment.*
- *Make things visible, including the conceptual model of the system, the alternative actions, and the results of actions.*
- *Make it easy to evaluate the current state of the system.*
- *Follow natural mappings between intentions and the required actions; between actions and the resulting effect; and between the information that is visible and the interpretation of the system state.* (Norman, 1988, p.188)

Building on these Norman proposes the 7 principles to enable designers to adopt a user-centred approach.

1. Use both knowledge in the world and knowledge in the head. By building conceptual models, write manuals that are easily understood and that are written before the design is implemented.
2. Simplify the structure of tasks. Make sure not to overload the short-term memory, or the long term memory of the user. On average the user is able to remember five things at a time. Make sure the task is consistent and provide mental aids for easy retrieval of information from long-term memory. Make sure the user has control over the task.
3. Make things visible: bridge the gulfs of Execution and Evaluation. The user should be able to figure out the use of an object by seeing the right buttons or devices for executing an operation.
4. Get the mappings right. One way to make things understandable is to use graphics.
5. Exploit the power of constraints, both natural and artificial, in order to give the user the feel that there is one thing to do.
6. Design for error. Plan for any possible error that can be made, this way the user will be allowed the option of recovery from any possible error made.
7. When all else fails, standardize. Create an international standard if something cannot be designed without arbitrary mappings (Norman, 1988, p.189-201).

We have focused here on Norman's early work because, we argue in the following text, thinking about users could in a way be better and more progressive than thinking about humans as things that engage with design outcomes. As we will see its possible to regard non-humans as users widening the scope of possible key stakeholders in an interesting manner. As such Alison Black's definition of user centred design from the Design Council in 2006 is a helpful.

'User-centred designers engage actively with end-users to gather insights that drive design from the earliest stages of product and service development, right through the design process'. Alison Black (2006)

Here we make the case for a re-evaluation of HCD and seek to challenge the assumption that humans should automatically occupy a dominant position in the design process. As part of this

examination we will also be looking at some of Norman's later ideas, in particular his own critique of HCD in the context of Activity Based Design (Norman 2005).

### 3 Going Beyond HCD

Our aim is not to replace HCD as a rubric or heuristic for everyday design activity across the board. There are excellent reasons why HCD or some version of it has become the de facto approach to professional design. We argue here that there is a changing cultural, social, commercial and technological landscape that will require a reassessment of the fundamental assumptions that underpin HCD. In particular when considering the board area of the Internet of Things the role of humans is complicated by the agency (decision making) of non-human actors. In his paper *Human-Centred Design Considered Harmful*, Norman identifies some of the fundamental assumptions open to challenge in HCD, for example, know your user, adapt technology to people and focus on the static product over the dynamic system (Norman 2005).

Partly these assumptions are grounded in the product centred nature of the principles Norman lays out in *The Psychology of Everyday Things*. Here design creates products (physical or virtual) that have to be understood and used by a public. The result is a focus on instructions and what cognitive load to impose on the receiver of designs in the principles above. The principles reproduced above focus on helping users live with the decisions made in the design process through for example including explanatory graphics or effective instructions.

As we will see below there are many and a growing number of examples where this distinction between designer and user (or person) is not at all clear-cut (Beegan and Atkinson 2008). This has lead to new types of design and innovation that exploit the interplay between use and creation, between designer and user. There are a very broad range of participatory design approaches where participants are welcomed into the heart of the design process rather than being the subject of insight gathering from designers as seen in conventional HCD. Processes such as co-design aim to work in close collaboration with a range of stakeholders (Sanders and Stappers 2008). This requires a new set of skills for the design professional who is becoming closer to a facilitator than translating insights into designs appropriate to the relevant technologies of production, a move from 'gatekeeper to innkeeper' (Cruickshank 2014). Beyond this in terms of the not just the participation but the power of the non-professional designer or person lies Open Design. Here there are design and innovation processes that often have no professional design input at all (Abel et al 2001, Cruickshank 2014). These process, and others, are complemented by innovation models such as Erik von Hippels Democratized Innovation (von Hippel 2006) and to an extent the more towards Open Innovation in business (Chesbrough 2003). This makes a societal case for looking beyond process that allow or even welcome people into a professional designer's creative process.

