Material Beliefs - open labs, speculative design, science and society

Tobie Kerridge, Jimmy Loizeau, Elio Caccavale, James Auger, Susana Soares

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Material Beliefs takes emerging biomedical and cybernetic technology out of labs and into public spaces[1]. The project provides access to technologies that will offer new configurations of bodies and materials. How can design stimulate a discussion about the value of these new forms of hybridity?

Rather than focusing on the *outcomes* of bioengineering research, Material Beliefs approaches research as an unfinished and ongoing set of practices, happening in laboratories and separate from public spaces. The aim is to make labs permeable, so that non-specialists can consider the research. With this in mind, labs are opened up as sites for collaboration between scientists and engineers, designers, and members of the public.

Alongside the everyday business of the lab, which might include submitting funding proposals, conducting experiments and gathering data, and then writing and publishing academic papers, the collaborations produce a parallel set of proceedings captured through drawings, photographs, films and discussions. This leads to the design of speculative prototypes, transforming the parallel activity into something tangible. These prototypes are exhibited, reconfiguring emerging laboratory research into a platform that encourages a debate about the relationship between science and society.

This paper opens with some description of the lab as a site for collaboration between design and engineering, then moves onto some examples of outcomes, and finally expands upon some strategies for opening up these activities to the public.

Designing in Labs

Material Imaginations was a proposal for funding to the ESRC by Robert Doubleday, Mark Welland, James Wilsdon and Brian Wynne. Their proposal followed on from a project described in a DEMOS report, See Through Science[2]. Here Doubleday set up an ethnographic project in Welland's Nanotechnology lab, the aim being to work with scientists to imagine the social outcomes of their nanotechnology research. Doubleday describes, "My role is to help imagine what the social dimensions might be, even though the eventual applications of the science aren't yet clear"[3]. Material Beliefs echoes the title of this proposal, and considers the role for *design* as a set of speculative tools for working with scientists and engineers.

above: Testing a blood pressure implant at the Institute of Biomedical Engineering

Design practice is not exclusively about making products out of technology. There is room for interrogation of its methods and aims, and an examination of the social relations that are intrinsically linked to the use of the material outcomes of design. The Interaction Research Studio at Goldsmiths emphasises that designed artifacts are subject to interpretation[4] and discusses the use of ambiguity rather than usability as a resource for design[5]. The Design Interactions course at the Royal College of Art supports pedagogy and research that develops a range of practices described as critical design[6].

These activities represent an extended role for design, and before discussing how this type of design might make links with laboratory research, it is important to mention creative practices that have established relationships with labs. SymbioticA in Perth hosts and trains researchers and practitioners, equipping artists with the skills to develop "wet biology practices in a biological science department"[7]. SymbioticA has developed a range of activities that include residencies, an MA programme and postgraduate research, all emphasising artistic enquiry. Also of note is Critical Art Ensemble, a collective of artists who work in partnership with local venues to provide programmes including workshops and seminars, providing resources for participants to work directly with biotechnology[8]. A third example here is Arts Catalyst, a UK organisation, again offering access for artists to participate in science and technology processes, including biotechnology[9].

Developing these contexts, the Material Beliefs projects have their home in the lab, and lead to speculative designs that are not intended for manufacture. Design processes are employed, and lead to the fabrication of prototypes, and the prototypes take on the formal qualities of a product, yet are not products. Designing a product has different demands, including time spent specifying materials (because unit cost is important), exploiting intellectual property opportunities, and talking to distributors. Rather than deploying prototypes as a halfway point leading to product innovation, the projects described here emphasise interplay between the prototypes and statements about social life.

In order to set up an instrument that allows this to happen, there is an attempt to make speculative design's association with science and technology more embedded. The project takes influence from Doubleday's[10] - and previously Bruno Latour's and Steve Woolgars[11]- encampment in labs. While these sociological associations with labs provide accounts of science in the making, our occupation is characterised by an attempt to have an impact on the lab environment and produce material outcomes. When designerly and speculative attitudes to science and technology get located at the site of laboratory research a contingent and overlapping practice develops.

above: A discussion about designing prototypes at Reading University, stills from a film by Steve Jackman

Examples of speculative design

Material Beliefs is scattered across different sites. It is administered at Goldsmiths, University of London, and supported at that site by the Interaction Research Studio and a design workshop. At the Royal College of Art, RapidForm is a rapid prototyping shop and the Design Interactions provides a studio. Key laboratory sites include the Institute of

Biomedical Engineering at Imperial College, Cybernetics and Pharmacy at Reading University, and the Institute of Ophthalmology at University Collage London. Project activities are based at the most appropriate site, and in some cases need to be run across multiple sites at the same time.

Noteworthy here is Neuroscope. Responding to research at the University of Reading[12], Neuroscope provides an interface for a user to interact with a culture of brain cells, which are cared for in a distant laboratory. An interface allows the virtual cells to be 'touched', resulting in electrical signals sent to the actual neurons in the laboratory. The cells then respond with changes in activity that may result in the formation of new connections. The user experiences this visually in real time, enabling interaction between the user and cell culture as part of a closed loop of interaction.

above: Neuroscope Prototype

At a key stage in the development of Neuroscope, Elio Caccavale was designing the artifact and producing CAD models which were then fabricated using an Object rapid prototyping machine, while David Muth was writing a visual client application to link the prototype to server software coded by Julia Downes, which communicated with an array of electrodes that linked to a neural cell culture maintained by Mark Hammond.

above: Neuroscope system

Elsewhere, less defined and smaller scale activities have lead to larger projects. *Mind the Loop*[13] was an event at the Institute of Biomedical Engineering (IBE) that had no clear design outcome. The silicon beta cell[14] is biomedical device developed at IBE that behaves like an artificial pancreas. It senses blood sugar levels in the body and applies this data to an algorithm which controls an insulin pump to regulate blood sugar levels. The loop is a biological system, made discrete and rendered in silicon. Arranged around this technology are different actors, including the bioengineer who builds the technology, the patient who might use the silicon beta cell, and the doctor who negotiates and implements use. Mind the loop was a conversation between these three people, documented and edited into a short film by Steve Jackman, that depicted how the description of a piece of technology is unstable, as it is subject to divergent values and expectations.

above: Mind the Loop, filmed at the Institute of Biomedical Engineering

While the silicon beta cell is an example of a biometric sensor for a local, body scale control loop, other technologies at IBE link to larger networks. In the case of an application for monitoring patients with chronic conditions, biometric data is passed over a mobile phone to a remote server at a health care centre[15]. As this research was being discussed at public events, including an evening debate at the Dana Centre[16], there was a discussion about the potential abuse of data provided by biometric monitoring services. Additionally, in the UK there is a discussion about the effects of parents anxiety about risk upon the rights and liberty of children[17]. Cotton Wool Kids is a documentary commissioned by Cutting Edge, in which the issues of monitoring bodies, and the effects of perceived risk upon childhood, collide. In one sequence an anxious mother seeks advice from an engineer about implantable GPS transponders to track her daughter[18].

above: Stills from Cotton Wool Kids, Cutting Edge for Channel 4 UK TV

Vital Signs aimed to locate these issues in a product that monitors a child's biometrics. The prototypes are a physical display for the output of the digital plaster[19], a platform for remote biometric monitoring. The plaster incorporates miniature sensors into a skin worn patch, and transmits this data about the body across a mobile phone network. This live data feed encodes information about respiration, heartbeat and movement. The prototypes then represent biometric data as movement. Vital Signs demonstrates how absent bodies are transformed into data and broadcast across networks to become expressed as behaviours in products. The aim here is not to be critical of biomedical research, but to ask some questions about how technologies reproduce and materialise social relations.

above: Vital Signs monitors

above: Vital Signs scenario

A third project, Carnivorous Domestic Entertainment Robots (CDER) takes the home as a site for a set of biologically enhanced robots. Engineering context for the prototypes included "Energy Autonomy in Biologically Inspired Robots"[20] a paper that came out of research at Bristol Robotics Laboratory, where electro-mechanical systems can generate their own power:

"Our interest however, is in generating energy from chemical substrate – food. We are therefore interested in a class of robot system, which demonstrates energetic autonomy by converting natural raw chemical substrate (such as carrots or apples) into power for essential elements of behaviour including motion, sensing and computation. This requires an artificial digestion system and concomitant artificial metabolism."[21]

above: Lampshade robot

Rather than consuming carrots and apples, the CDER make use of microbial fuel cells to breakdown entrapped flies and mice. These robots are devices for utility, drama and entertainment. They exist in a similar way to an exotic pet such as a snake or a lizard, where owners provide living prey and become voyeurs in a synthesized, contrived microcosm. The predatory nature of these autonomous entities raise questions of life and death, taking us out of the moral comfort zone regarding the mechanized taking of life

above: Fly-paper robotic clock

This spectacle competes with programmes such as Big Brother, Wife Swap or televised, edited and dramatised depictions of war. As consumers of these programmes, like those who keep vivariums, we have the potential to be repulsed, engaged or both and as voyeurs might consider ourselves complicit.

above: Carnivorous Domestic Entertainment Robots at LABoral

How design contributes to science and society issues

In the UK there is an ongoing discussion about how to involve the public in science and technology[22]. At a policy level, this is a discussion about democratising access to the research that will have its outcomes in the products and services we use[23]. Public engagement of science previously focused on demonstrating to the public that science produced a range of benefits[24], performing an educative role to address gaps in the public knowledge[25]. Contemporary public engagement is tasked with responding to descriptions of science and the public that are less about cognition, and more about contextual issues, such as the communities through which science and technology are encountered[26]. GM crops are an example of a technology that is understood as much through the agenda of campaigning groups like Greenpeace, as it is through scientific assurances of safety[27]. As a result of these new policy attitudes about what public engagement of science might look like, it is a good time to extend design practices that ask questions about our relationship with technology and science.

Additionally there is some pressure on science and engineering researchers to *do* public engagement[28]. As a researcher, being able to show you have participated in public engagement activity strengthens a funding application. This was something that was appealed to when researchers were initially invited to collaborate. It goes some way to establishing a recognisable context in which to hold the activities that form a collaboration, in a way that makes some sense for everyone.

Responding to these conditions, the Material Beliefs collaborations are open to the public wherever possible. Public events have been curated at The Dana Centre, the V&A, MoMA, the Design Museum in London, The Royal Institution of Great Britain, the National Theatre, LABoral and Selfridges. These events frequently open up a discussion about partial outcomes, and act as a cross between project crits and think-tanks. The public events move between venues associated with arts or science, so that science and engineering is discussed in a design context, and science institutions are opened to design processes, so that both disciplines become challenged by the others format.

Other events operated at a smaller scale, and with more defined audiences. Partnering with an arts education project, The Stephen Lawrence Centre was a venue for a group of young people to be introduced to speculative design practices. An exhibition of the prototypes at the Royal Institution lead to designers participation in a family day, where 3-7 year olds designed their own fly eating robots. Educational activities, including workshops and presentations with graduate and postgraduate students, enabled issues around science and society to become subject to the disciplinary concerns of the students. Often this provided a mechanism for their interests to establish fresh relationships with science and technology.

above: Family day at the Royal Institution of Great Britain

It is useful to briefly refer to one of these events. A workshop was held at the Institute of Biomedical Engineering (IBE) for postgraduate design students at the Design Interactions course at the Royal College of Art. The aim of the workshop was to provide students from the RCA with an embedded view upon biomedical technologies, and for researchers based at IBE to have a refreshed set of responses to their research.

The workshop included an introduction and tour from a director at the institute, with presentations from researchers, and a simple lab experiment, where DNA was isolated from saliva swabs. The lab then became the location where a four-week project brief for the students was set. Researchers from IBE and Reading University took up visiting tutor roles at the RCA, offering tutorial sessions, and providing feedback on the projects. By launching the project at the IBE, the aim was to connect designers fascination with and trepidation towards biotechnology with a mundane and situated understanding of lab based research, along with an awareness of contemporary science and society agendas, which were presented within the brief.

.above: Design Interaction students isolating their DNA at the Institute of Biomedical Engineering

Closing remarks

The projects described here hopefully provide some early description of how designers might become embedded within laboratory spaces, and conversely how engineers might be offered a presence in design studios and exhibition spaces. These mutual incursions are encouraged through loose collaborations, that move towards the design of speculative prototypes.

Material Beliefs proposes that by opening up the process of collaboration between bioengineers and designers, non-specialists are able to respond to science in direct ways. Design offers a range of methods for lay members of the public to develop their curiosities with science and technology. Potentially there are opportunities for the public to take an active role within the production of research, or at least to play a role in the discussion of unfinished research, in terms of its social value and ethical implications.

Rather than see science and technology as a set of finished and discreet products and services that have their effects upon us, Latour described how science is complex and unfolding. It is enacted through a relationship between peers and rivals, institutions, markets, funders, politicians and ethics committees[29]. This paper has tried to sketch how is might be possible to situate a creative practice productively somewhere amongst this network.

Project credits

Material Beliefs is based at the Interaction research Studio, in the Department of Design

at Goldsmiths, University of London, and is funded by the Engineering and Physical Sciences Research Council, through a Partnerships for Public Engagement Award.

The project is managed by Andy Robinson, while designers James Auger, Elio Caccavale, Tobie Kerridge, Jimmy Loizeau and Susana Soares lead four clusters, supported by collaborations with Steve Jackman, Aleksandar Zivanovic, Julian Vincent, Kevin Warwick, Slawomir Nasuto, Ben Whalley, Mark Hammond, Julia Downes, Dimitris Xyda, David Muth, Tony Cass, Olive Murphy, Nick Oliver, Dianne Ford, Luisa Wakeling, Julie Daniels and Anna Harris.

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