Co-designing Design Fictions: a New Approach for Debating and Priming Future Healthcare Technologies and Services

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Abstract

Background   Design fictions (DFs) are emerging as a tool aimed at engaging people in debating and questioning the direction of future technologies, services and possible societies. Following the challenges placed on healthcare provision by an ageing population, governments are introducing policies related to ageing that will shape future healthcare services. The exploratory ProtoPolicy project, investigated how co-created DFs might be used to help older citizens imagine the future implications of policy initiatives through the lens of technology in an ageing society.

Methods   A co-design research approach was employed. In collaboration with older citizens (n=21, 65-94 years old) the project team co-created two DFs based on citizen responses to government policy, which explored the issues of assisted living/smart-homes and assisted dying/euthanasia in the UK. Feedback on the DFs was sought from citizens at a co-design workshop.

Results   Five themes emerged from the thematic analysis of the workshop engagements with citizens: increasing the plausibility and acceptance of future healthcare technologies and services, raising ethical concerns and questions, conceptualising new healthcare producs and services, helping with understanding and decision-making, and service/technology requirements capture.

Conclusions   Understanding and engaging with more complex social healthcare technologies through a co-design design fiction approach might provide added value for citizens in priming new technology introduction in healthcare services. Co-designing design fictions can also provide researchers with more in-depth insights about the preferable futures articulated by different groups within the context of technology and healthcare services.

Keywords   Design for Healthcare, Design Fiction, Speculative Design, Health Services Research, Research Methods, Healthcare Technology

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1. Introduction

We live in an ageing world. The United Nations estimate that 1.4 billion people will be over 60 years old by 2030 (United Nations, 2015). In the UK there are currently 11.4 million people over 65 and by 2040, 24.2% will be aged over 65 (AgeUK, 2016). In response to this the UK government has developed a number of policies on ageing [Older People (Gov.uk, 2016a), Health and Care Integration (Gov.uk, 2016b), Housing for older people (Gov.uk, 2016c)]. Within this context, ProtoPolicy was set as an exploratory pilot research project that ran from June to September 2015, to explore how co-created design fictions (DF) might be used to help older citizens imagine the future implications of policy initiatives in creative ways.

1. 1. Science fictions and design fictions in healthcare

Future technologies are often closer to science fiction than many people think. The history of science has demonstrated that the dividing line between science fiction and scientific fact is often overlapping, so that what appears completely unrealistic in one time may become scientifically possible within a few decades (Kirkpatrick et al., 2006; Dourish and Bell, 2014). In the field of medicine and health, science fiction has often paved the way or influenced medical and technological advances in areas ranging from genetics and transplants to robotics (Klugman, 2001; Petersen et al., 2005; Hockstein et al., 2007). Although often fictitious, valid concepts may be derived for medical practice and patient care, as they have been through projects exploring organ transplantation and prosthetics. For example, Mary Shelley's *Frankenstein; or, The Modern Prometheus* an early proto-science fiction novel influenced organ transplantation (Wohlmann et al., 2016), while 3D printed prosthetic technoscience (Smith, 2016) central to the Iron Man sci-fi series has had a bearing on the development of robotic arm prostheses.

The value of science fiction in design has also been recognised in the rise of a new method for design practice, research and designing technology, called design fiction (Knutz et al., 2014; Bleecker, 2009). Design fiction draws on both science fiction's ability to depict imagined design objects within a diegesis and its critical potential in exposing the use of technologies within possible worlds as chosen social constructions. For instance, the ageing society depicted in Robot and Frank (2012) on one hand foretells researchers' experimentation with robotics and artificial intelligence as a potential future caregiver of older people; and on the other hand it depicts some of the socio-ethical questions such a technology service can lead to. In a similar fashion Design fictions –like short films, prototypes and graphic novels– are often provocative and engage people, encouraging them to envision, explain and raise questions about the direction of future technology and possible worlds.

1. 2. Speculative design and design fictions in design research

ProtoPolicy considers DF a form of speculative design. According to the taxonomy proposed by Hales, speculative design is an approach enabling us to think about the future prospectively and critically (Hales, 2013). One of its principal assumptions is the negation of the status quo and the initiation of discussion of possible future scenarios through a

[1] The ProtoPolicy research consortium included Lancaster University, PDR at Cardiff Metropolitan University, Falmouth University, the All–Party Parliamentary Design and Innovation Group, Age UK and the Design Friction studio. For more information see: http://imagination.lancs.ac.uk/activities/ProtoPolicy

confrontation with a tangible object or process, the so-called design fiction.

Dunne and Raby (2013) draw a model depicted in Figure 1, for considering potential scenarios for the future. Based on Voros' foresight work (2001) it shows concentric cones representing the expansion of possibility across a passage of time. The widest cone (possible) is constrained only by what is imaginable; it may even transgress the laws of physics. The narrowest cone (probable) represents the likeliest extrapolations of existing trends, or rather the constraints of our current understanding and ability. Between the narrowest and the widest cones sits another that depicts a space of plausible futures, those that we may open through scientific discovery, or new social practice. Perhaps inevitably, given design's industrial provenance, most design practice happens in the bounds of the narrowest probable cone. Overlapping a part of both plausible and probable futures, Dunne and Raby (2013) delineate an area (darkest colour) that may offer preferred futures, in doing so they narrow Voros' understanding which considered the preferable to operate across the entire range of futures and position the preferable as being in tension with that which the probable may offer. In articulating desirability subjective, contested, views are to be expected, as such views are 'emotional' and built on 'value judgments' (Voros, 2001). The model has received criticism regarding to whom preferable futures refers to (Tonkinwise, 2014). In relation to this, speculative design and design fictions are not just about preferential futures. Other ways of interacting with the public through design fictions could be employed to identify new areas of development, or identify unwanted or negative consequences. It is within this context that the work presented in this paper explores the use of co-designed design fictions and their presentations as preferential futures.
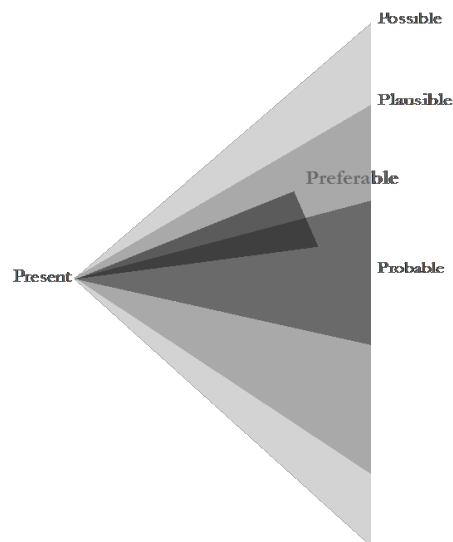
Figure 1 The Speculative Design Spectrum PPPP, based on an illustration by Dunne & Raby (2013).

Speculative design uses design thinking tools and methodologies such as scenarios, brainstorming and rapid prototyping along with techniques borrowed from art, literature, film, psychology, philosophy, anthropology and ecology to create DFs – provocations or '*narrative elements to envision and explain possible futures for design*' (Tanenbaum et al., 2012).

Design Fictions are therefore a type of speculative design (Dunne and Raby, 2013). A number of definitions exist for design fiction (Bleecker, 2009; Markussen and Knutz, 2013). For Hales, *'design fictions create a discursive space within which new forms of cultural artefact (futures) might emerge'* (Hales, 2013). Similarly, Sterling suggests that design fiction *'is a contemporary form of forward-thinking intervention that has been enabled by the current networked media environment'* (Sterling, 2009). According to Bleecker (2009) Design fiction is about creative provocation, raising questions, innovation, and exploration.

We can therefore assert that DF serves both to give account and intervene. Kirby (2009) focuses on the mutual benefit created in science consultants' relationship with science fiction filmmakers and uses the term diegetic prototypes 't*o account for the ways in which cinematic depictions of future technologies demonstrate to large public audiences a technology's need, viability and benevolence'*. DF adopts the strategy for design practice; it uses a fictional paradigm to permit the making of technological shifts within a possible world and then presents that possibility as artefact, image or audio to stimulate debate about potential futures and current directions.

Design fictions do not claim to predict the future; they act as aids to enable their audiences to act as interlocutors. For instance, the Government Office for Science, in the UK, has employed speculative design in a project to bring together and generate new evidence about the likely impact of an ageing population on society. It was found that guided discussions allowed participants to move beyond polarising debates for 'good' or 'bad' to voice opinions about the images that were not so immediately obvious – for example, their positive aspects and the points of conflict within them (Voss et al., 2015).Furthermore, Pasman (2006) has introduced and discussed the possible potential and application of design fiction as a service design approach. He has argued that design fiction could be a new and innovative way for service designers to explore and define new services in a contextually rich and holistic way in the beginning of a design process (Pasman, 2016).

DFs do not focus on implementation, but on generating rich discussion of 'what-if' scenarios in and between differing groupings. The authors posit that DFs are concerned with progress, ideas for the better, but they take into account that better means different things to different people and corporations (Dunne and Raby, 2013). Here lies one of the challenges and issues of DFs, as they are typically designed and developed by individuals with a certain educational background and skillsets (Auger, 2013) who may have a very different view of what preferable future may mean for the public. Furthermore the involvement of experts is still the most common method used for forecasting emerging health technologies and services excluding citizens from this process (Doos et al., 2016).

Therefore, there is a need for approaches that enable and facilitate, on one hand, the participation of citizens in the design of future healthcare systems; and on the other hand open debate on the social, legal and ethical complexities arising from technological intervention in future healthcare systems and services.

2. Method

A co-design research methodology (Sanders and Stappers, 2008; Steen et al., 2011; Boyd et al., 2012) including three main phases was employed, namely problem definition, developing DFs with stakeholders, prototyping and testing. Participant ages ranged from 65-94 with a mean age of ±71.

Table 1 Workshop participant information

Workshop No	Location and duration	Participant Information
1	Lancaster, UK, half a day	14 (4 male, 10 female); Living independently
2	Redruth, UK, 2 days	7 (2 male, 5 female); Living in sheltered accommodation

2. 1. The Co–design of the design fictions

Initially, the policy and academic contexts for design negotiating political questions were explored through secondary research and an examination of the government policy documents around the theme of ageing. This helped identify a number of related government policy initiatives (such as 'ageing in place', integrated health and social care, ageing well and several others) that might be explored in the next stage with the stakeholders. Extracts from these policies, that specifically related to the ageing in place agenda, were explored in two co-designworkshops in Lancashire and Cornwall with community groups and older citizens. The workshops were conducted in June 2015. As a co-design approach (Lee, 2008; Xie et al., 2012) requires participants to engage in the design process 'as experts on their experience domains' (Visser et al, 2005) an older persons' perspective on the ageing in place agenda was essential to the process. The co-design approach was also adopted in appreciation of the likelihood of limited interest in lengthier contacts there being no direct outcomes for participants.

A range of activities and tools were employed in both workshops to explore the use of DFs in negotiating policy implications. These included discussions in small groups considering nascent policy statements; making exercises that explored people's values through their relationship with technologies of the past and of imagined futures; activities exploring linkages between the group's ideas and policy statements through discussions and table-top affinity mapping; using making exercises to design and prototype a range of services and products for potential futures in response to their understanding of the policy statements; introducing emergent technology to develop 'what if?' scenarios set five, ten and an indeterminate number of years into the future. These speculations were shared, discussed and ranked by the group. The themes presented covered communication (n=7), transport (n=6), independent living at home (n=3) and the health economy (n=2) with 16 of the 18 speculations related to the ageing in place agenda. All speculations, concepts and ideas that emerged from the two co-design workshops were documented via audio recording, photography and short video presentations capturing participant ideas. This process led to the development of several co-designed speculations defined and prioritised by the workshop participants. This was a crucial step in the process as it specified what where the key for the elderly citizens concepts and speculations that the design team should take forward.

2. 2. Ethical considerations

Although co-design research is inherently ethical, due to its democratic relationships within the research process, there are ethical challenges too (i.e. representation, accountability, social responsiveness, etc). Paticularly, in this project the research team worked with vurnerable populations and dealt with very sensitive issues, such as euthanasia that might affect the study participants. The experience and expertise of the project team in co-design and ethics enabled it to deal effectively with ethical concerns and embed the ethical principles & practice for community-based participatory research established by the Centre for Social Justice & Community Actions, Durham University[2] and adhere to the Lancaster University ethics policy[3]. To further address some of the ethical considerations and challenges the research team recruited workshop participants via the local Age UK after having consulted with them on the nature of the research areas. Prior to each workshop a consent form and information sheets on the research project and workshop nature was distributed by the local Age UK to potential research participants so that there was enough time to ask any questions and make an informed decision. In all workshop sessions professionals from Age UK were present and able to deal with any discomform that may had been exhibited by workshop paritipants on the topics the workshops touched and offer advise and professional support if required.

2. 3. The crafting of the design fictions

The workshop insights and co-designed speculations were translated into DFs. This was achieved by analysing and coding the captured data and working with Design Friction, a project partner, to develop a series of design concepts for the DFs. This included three main stages. Firstly, crafting the provocations, by thematically sorting the participants' insights and giving consideration to the areas of contention that might be exposed in debate on an imagined future. Secondly, attention was then paid to combining current technological, social and economic trends with insights from workshops. In particular, existing concepts were taken and unusual matches and crossovers that might feel familiar and plausible to an audience were explored. Embodying speculations in everyday artefacts (e.g. user manual, newspaper article, flyers, etc.) was the final step in the making of the DFs. This was critical in order to find formats that would be familiar, easily understood by non-experts whilst being provocative; and at the same time simple to prototype, low-cost and quick to produce, and also easy to disseminate. Defining details in the speculative prototypes with points of equivalence to our existing world was important in assuring that the objects did not appear to be too distanced from our society.

[2]See: https://www.dur.ac.uk/resources/beacon/
[3]See: http://www.lancaster.ac.uk/media/lancaster-university/content-assets/documents/lums/research/Ethics-code-of-practice.pdfCBPREthicsGuidewebNovember20121.pdf

Finally, the process went on to ensure that the artefacts could articulate themselves independently, whilst offering a more rounded encapsulation of views within the debate when brought together. Each speculative object was created with carefully designed details (such as the disclaimer and legal agreement found in the Soulaje manual and the Smart Object Therapist job description) which aimed to provide the target audience with clues as to the speculative society which made it manifest. The artefacts were designed to stimulate conversation to make statements as to their intent, but to leave many questions unanswered so audiences could grapple with the speculations embedded in them. Although the design

fictions were not crafted by the workshop participants per se, the approach adopted ensured that the DFs developed were a true reflection of the speculations and concpets defined by co-designers at the workshops. This meant that an iterative design process was employed, where the crafted DFs were constantly measured and refined against the speculation characteristics defined by workshop participants.

2. 4. The two design fictions

Figure 2 The SOULAJE Prototype

The Soulaje DF[4], a self-administered euthanasia wearable was designed as a response to the workshop co-designers expressed desire for self-control in their lives in relation to living and dying with dignity. It was conceived as an indirect response to participant perception and the feeling that the ageing in place policy removed control from older people and viewed them as a burden on society. Soulaje aimed to further open the debate around the societal, ethical and legal aspects of technology-enabled assisted dying. The Soulaje DF comprised two documents, namely a quick start guide for the Soulaje and an anti-euthanasia campaign flyer, a prototype of the euthanasia wearable and a short video clip advert of the Soulaje 'product'. Set after the year 2021 the Soulaje DF provides a medical product for self-administered euthanasia. According to the DF the Soulaje product is developed and distributed by a third party business, which has been sub-contracted by a central healthcare service, and is available to people over a specific age in consultation with a GP. A number of safeguards are built into the wearable to avoid misuse, as described in the quick start guide. Worn on the wrist, like a watch, the Soulaje device comprised a capsule containing a lethal drug and a drug delivery mechanism controlled by a touchscreen interface (see Figure 2).

The Smart Object Therapist (SOT) DF[5] comprised of three documents, specifically a SOT job application, the SOT intervention report and prescription, and a short video interview between the SOT and a smart object home user. Set in the year 2020 the SOT interview DF sets the speculative scene by presenting the skills a SOT is expected to have in the envisaged integrated health and social care service model, where older people age at home supported by an array of smart appliances. The job of a SOT is not limited to fixing technical faults it is

[4]Visit http://
imagination.
lancs.ac.uk/
outcomes/
Euthanasia_
Wearable_
Design_Fiction
to view all
SOULAGE
design fiction
material.

also requires 'recalibrating' human behaviour to facilitate interaction between smart objects and their owners. The SOT intervention report and prescription DFs present a possible world where the SOT has been called in to intervene between the homeowner and smart home to resolve an issue. The SOT DF creates an appropriate and open environment for debate by exploring 'misbehaving' smart home technology. In the scenario the smart self-refilling fridge of its diabetic owner, Mr Bell, caused havoc when it amended its owner's dietary requirements and automatic food stocking after confusing Mr Bell's grandson's 'genetic' traits for Mr Bell. The short video is a post-briefing interview between the SOT and smart homeowner following the SOT's visit. The DF featured two professional actors who devised the scenario under the direction of the research team, based on the three SOT documents. This has been considered a very powerful method of requirements analysis as part of a range of participatory practices promoting greater older adult involvement (Rice et al., 2007).

2. 5. Analysis

Following their development the DFs and the concepts they encompassed were explored further, with feedback sought from citizens at a co-design workshop in Lancaster in September 2015. Whereas the co-design workshop was run with the same group that co-created the DFs and focused on a discussion of the DFs, their underpinning speculations and the ethical, societal and legal challenges and issues that they presented. The discussions that took place were audio recorded and the activity documented via photography. Thematic analysis was employed for data analysis (Graham, 2007), where all data collected are involved in a process of identifying themes throughout coding, indexing, and then categorizing towards drawing common themes.

3. Results

Five main themes emerged from analysis of the workshop engagement with citizens where the co-designed DFs were employed as a tool to open a discursive space. Namely plausibility and acceptance, ethical concerns and questions, conceptualising new healthcare producs and services understanding and decision making, and requirements capture.These are presented in more detail below.

3. 1. Plausibility and acceptance of future heathcare technologies/services

The potential and value of the DFs in increasing the plausibility and acceptance of future healthcare technologies and services was one of the main themes that emerged. Several participants used science fiction movie references to help them in accepting that the DFs were plausible and may potentially occur.

'Well, there is some technology that you would have seen in a science fiction film several decades ago and thought oh that's the future, that's science fiction; and some of it, it's here now. So things like videophones. [Q1.1]

For other participants plausibility and acceptance of healthcare technology came through reflection on lived experiences with technologies that were once deemed as science fiction.

'So things that were really fantasy just a few decades ago we do have some of it [sic] *now. I have a smartphone and I cannot believe the things that are available and you can do with it. So things like this [referring to the SOT design fiction] may well happen.'* [Q1.2]

Personal experience and awareness of existing healthcare technology, especially when it has occurred within a community of friends, enabled some participants to make connections with the presented DFs (the Soulaje DF in this case) and interrogate their likelihood.

'Jane reversed her type I diabetes and she has one of these wrist things which tells her exactly how much she's walked every day and it also monitors her sleeping patterns, so she can see that now by doing more exercise she is sleeping a lot better. So we are already starting on some of these'...'Amazing you can get that NOW! So you can have your health monitored at home, that's possible.' [Q1.3]

Furthermore, being able to associate the DFs to existing and emerging societal challenges (in the case of the SOT DF) as well as the increasing complexity of smart home devices assisted in increasing the degree of acceptance of the DFs. In addition to the above, the impact of current affairs plays an important role on the acceptance of the DF theme into the sphere of believability, and potentially desirability, for specific sections of our society. In particular, the theme of assisted dying has been discussed in the UK parliament and has featured in the media leading one participant to reflect on the probability of the DF's topic. They recognised that though the DF may seem an unlikely science fiction, it represented a broader shift toward pro-euthanasia positions that address the difficult societal and legal challenge faced by some members of UK society.

'...it all seems like complete science-fiction but there is such of lobby now for people who are facing the end of very painful end of lives' 'they've taken it into the House [of Commons] again that was in the paper this last week as well because there [sic] *said people shouldn't have to go abroad for this and they want to see changes in the law'.* [Q1.4]

3. 2. Ethical concerns and questions

The ability of DFs to facilitate and encourage the drawing out of ethical concerns raising questions regarding the societal and ethical issues of current and future healthcare services and technologies was another theme that emerged. Following their initial reactions the workshop participants discussed the DF concept in detail unpicking how it would work as a future service and more critically giving consideration to the ethical and legal challenges that would be faced.

More precisely the presentation and interaction with the DFs prompted participants, on one hand, to identify a number of unwanted and negative consequences of the services and concepts behind the proposed DFs. These related to issues around capacity, control, confidentiality and privacy in relation to the Soulaje DF and the topic of euthanasia, and lack

of exercise and isolation with regards to the SOT DF and assisted living.

'An unwanted side effect of that sort of technology is that it would actually keep people in their homes rather than encouraging them out of their home on their [sic]day-to-day basis. This would have [sic] impact on their health and mental health, it's about interactions, about being stimulated [sic] all sort of other things not met by technology' [Q2.1]

For example, the following statement generated a rich debate about capacity issues, next of kin rights and the nature of personal choice and control in one's life.

'Another complication I've just thought about is that you've got, say this John Smith taking his life and Jackie is next of kin. It could be that the next of kin strongly disagrees with what he wants to do, so then who do you put down of [sic]the next of kin?' [Q2.2]

On the other hand, it encouraged and enabled participants to raise ethics-related questions that may not have been possible through a typical debate about euthanasia or smart homes.

'Very difficult to say. When you are active enough to do it yourself you [sic]want to put these things [referring to the SOT technology] as far away from you as you could, wouldn't you?' [Q2.3]

Ethical questions were raised with regards to who would administer a euthanasia service and the societal impact it would have in terms of the economy. A concern was raised with regard to the financial savings an assisted dying service might make and how that might spur its wider adoption. This argument was strengthened by the mention of a related healthcare service (resuscitation opt-out service) reported in the news.

'That raises a whole [sic] ethical questions. If this is causing savings to the NHS because people take their own lives rather than costing the NHS money then do GPs then start encouraging people. I mean you've got the front page of the Daily Mail saying that practice nurses are ringing people and say can we put do not resuscitated [sic]on your files already' [Q2.4]

3. 3. Conceptualising new healthcare producs and services

Apart from ethical concerns and questions, the presentation and interaction with the DFs prompted participants to identify and conceptualise new healthcare products and services, where the technology embedded in the DFs could be further exploited. These ranged (in the case of the SOT DF) from services for people with physical disabilities and incapacity, to services for people with dementia and to services related to food safety in general.

'Somebody who needs this, like someone incapable who cannot go out and do their shopping, such as Jane.' [Q2.5]

'If the fridge could recognize the uncooked food, cause my mother put liver in the oven in a plastic dish; if it [the smart fridge] just said Mrs Smith this must go in the fridge. This would have been useful and I wouldn't have to check every time' [Q2.6]

In the case of the Soulaje DF, the proposed area for development focused on pain relief.

'A wheelchair user who needed morphine and could not get into the fridge to get the medicine...Or even in childbirth it could be used. For example, after childbirth I had morphine and you use less if you do it yourself than if it is administered to you.' [Q2.7]

One interesting response to the DFs presented in the workshop, came from a participant who recommended an alternative use of the proposed DF technology skewing the concept. The suggestion subverted the concept of the euthanasia wearable and, in the participant's own words, focused on 'saving instead of taking life'.

'Coming back to the [euthanasia] watch, if that could be used to help medical science, thinking of the diabetic, it could use it to insulin or a wheelchair user needing morphine, to use it for that for good purpose...if you use it in an emergency [sic] could save a life rather than taking one' [Q2.8]

3. 4. Understanding and decision–making

Moving on to the third theme, several participants employed the DFs as a 'sense making' tool. DFs were used within this context in two different ways. A few participants utilised them as a medium for developing and enhancing their understanding of the concepts and technology the design object embodied through questioning and reflecting on it. This was especially useful as the DFs included technology unfamiliar to a few of the oldest workshop participants.

'Like trouble-shooters for the technology, is that what it is?' [Q3.1]

'I think it would be an adviser to fix the technology, it would be somebody to give you the additional help that you would need with the new technology' [Q3.2]

The SOT DF was less transparent in terms of the technology and concept it incorporated. Some participants employed DFs to express and share their own understanding with other members in the group through circulating and demonstrating the DFs. In addition to this the DF material served as a prompt for some workshop participants to explain to other group members the technical concepts and imagined future services that the assisted smart object environment of the SOT DF introduced.

'So what [the design fiction] is saying then is that it [the smart fridge] can recognize who you are what your dietary habits are and then it can tell you actually whether the food you are eating are the best things for you' [Q3.3]

'If you had some sort of a design at home that would allow you a safe discharge to go home, I think this is what they getting at with this [the SOT]' [Q3.4]

Participants employed different strategies to explain the DF concepts. For example in the above quote a workshop participant used lay language to summarise and simplify smart home object technologies, whilst the participant in the quote below used an analogy from another technology enhanced setting to illustrate the potential value of a smart fridge

concept for older people.

'If you had a smart fridge, it would be able to maybe tell you when you are running out of things and automatically reorder them for you will so you know. In the future you can have like an automatic Tesco account and on a weekly basis it's sort of the fridge a bit like in the supermarkets when everything is scanned at the checkout well they know they've got to reorder those things in now'. [Q3.5]

Apart from enhancing understanding the DFs went even further to contribute to more in-depth thinking and debate, a point participant were aware of themselves.

'It's been a very interesting afternoon; deep thinking isn't it. You'll go home and still think about it'...'The more and more you talk about this the deeper and deeper you get into this, it's all what if, what if' [Q3.6]

The following participant quote illustrates how initially entrenched positions and reservations regarding euthanasia are negotiated following the introduction and debate of the Soulaje DF.

'I'd say I've got reservations about euthanasia per se but if it was to be permitted, I think this would be, I think there is plenty safeguards built in that and I like the idea that it is within a person's control they don't depend others to implement it, so my reactions are mixed' [Q3.7]

In another example a clear positional shift is evident. As the participant admits the discussion around the DF and its encapsulated concepts has led to more deep thinking and to question their current understanding and position on the subject.

"I think there's room for development" "Look how much you've changed over the last ten minutes! You are kind of warming a little bit to that" "Yes, cause I've been thinking it through and I've been thinking about my mother and how it could have helped her, but with reservations" [Q3.8]

Another interesting response was that of a participant who expressed the desire to take home and employ another DF material (the Soulaje user guide) as a tool to challenge a friend to reconsider their end of life views. It was interesting to note that the participant expressed that although she had tried several different ways of engaging in conversation with her friend about end of life issues, she believed that this would have a much stronger impact.

'I'm gonna take one of these [the euthanasia design fiction user guide]. I've got a friend who thinks the end of life ought to be, it [the design fiction material] will tell her some thing about it, won't it? And make her think about it in a different way' [Q3.9]

3. 5. Requirements capture

Identifying the techno-scientific requirements, opportunities and challenges for future healthcare services and technologies formed the last theme. The DFs acted as a trigger for the technical requirements capture of imagined futures. Examples of this included human

computer interaction methods (in the case of the SOT) and determining the correct dosage for Soulaje based on the end-user's weight.

'Presumably you would need different doses for different weights of people' [Q4.1]

'It could communicate with you; a message could come to your TV screen, cause older people like TV, that would say you may have your sausages or your rice pudding it balances with your salad' [Q4.2]

The DF prompted the posing of questions regarding technical challenges and limitations. Examples included the loss of mobile signal reception whilst operating the Soulaje and personalising the SOT for a family household.

'You know when your next of kin is meant to receive a message that you have initiated the euthanasia process. What happens if there is no mobile phone reception? You would not receive the text message then.' [Q4.3]

'Does it [the SOT] suit people living in a family? How does it individualize diets for more than one person? Does it cater for day to day choices with food?' [Q4.4]

Very specific and well though out questions were also raised with regards to the logistical framework underpinning the services embedded in the DFs and the service delivery mechanisms. These related to the purchasing, storage and use of the Soulaje and the implementation and maintenance in the case of the SOT. In addition to this the crafting of the SOT DF material (the job advert) illustrates how the language employed has managed to provoke a reaction about the DF itself that led then to a discussion of person-centred healthcare services. This led a participant to raise a thoughtful question regarding the eligibility of non-human agents to apply for the SOT jobs. According to the participant the question was raised in response to the way the DF was written and what it therefore might imply.

'Can robots apply for this job, cause it says candidates must demonstrate a strong autonomy and empathy for humans' [Q4.5]

4. Discussion

There are several important questions that arise from the findings, which are discussed in this section. These relate to:

- How have people criticised the DF?
- What are the insights that came from that critique?
- How the use of the design fictions produces different results from having a debate about euthanasia or smart homes?
- What are the design principles underpinning future social healthcare technologies?
- How are they currently articulated?

The findings presented above reveal that research participants' critique of the design fictions was incisive, constructive and multifaceted. Initially participants responded emotionally to the DFs in most cases forming a negative view towards them (e.g. Q2.1). Their first reactions were polarised and dismissive (e.g. Q2.3). They then started accepting the likelihood of these, or similar, technologies occurring, despite them being seen as science fiction by some participants (e.g. Q1.2), through the use of sci-fi movie references (e.g. Q1.1). A few participants started relating, and gradually warming, to some of the concepts behind the DFs through sharing experiences of people in their social circles (e.g. Q1.3, Q2.5), from the media (e.g. Q1.4) or their own lived experiences (e.g. Q2.6).

A number of insights were generated from that critique with beneficiaries; namely workshop participants (citizens and researchers). For workshop participants DFs served as a way of interrogating potential healthcare technologies. On one hand, they enabled them to query and examine the negative, unwanted side-effects and impact of such technologies (e.g.Q2.1) and on the other hand, to explore and consider the potential positive benefits arsing from them (e.g. Q2.5, Q2.7). At the same time they enabled participants to delve into and raise incisive ethical questions that arose from technologies portrayed affect on both individuals (e.g. Q2.2) and society as a whole (e.g. Q2.4).

In addition to this, DFs served in increasing the depth of workshop participants' understanding of the services and products embedded within them. By interacting with and sharing the DFs participants were able to make sense (e.g. Q3.3, Q3.4) and reflect on new complex technology-based services and products (e.g. Q3.1, Q3.2) with some even embedding them into existing service infrastructures (e.g. Q3.5). The depth of participants understanding of DF portrayed products and services was further demonstrated by the well-thought out questioning of their technical requirements (e.g. Q4.1, Q4.2) and the technical challenges of implementation (e.g. Q4.3, Q4.4). Understanding and engaging with more complex social healthcare technologies, as in the case of the people in the workshop, might provide added value in priming new technology introduction in healthcare services. By reflecting and discussing the technoscientific elements of a DF citizens can engage in debate and critique of the type of society and healthcare service model currently available and consider emergent possibilities. For example, the presented DFs encouraged a debate on privatisation versus publicly available services, as both DFs where introduced as future commercial healthcare services. Furthermore, the topics of pervasiveness and personalisation of technology were explored as each DF set out a different model: SOT, the former and Soulaje, the latter.

Negotiating ones understanding, and questioning entrenched positions that may lead to positional shift, are outcomes of the process of engaging with DFs. For instance, it was evident that the physicality, demonstration and sharing of the DFs led several workshop participants to question their initial views (e.g. Q3.6) with some of them warming up to the ideas embedded in the DFs (e.g. Q3.7) or even shifting their position (e.g. Q3.8). Others, were also keen to reuse the DF material beyond the workshop context as a tool to assist friends in taking a more considered and informed view to the subjects touched on by the DFs, such as assisted dying (e.g. Q3.9). These examples highlight that people involved in a co-design DF

process are more likely to become predisposed to the potential role of healthcare technologies in their lives. As designers and researchers we gained clarified in-depth insights about policy around the areas explored by the DFs, about people's understanding of technology, and most importantly articulations, and critiques of, preferable futures for different groups within the context of ageing and healthcare.

5. Conclusion

Design fiction and speculative design are emerging, and being considered, as a relevant tool and useful approach in the context of design research (Sterling, 2009; Dune and Raby, 2013; Blythe, 2014; Linehan et al., 2014). However, the focus of DF and speculative design tends towards influencing interaction design and is based on the exploration of innovations in human computer interaction technologies (Blythe, 2006; Schmitz et al., 2008; Shedroff and Noessel, 2012; Dourish and Bell, 2014). Furthermore, within this context DFs are predominately crafted by design experts and other skilled professionals.

In the ProtoPolicy project we explored how co-created DFs might be used to help older citizens imagine the future implications of policy initiatives related to ageing in place in creative ways. Our thematic analysis of the findings, following the presentation of DFs to citizens, who took part in the co-design process, suggest that there is an opportunity and a value in exploring DF and speculative design beyond their current use in design research. Five themes were identified. Firstly, the potential value of the DFs in increasing the plausibility and acceptance of future healthcare technologies and services; secondly facilitating and encouraging the discussion and sharing of ethical concerns and raising questions regarding the societal and ethical issues of current and future healthcare services and technologies; thirdly, conceptualising new healthcare producs and services; fourthly employing the DFs as a 'sense making' tool; lastly the DFs acted as a trigger for technical requirements capture for future healthcare services and technologies.

Further analysis and discussion of the research findings have revealed different benefits and insights for citizens and researchers. In the case of the former the findings highlight that people involved in a co-design DF process are more likely to become positively predisposed to the potential role of healthcare technologies in their lives. Understanding and engaging with more complex social healthcare technologies might provide added value in priming new technology introduction in healthcare services. This was demonstrated in the workshop where participants with initially entrenched positions negotiated their reservations leading to positional shift in their attitude towards the concepts and services portrayed in the DFs. For researchers, DFs can provide more in-depth insights about not just policy but also about people's understanding of technology. It can help researchers gain a better view and deeper analysis and criticism of the preferable futures articulated by different groups within the context of ageing, healthcare and technology.

Lastly, we recognise that this article has provided grounding for the investigation of co-

designing design fictions as potential approach for debating and priming future healthcare technologies and services, and that the area merits further research explorations.

References

1. Age UK. (2016). Later Life in the United Kingdom Report, February 2016. Retrieved Feb 26, 2016, from http://www.ageuk.org.uk/Documents/EN-GB/Factsheets/Later_Life_UK_factsheet.pdf?dtrk=true.

2. Auger, J. (2013). Speculative design: crafting the speculation. *Digital Creativity, 24*(1), 11-35.

3. Bleecker, J. (2015). Design fiction: A short essay on design, science, fact and fiction. 2009. *Retrieved June, 16*.

4. Blythe, M. (2014, April). Research through design fiction: narrative in real and imaginary abstracts. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 703-712). ACM.

5. Blythe, M. A., & Wright, P. C. (2006). Pastiche scenarios: Fiction as a resource for user centred design. *Interacting with computers, 18*(5), 1139-1164.

6. Boyd, H., McKernon, S., Mullin, B., & Old, A. (2012). Improving healthcare through the use of co-design. *The New Zealand Medical Journal (Online), 125*(1357).

7. Doos, L., Packer, C., Ward, D., Simpson, S., & Stevens, A. (2016). Past speculations of the future: a review of the methods used for forecasting emerging health technologies. *BMJ open, 6*(3), e010479.

8. Dourish, P., & Bell, G. (2014). "Resistance is futile": reading science fiction alongside ubiquitous computing. *Personal and Ubiquitous Computing, 18*(4), 769-778.

9. Dunne, A., & Raby, F. (2013). *Speculative everything: design, fiction, and social dreaming*. MIT Press.

10. Gov. UK. (2016). *Policy Older people*. Retrieved Mar 11, 2016, from https://www.gov.uk/government/policies/older-people.

11. Gov. UK. (2016). *Policy Health and social care integration*. Retrieved Mar 11, 2016, from https://www.gov.uk/government/policies/health-and-social-care-integration.

12. Gov. UK. (2016). *Policy Housing for older and vulnerable people*. Retrieved Mar 11, 2016, from https://www.gov.uk/government/policies/housing-for-older-and-vulnerable-people.

13. Graham, G. (2007). Analyzing qualitative data. *Qualitative Research Kit*. London: Sage.

14. Hales, D. (2013). Design fictions an introduction and provisional taxonomy. *Digital Creativity, 24*(1), 1-10.

15. Hockstein, N. G., Gourin, C. G., Faust, R. A., & Terris, D. J. (2007). A history of robots: from science fiction to surgical robotics. *Journal of robotic surgery, 1*(2), 113-118.

16. Kirby, D. (2010). The future is now: Diegetic prototypes and the role of popular films in generating real-world technological development. *Social Studies of Science, 40*(1), 41-70.

17. Kirkpatrick, C. J., Fuchs, S., Peters, K., Brochhausen, C., Hermanns, M., & Unger, R. E. (2006). Visions for regenerative medicine: interface between scientific fact and science fiction. *Artificial organs, 30*(10), 822-827.

18. Klugman, C. M. (2001). From cyborg fiction to medical reality. *Literature and medicine, 20*(1), 39-54.

19. Knutz, E., Markussen, T., & Christensen, P. R. (2014). The Role of Fiction in Experiments within Design, Art & Architecture. *Artifact, 3*(2), 1-8.

20. Lee Y. (2008). Design participation tactics: the challenges and new roles for designers in the co-design process. *Co-Design, 4*(1), 31-50.

21. Linehan, C., Kirman, B. J., Reeves, S., Blythe, M. A., