Turned On / Turned Off: Speculating on the Microchip-based Contraceptive Implant

Sarah Homewood
IxD lab, IT University of Copenhagen
Copenhagen, Denmark
shom@itu.dk

Clint Heyer
K3, Malmö University
Malmö, Sweden
clint.heyer@mah.se

ABSTRACT
For over 50 years, hormone-based contraceptives have allowed women to control their fertility, thus reconfiguring society and how women relate to their body. On the horizon are long-life microchip-based implanted contraceptives that can be turned on and off, which may further the societal disruptions of 'the pill'. Framed as interactive technology, we speculate on the design space of controllable implanted contraceptives. We explored existing implanted contraceptives through a performance ethnography of their implantation. Inspiration from this process informed a speculative video of living with controllable implants and a guide for healthcare professionals. These materials, along with expert presentations, backgrounded a design workshop in which participants unpacked issues around controllable contraceptive implants. Participants created and roleplayed physical mock-ups of controllers, manifesting discussions around security, relationships and hormones. Drawing from the outcomes of the workshop, we produce a speculative design in the form of a film and physical mock-ups.

Author Keywords
Implant; hormone; performance ethnography; contraception

ACM Classification Keywords
J.3 [Computer Applications]: Life and Medical Sciences—*Medical information systems*

INTRODUCTION
Implantable microchips that allow controlled, micro-dose drug delivery over several years are currently under development and human trial [5,13]. The implant consists of hundreds of sealed micro-reservoirs which are electronically managed by a chip, which itself can be controlled via short-range radio. One of many potential application areas for this technology is female contraception [8]. Two advantages over current non-digital hormone-based implants is that the microchip can last 16 years (rather than five), and women can turn it on or off [9]. The tension between the advantages resulting from the 'technological fix' [12 p122] that the implant represents, and the political and societal implications of this new form of contraception provides the motivation behind this research.

The stakes for this new form of contraception are high. 'The Pill' allowed women to decouple sex from reproduction [4], to control their natural hormonal cycles, thus refiguring how they relate to their own body. Implantable, controllable contraceptives are expected to be on the market in 2018 [9], but little is published about how the controller might look or function, and its manufacturer declined to participate in this research. Interaction design is well-placed to investigate the design space of 'insertables' [7] such as this. Because of the implications of this technology, we suggest this investigation should begin now, albeit in a speculative manner, rather than awaiting its general availability. In the present paper, we begin this work using design, embodiment and performance techniques with an emphasis on the emotions and narratives surrounding interactions [3 p244, 10] in order to draw out findings and speculate on the design of controllable contraceptives.

BACKGROUND
As implanted devices become more common - for medical reasons or otherwise - so too are the risks of their unauthorised control or access [1]. This is particularly problematic for life-critical implants such as pacemakers, already shown to be vulnerable [2,6]. Implanted microchips pose new security challenges. Unlike pacemakers, which are wirelessly controlled by medical practitioners in a clinical setting, the contraceptive microchips are intended to be controlled by consumers at home.

While some work has investigated the possibilities of interacting through the skin with different kinds of input technologies [7], our work concerns indirect interaction with the implanted device, using a kind of remote control. In general, there has been little exploration of the design opportunities and challenges for controlling implanted devices, especially so in this domain.

PERFORMING IMPLANTATION
To begin our exploration into future implants, we considered the case of existing non-digital hormone-based contraceptive implants. Drawing on the first author's background in dance

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performance, and the goal of drawing out the emotional and physical experience of receiving an implant, performance ethnography [11] was the primary method.

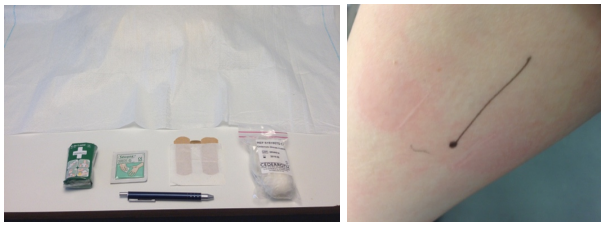

Figure 1. Re-enactment props (L), implant insertion mark made on designer's body by participant (R)

We used four participants, between the ages of 25-32, studying at university, two were personal acquaintances of the first author. Two of the participants currently have the hormonal implant, while the other two had it previously. Sessions were conducted one-on-one, lasted between 30-90 minutes and held at a location convenient for the participant. Following the session, participants were interviewed.

Following Laurel [11], we used props, improvisation and re-enactment to empathise with participants and gain our own bodily experience of their procedure. Simple staging was used to set the scene of a doctor's surgery, laying down a medical sheet on a table or bed, and furnishing medical props such as bandages, surgical gloves, disinfection wipes, and a pen to represent the implant applicator (Figure 1).

Upon arriving at the staged doctor's surgery, participants were told that they were to play the role of the medical practitioner, and that the researcher (the first author) was to play them. Together they were to re-enact the participant's implantation procedure. The participant was asked to direct the researcher in how to move and position themselves according to the participant's experience of their procedure.

Without prompting, all participants engaged with the props to support the re-enactment, two participants using the pen as both the implant applicator as well as a pen to mark the insertion point. Participants alternated between recounting events in the first-person and third-person, telling the researcher how to react. The researcher maintained a relatively passive state during the procedure, instigating no movement of her own accord, and holding posture only as to not fall over. Participants could then take charge of her body and direct her movements physically by moving her limbs (as two did), or through verbal commands.

Although there were few participants, it became clear they had rather different experiences of their implantation. For some, the procedure was straightforward, with little in the way of tension. For others, it was a frightening experience, bordering on traumatic. Although the re-enactment was based in the physical procedure, participants readily expressed their remembrance of emotional state as the session progressed. One participant directed the researcher (as she herself was directed) to pinch the skin on her stomach to distract her from the thought of the applicator entering her body. This action represented her fear and the coping strategies employed to manage it.

IMAGINING THE CONTROLLABLE IMPLANT

We resisted deep analysis of the performance ethnography and ensuing discussion with participants. Instead, we used these impressions to inspire the scripting and production of a short film (Video Figure 1). Briefly, the film is set in a couple's bedroom, and makes reference to security, transhumanism, new rituals, sex, pregnancy and hormonal side effects. The audience is given the female character's first-person perspective, with her male partner talking directly to camera.

To probe into people's concerns of the product, a 90-minute design workshop was held. It was publicly advertised online and with posters around campus, attracting 20 participants, 9 of whom studied interaction design. 11 participants self-identified as female, 9 as male. The speculative film, a presentation on the product and presentations by two female health experts, introduced participants to the technology and topic. One of the experts professionally advised women on natural forms of contraception (such as the Fertility Awareness Method), the other was a practitioner from the campus sexual health clinic with thirty years of experience of prescribing hormonal contraceptives.

Participants were asked during the workshop to complete parts of a questionnaire, including the question "what is your initial reaction to the contraceptive microchip?" Security and control were concerns of 13 participants, relating mostly to who would be able to control the chip and under what circumstances. One woman noted, for example *"what is interesting is the question of control, which is supposed to be the woman's but it could be someone else. I think I would check compulsively if it's turned 'on'"*. The issue of an invisibly implanted chip's accountability was brought up by four other participants. These reactions were used to produce a speculative leaflet for healthcare professionals to introduce them to the product and sensitise them to the perceived concerns of potential users.

DESIGNING THE IMPLANT CONTROLLER

The second stage of the design workshop was a turn toward the design of a remote control for the microchip. Participants were asked to model controllers in white clay and to annotate the controller on a piece of paper, describing how it worked (Figure 2). After this activity, participants were invited to form pairs for a roleplay exercise. One person took the role of the healthcare professional introducing their controller to the other, who acted as the patient, about to take the controller home after the implant procedure. Roles were then rotated so all controllers were introduced. Participants were asked to show (and ask about) how it was used, its appearance (since the clay material lacked clues of material and finish), where it might be kept and who might use it.

Figure 2. Design workshop and created controllers

Following the workshop, we attempted to identify the issues embodied in participants' designs. The controllers tended to reflect the themes from the prior stage of the workshop, several controllers for example reflected the issue of accountability by providing visual feedback of the microchip state. Two participants chose to observe rather than create controllers themselves. Roleplaying and discussion was useful for the participants to clarify and develop their ideas. In the below exchange, an idea occurs to P7 in the course of discussing with P1:

P7: Oh yes, to the crazy idea. I made it look like a baby. And if you, if you choose... I don't know why but uh, it could also be, afterwards I thought maybe you could choose when you buy the implant you could have either a very nice baby looking very nice or a warning, like something "urghh"… this is what happens if you…
P1: To be honest I imagine this as something more as a teddy bear collection, like when you have something as a teddy.
P7: Yeah, well could be. Well then I thought about also, if you already have a kid what if they find it and start playing with it, also the same thing with that (gesturing to P1's remote). And I was thinking if it were for men too, I don't think it is at first, but if it were for men too, that is a question I think. I think it could be quite revolutionary.
P1: Yeah I don't know why really there is no conversation happening really for these things for males.
P7: Now I got an idea. What if, it could be, both have an implant, what if there is a need of some mutual… pushing together (laugh) so you could both (conceive?).

Doing it together

Surprisingly, only one controller explicitly related to sex. It took the form of a sex toy, based on the assumption that the chip would be placed inside the vagina. Controlling fertility was thus intertwined with the stimulation and penetration of the body. This raises questions of the circumstances of fertility control: in some cases, the penetration might provide erotic stimulation, and in other situations might be considered a violent physical invasion.

For three other participants, their controllers reflected mutual control over the chip through some form of two-part controller. Each party keeps their own part of the controller, which only functions when brought together to form a whole. One participant imagined a ritual around the creation of the parts – each controller would be moulded to each other's hand shape, and there would be a ceremonial gifting of the man's part of the controller by the woman: "*this you can give as a gift for someone who will take part in your pregnancy,*" noted one participant. Interestingly, three out of the four controllers that related to mutual control of the chip used a split design. Joining the parts when it is time to turn the chip on or off could be a moment of significance in a relationship. We also interpret their forms as a tangible 'keepsake' or memento of the intimate relationship they share.

Form

Most of the controllers seem to have a neutral form, with little to indicate their significance to sex or fertility. Four participants made non-descript buttons, perhaps fitting a plain clinical aesthetic, that could have easily been any sort of internet-connected button. A contrary example is participant P7's *'crazy idea'* controller described opposite.

Security

Several participants designed controllers with security in mind, for example with in-built fingerprint readers, code entry or the ability to locate a lost controller. Participants seemed to frame the controller as the 'key' to the microchip. To some extent the split controllers also provide a mechanism of accountability and security in the use of the controller. Even though there are stories in the mass media about the risks of passports and cash cards being manipulated by unauthorised devices, participants didn't register the same threat to the implanted chip itself. This suggests a worrying naivety – even on the part of participants that stated they were concerned with hacking – that designers should consider.

Hormones

Although nine participants expressed health concerns over hormone-based contraceptives, only three created controllers that directly related to the hormones delivered by the microchip. Two of the controllers modulated the amount of delivered of hormones, perhaps, for example, in relation to experienced side-effects. Another participant considered a companion app for registering self-reported mood and weight so side effects can be monitored and hormone levels automatically adjusted.

CONTRACEPTION IN A RELATIONSHIP

Drawing from the outcomes of the workshop, we decided to further elaborate on the notion of mutual control of contraception in the context of a stable relationship. We also wanted to incorporate suggestions of rituals for entering into mutual control and eventual shared use.

Figure 3. Controller necklaces in their presentation box, and a still from Video Figure 2.

Inspired by the symbolism of commitment in exchanging and wearing engagement rings, we designed a two-part controller in the form of necklaces, white for the female, black gifted to the male (Figure 3). For the male, wearing it publicly expresses a commitment to his partner, that one day they will attempt to conceive a child together. The design makes a

demand of the male, reflecting our finding during the performance ethnography that some women resent having to bear the greater burden for avoiding pregnancy. The female partner would likewise keep and wear the other part, signifying her commitment of shared parenthood with her partner. The form of the jewellery was inspired by common fertility symbols. Inserting the male part into the female likewise references the joint act of penetrative sex. Several low-fidelity prototypes were made of the jewellery and presentation box. We also scripted a scene concerning the jewellery, speculating on its role in a relationship, and drawing on the experiences and findings of our investigations. Actors were hired and the film was shot, again from a first-person perspective (Video Figure 2).

PERFORMANCE AND IMPLANTABLES

Nine months after the initial implantation performance ethnography, we interviewed our four participants again to understand their experience of the session. The approach seemed to open up alternative reflections and perspectives unavailable through classic techniques such as contextual interviews. As one participant noted *"to be asked to re-enact it allowed you to remember physical parts – [to] go into the memory in another way. The memory was more alive"*. In the design of body-centric technologies – such as wearables and insertables – being able to draw out recollections and reflections of bodily experiences would seem highly valuable.

This also raises ethical concerns. While none of our participants had a negative experience from the research session, two wondered whether it was because their actual implantation procedure was not negative. The method risks revisiting traumatic experiences also in a way that makes them *"more alive"*. Notwithstanding, for one participant, for whom *"all the memories around contraceptives are negative"*, the re-enactment proved positive: *"…it felt good to discuss it with you – a bit therapeutic."* The re-enactment would seem to be an intimate experience, by both revisiting and sharing an otherwise private experience, and, we believe, because of the bodily contact involved between participant and researcher. Dialogue with participants seemed to reflect this, with participants expressing their emotions more readily than with the other forms of inquiry. That said, each inquiry had quite different aims which does not support direct comparison. In our case, personal relationships with some participants lowered barriers to intimacy that might otherwise preclude this mode of inquiry with unknown participants.

The performative nature of the method places demands on participants. The process of acting out and acting on another person isn't an everyday activity for most, and one participant reported feeling uncomfortable with this, since she is *"not an actress"*. Further refinement of these approaches is needed to lower participants' performance anxiety.

CONCLUSIONS

In this paper we describe our method and results of exploring a speculative design space of controllable, implanted female contraceptives. This paper aims not only to bring the subject to light, but we hope that this research will make visible the value in performance-based and speculative methods when exploring the implications of such a complex, emotionally weighted and political application of technology. The contribution of this paper is firstly in the novelty of bringing this domain to the interaction design table. The introduction of this technology will potentially have a transformative effect on society, and women in particular. Although described in the popular press and articles in the medical field, the technology needs to be critically examined from the perspective of how we will interact with it, and the role it may play in our lives. This work is our own modest attempt at doing so.

Secondly, we use performance ethnography to uncover bodily experiences and narratives through re-enactments, and report on its potential. We used performance to understand how women experience the process of implanting existing contraceptives. This technique was critical for drawing out the lived experiences of our participants in order to ground the following research. Interestingly, it allowed participants to re-enact their experience through the researcher's body, seeing and touching in the third person as they themselves were seen and touched during the process. In doing so, the typical power of the designer was shifted, as the designer themselves becomes a manipulatable prop for the re-enactment.

Thirdly, the findings of the design workshop point to several issues for the design of controllable implanted contraceptives, suggesting opportunity for design as well as what people may take for granted about it. Participants' controllers reflected the *mechanism* of hormone-based contraceptive, *control* over the microchip's functioning, the *implications* of fertility and sex, and the *role* within relationships. Amongst concerns of security, form and hormones, was the notion of mutual control over contraception, which we further developed.

Fourth, we produced two films, informed by our research, which ground the ideas and give accessible form to some of the issues present and facilitating their propagation. The films question gender and sex roles within contraception and how new forms of contraceptive technologies can mediate conversations of parenthood and our sexual relationships.

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