Its not just in terms of design process that there are grounds for a going beyond HCD, there are also arguments made in terms of social responsibility. Again this is partially recognised by Norman but taken much further by Joaquim Lioveras. In 2009 Lioveras called for a move beyond User Centred Design (2009) instead calling for a Global Design movement, he says

‘in the future hybrid biological-artificial beings may exist that are a mix of biology and technology or some biological beings may be replaced by artificial ones. In the past these ideas were only expressed in science fiction. Robots will evolve and will be able to do many jobs’

Lioveras highlights the tension between a move towards personalisation and a wider community responsibility. For example an individual may want to indulge in conspicuous consumption for

personal gratification but cumulatively this has wider societal impacts that affect us all. This tension can also be seen when the people can easily make their own personal products beyond any outside regulation. While there are a growing number of people making things for themselves there are also growing communities that are interested in sharing and profiting from their designs. This could be through the sale of the physical products or by selling the digital models that can then be either created as they are or modified. There are a number of platforms that facilitate this kind of exchange of products and models for products, examples include Shapeways ([www.shapeways.com](http://www.shapeways.com)), Thingiverse ([www.thingiverse.com](http://www.thingiverse.com)) Quirky ([www.Quirky.com](http://www.Quirky.com)) and Ponoko ([www.ponoko.com/](http://www.ponoko.com/)).

To a designer's eyes some (many) of the designs available on sites such as Quirky and Shapeways are not well designed. 3D printed handcuffs are not robust enough to really act as a restraint (perhaps this is a good thing). More seriously Shapeways has recently removed any gun components from its download database. In America this is a hot topic with 3D printing seen by some citizens as a way to sidestep the real or imaginary threat to their ability to purchase guns via normal means. Groups like Defence Distributed ([www.desfencedistributed.com](http://www.desfencedistributed.com)) have set up an online repository of models that can be used to create gun components ([www.wikiweps.org](http://www.wikiweps.org)).

While Lioveras's ideas have been widely taken up in the area of sustainable design (G. G. Acosta and C. R. Romeva 2009, Lange-Morales et al) the issue of 3-D printing guns puts the spotlight on the ethical implications of citizen-led design and manufacture and draws the relevance of Lioveras' call for an ethical framework out from ecological considerations into the mainstream consumption of products. The open, free creativity and optimism of the proponents of FabLab is facing a challenge by people taking openness seriously this seriously and using technology for their own agendas that are challenging to mainstream or liberal sensibilities.

This call for an ethical framework is not a new debate, it closely echoes the concerns raised in K Eric Drexler's seminal book on nanotechnology *Engines of Creation: The Coming Era of Nanotechnology* way back in 1986 (Drexler 1986). Drexler's solution was to make the means of design free to all but to make the means of making these designs closely controlled. In contemporary society the means of self-production are already in place for anyone with a web connection and developing quickly to maturity. In the area of Open Design, where design is undertaken by people outside the professional design / innovation ecosystem (Cruickshank 2014) there is a growing realisation that when these approaches are used with real people undertaking critical problem solving for that will affect lives (rather than say looking for a new mug or T shirt) the ethics of self or non-expert design are more problematic. In a paper 'Closing in on Open Design' Cruickshank and Atkinson (2014) look at the ethics of a group of open designers with cystic fibrosis designing furniture for themselves as considerable cost the them in manufacturing these designs.

## 4 Escaping the Designer/User Spectrum:

We have seen in the above examples a range of design activity, at one end designers have a controlling agency and welcome people into their design process, at the other end of this spectrum people have controlling agency and through activities labelled open design and democratized innovation they non-professionals have the controlling agency. In both cases we have demonstrated that these positions can be problematic. In this paper we are arguing for a disruption of this spectrum where users central either directly or spoken for by designers. We want to promote a debate by arguing that both conceptually and practically there is a good case for recognising explicitly that non-human actors have the potential for agency. This has the potential to disrupt design approaches that are fundamentally based on humans as the preeminent concern. We outline

the practical and then the philosophical foundations of this position below, drawing on the potential of digital technology and networks and conceptually on Object Orientated Ontologies.

## 5 Smart Objects and the Internet of Things (IoT)

Networking and digital technologies are radically changing the way objects interact with us and critically with each other. Under the broad term Internet of Things (IoT) these capabilities are giving non-human actors agency in our environment. The means of production and ideas such as truth to materials have always had a framing or envelope defining influence on design. Within the IoT we are moving beyond this context setting function to more active modes of contribution by non-humans. In an age of automated Bots, IBMs Watson (Baker 2011) and the Internet of Things the bedrock of this assumption that humans are the most important actors is being eroded daily. A key question for the future of design is how to design when non-human actors in the landscape have agency, respond independently and act as part of a wider system. We already see this in a tentative manner in things like SEO (search engine optimisation) where websites are designed to be more ‘appetising’ to the virtual robots or ‘spiders’ moving around the web cataloguing and understanding the connections between sites to make our web searches ever more effective.

In a key paper in this area Kortuem et all define IoT as ‘a loosely coupled, decentralized system of smart objects — that is, autonomous physical/digital objects augmented with sensing, processing, and network capabilities’ (Kortuem et al 2010). The influential Disruptive Civil Technologies report identified IoT as one of 6 technologies likely to disrupt US interests before 2025. In this report it identifies the ability of Software to ‘makes sense of’ data and other information as a key indicator of IoT development (NIC 2008). In both of these descriptions autonomy (agency) is a defining features. Kartuem draws the distinction between sophisticated but ‘dumb’ systems that, for example, track the movement of good through warehouses using technology such as RFID and systems that use smart object that have a level of understanding built into them, that is they are aware of their surroundings and can respond to changes. Its these smart objects that characterize a move to IoT. Kortuem et al define smart objects as having the capacity to ‘sense, log, and interpret what’s occurring within themselves and the world, act on their own, intercommunicate with each other, and exchange information with people’ (Kortuem et al 2010).

While the examples described here places this activity in a technological context, and smart objects as artificially constructed artefacts, the definition above does not restrict smart objects to the artificial. We humans very much qualify as smart objects here as much a, say, an autonomously driving car. We can all be regarded as potential objects in the IoT with the same potential for agency (no more or less) than the smart objects developed in conventional innovation processes (smartphones, fitness monitors, games and so on). Together these objects interact communicate and reason (have agency). This raises some profound issues for design. In this area it does not make sense to place humans in a hierarchical position, as the centre of focus. In the IoT effectiveness comes from the whole system working together without predication one type over another, often it will be the effective interaction of non-human actors that will determine effectiveness.

There is a rich tradition in philosophy that challenges the primacy of humans. In one sense this can be traced back to Heidegger's Being and Time (Heidegger 1962, 15<sup>th</sup>. ed) through to the writings of Deleuze & Guattari (1996), who in particular have influenced many recent philosophies of New Materialism or Object- Oriented Ontologies. Closer to design we have Levi R. Bryant's, Onto-cartography, An Ontology of Machines and Media (Bryant 2014).

Since 2007 there has been a proliferation of texts, conferences, lectures and books broaching the wider topics of Object-Oriented Ontologies stemming from Graham Harman, New Materialism stemming from Rosi Braidotti and Jane Bennet and wider branches of continental philosophy stemming from Alain Badiou and Francoise Laurelle (Mullarkey 2006). We will consider the diverse selection of philosophies and examine their ramifications in design. Despite the differences between Object- Oriented Ontologies, these philosophies propose that reality can be known without its being shaped by and/or for human comprehension. We will provide a basis for the approaches we believe designers can consider when working with these recent theories.

Supporting this, and in resonance with Lioveras's call for Global Design as a concern for ecological issues, some philosophers in this area criticize environmental thinking for purporting to be focused on the real world but in fact remain rooted in the abstract. While other thinkers, focus on materiality, thereby characterizing an object of one scale or another into a flat interconnected hierarchy (or ontology).

## 6 Rationale for change, a move from hierarchies to a flat ontology:

Describing the nuances of New Materialist and Object-Oriented positions lies outside the scope and space available within this paper but in engaging with some of the core philosophical ideas in this area it is possible to draw out some key issues to be addressed in the reformulation of design processes for IoT. At the core of our interest is how recent Object- Oriented philosophies and New Materialist theories provide a basis for how to navigate and re-contextualise the levels of micro-politics and the personal, local engagement, and issues revolving around sustainability and the various manners in which non-humans have their own agency. Deleuze & Guattari comment on the qualities of micropolitics by focusing on the scale of the components interacting in a network and the nature of those interactions. While the macro scale may be more visible, we are also keeping in mind that you can have a macropolitics of a two person interaction, or the micropolitics of a large group (Deleuze & Guattari 1980).

Object-Oriented Ontologies follow in the philosophical lineage of Deleuze & Guattari and are closely aligned to the philosophies of Bruno Latour and Manuel De Landa. The latter, in his book, Intensive Science and Virtual Philosophy (De Landa, 2002) writes,

'In a flat ontology of individuals, like the one I have tried to develop here, there is no room for reified totalities. In particular, there is no room for entities like 'society' or 'culture' in general. Institutional organizations, urban centres or nation states are, in this ontology, not abstract totalities but concrete social individuals, with the same ontological status as individual human beings but operating at larger spatio-temporal scales.' (DeLanda 147)

Recent critiques of Flat Ontologies, note the tension at play with how Object Oriented Philosophies conceive of relations and how they sit in the hierarchy of the flat ontology. Object- Oriented Ontologies place more attention on the objects themselves and less attention on their relations. In order to expand how we think about design and objects, the ground between New Materialism and Object- Oriented Philosophies can be explored.

The philosophical lineage of New Materialists builds upon Deleuze & Guattari and engages with the question of subjectivity. Deleuzian feminists such as Rosi Braidotti Elizabeth Grosz are examples of this line of thinking. However, this subjectivity is a multiplicity, a post-human one. And it tries to step

away with the 20th century psychoanalytic vision of the subject (schizo-subjectivity) towards a nonhuman one. Moreover, New Materialisms are about political emancipation, more sustainable becomings, and traditions that look into a human-nonhuman continuum, perhaps in a more accountable manner.

A major distinction between Object- Oriented Ontologies and New Materialisms is that the latter actively works on ethical and political projects. Jane Bennett's, *Vibrant Matter*, is "a political ecology of things." (Bennet, 2010) She calls for a new, human relationality towards thing-power. Similar to examples noted by Bennet, Bryant provides an example of the cycle involved in spillages in an ecosystem. He considers how a spillage enters a water supply, moving onto contaminating wildlife and eventually reaching humans who eat contaminated wildlife. Bryant is concerned with how different systems, encompassing both human and non-human elements, are entered in various ways. Echoing Bennet and New Materialist thinking, Bryant remarks, "A body, as it were, is sheathed in a world." (Bryant 2014) Here we can start to see how Bryant is aligning culture and nature in the realm of and how it interacts with the human. This can be a starting point for considering how these theories and how this thinking can be translated to design.

## Implications for UCD

Jane Bennet in *Vibrant Matter, a political ecology of things*, writes:

"I have been trying to raise the volume on the vitality of materiality per se, pursuing this task so far by focusing on nonhuman bodies, by, that is, depicting them as actants rather than as objects. But the case for matter as active needs also to readjust the status of human actants: not by denying humanities awesome, awful powers, but by presenting these powers as evidence of our own constitution as vital materiality. In other words, human power is itself a kind of thing-power. At one level this claim is uncontroversial: it is easy to acknowledge that humans are composed of various material parts (the materiality of our bones, or the metal of our blood, or the electricity of our neurons). But it is more challenging to conceive of these materials as lively and self-organising, rather than as passive or mechanical means under the direction of something nonmaterial, that is, an active soul or mind." (Bennet 2014)

Here we see Bennet invoking various notions of the agency of the components in the body and how systems function. This is aligned with the thinking of Bryant. According to Bryant, his concept of Alien phenomenology is a component of Onto-Cartography. (Bryant 2014 p69) By invoking Spinoza, Bryant outlines that the ethical consideration of 'Alien Phenomenology' helps to extend the boundary of humans and non-humans and opens out the relations of human to non-human to machine; and not just what machines can do for us. Onto Cartography is the mapping of relations or interactions between machines, the mapping of relations between machines and interactions, and how they influence each other or are modified. Bryant writes, about flows and permeability in the similar manner to that of Stacy Alaimo and Nancy Tuana. He remarks, "If we are to change and influence these machines we must interact with them in terms of how they encounter the world so as to devise strategies for getting them to respond." (Bryant 2014 p72) Bryant then postulates that, "... it is necessary to determine the flows to which these machines are open, how they operate out of these flows, and what goals or aims animate these machines." (ibid)

Stacy Alaimo's concept of trans-corporeality and Nancy Tuana's concept of porosity revolve around the notion that things enter and exit a system or assemblage. Stacy Alaimo's (2010) *Bodily Natures: Science, Environment, and the Material Self* uses the concept of trans-corporeality to indicate the porosity of the bodies and inseparability of bodies-environment. Alaimo uses examples of everyday

objects, such as plastics, entering our bodies, especially in cases of Multiple Chemical Sensitivity (MCS). Other cases Alaimo mentions are environmental justice problems - pollution, people exposed to minerals in mining, etc. In Levi Bryant's, *Onto-cartography*, he relies heavily and analyses Alaimo's theories. Bryant writes, "The concept of trans-corporeality, similar to that of structural coupling and binary machines, underscores the way in which bodies are intermeshed with one another, mutually affecting and being affected by each other. Trans-corporeality teaches us of a world where things that seem to be over there and thus apart us intermesh with us in ways that significantly impact our local manifestations and becomings." (Bryant 49)

Nancy Tuana uses the term "viscous porosity", to indicate how our bodies are open to various objects in her article *Viscous Porosity: Witnessing Katrina* (2008). Tuana places human bodies in the middle of a wide range of phenomena caused by Hurricane Katrina and demonstrates how "cultural" things permeate "natural" ones, a point which Bryant also contend. What both Alaimo and Tuana's theories, perform is to erase the boundary between inside and outside through these real-world examples. In this line of thinking, they move beyond traditional Object Oriented Ontologies approaches, which maintain that objects have a fixed interior and exterior.

Here we see multiple strands of philosophy that intersect at a number of points critical to practical design for the Internet of Things, both in terms of the things that are designed but even more so in the processes used for the act of designing. Most important of these is the assertion that hierarchies, especially unexamined hierarchies should be treated with suspicion. This very much applies to the assumption that the human is the 'unit of analysis' that design is built upon. We need to reassess how we design when humans are not the sole yardstick, when non-humans need to be considered as agents in the process.

These theories focus on transformations in the ways we currently produce, reproduce and consume our material environment. The analysis of our daily interactions with material objects and the natural environment is also of importance. We are questioning the place of humans within a material world. Even as things, objects, actants, and the nonhuman engage in a wide array of pursuits, the anthropocentric perspective seems to confine humans certain roles. There is potential for transformation in design which involves innovation in how we build new things, retrofit, reconcile our waste, and what materials and processes we use in the first place.

Recently theorists have been focusing on notions of deep time, the anthropocene, and extinction. With this Latourian line of rationale, comes a focus on the agency of things in relation to the displacement of a politics of the people. Nonhumans, actants, and distributed agency are utilized when thinking and writing about the strategic coming together role of non humans and humans in relation to collective power. There have been calls to collaborate in order to mobilize this collective power. Jodi Dean notes that, "When the scale is anthropocenic, the details of political organization fall away in favor of the plurality of self-organizing systems." (Dean 2016) Theorists such as Dean, argue that the Anthropocene requires a new ontology, while keeping in mind that, "geologic time's exceeding of human time makes it indifferent even to a philosophy that includes the nonhuman. If there is a need, it is a human need implicated in politics and desire, that is to say, in power and its generation and deployment." (Dean 2016)

Christian Parenti's book, *In Tropics of Chaos*, ruminates on the "catastrophic convergence" of the nexus of poverty, violence, and climate change. His arguments centralize on the inequity of this catastrophe, "on areas already devastated by capitalism, racism, colonialism, and militarism." (Parenti 2011) This leads to the recent line of thinking from theorists that public and foreign policies

aimed at reconfiguring economic inequality can be seen as necessary for adapting to a changing climate.

This leads us to consider the engagement of these ideas with , in which the human and non human is at the center of their respective realms. Donna Haraway is at the forefront of the recent theories surrounding the concept of the ‘Capitalocene,’ which emphasizes the place of advanced capitalism in the Anthropocene. Rosi Braidotti's offers a post-human theory, which breaks down the dynamics between the human and the non-human distinction. Braidotti considers the productive potential of the posthuman condition. These lines of thinking beget the questions: How does current design research respond to these challenges and how does it explore the topics of Anthropocene or Capitalocene?

## 7 Implications and Conclusion

OOO and materialist approaches present a rich area of philosophical intervention that problematizes the human as the unit of concern in design processes, especially when designing for the IoT. In this section we will explore a limited number of the implications for design, really the intention here is to start a more comprehensive, far-reaching debate on this area rather than a comprehensive review or offering solutions. To help focus this discussion we will be focusing on two of Norman's seven fundamental principles for user centred design, not to criticise these principles but to use them as a catalyst for a wider discussion about the issues we need to address to reflect the new possibilities of designing for IoT. Norman has already challenged the principles of UCD. In a paper exploring where UCD could be damaging he proposes an alternative called Activity Centred Design (ACD). Broadly ACD is a call for designers to refrain from engaging with their users. ‘Sometimes what is needed is a design dictator who says’ “ignore what users say: I know what’s best for them”’. (Norman 2005) This is a move to (sometimes) free designers to use their intuition instead of engaging with external actors. This is an interesting provocation that maps to real world design practice, in the context of this paper Norman is positioning designers in relation to users in general. Here we argue that users can be regarded as smart objects (both human and non-human), as such this could fit into an ACD approach but its not dependent on it.

The seven principles of used centred design have become part of the DNA of contemporary design practice, education and theory. To stimulate a wider debate here we will look at 2 of these, presenting a series of questions for further exploration when designing for the IoT.

*1. Use both knowledge in the world and knowledge in the head. By building conceptual models, write manuals that are easily understood and that are written before the design is implemented. (Norman 1988)*

This presents a number of challenges

- How can the knowledge contained within smart objects be used / accessed?
- What conceptual models are comprehensible to smart objects? How do these relate to conceptual models comprehensible to humans? How can both of these (or one common model) inform the design of complex systems
- In a networked world, designs emerge and continually evolve rather than being completed, how does this relate to knowledge required as well as knowledge generated within actors in the system as well as cumulatively across the system?

*3. Make things visible: bridge the gulfs of Execution and Evaluation. The user should be able to figure out the use of an object by seeing the right buttons or devices for executing an operation. (Norman 1988)*

- Who is the thing being made visible to? How can/do smart objects experience the world, how does this inform their understanding or experience of the world, how should designers be accommodating this different view of the world?
- How can smart objects be made easy to figure out, and critically how can we design to help smart objects figure out other elements in the design? This notion of affordances for and of smart objects in the IoT, the right equivalent of buttons to change things is core to the challenge of designing for the IoT, what are the affordances for human and non-human smart objects to interact with each other?

There are many questions here, and many more unsaid. We are not in danger of smart objects gaining true intelligence right now (in the next year or so) but the degree of agency objects are gaining is increasing. Things such as autonomously driven vehicles are a very visible example of this type of agency. This paper argues that *now* is the time to get to grips with the implications of smart objects with agency in the design process and to develop new fundamentals of design that can accommodate non-human agents. OOO and New Materiality offer an interesting conceptual starting point for this discussion.

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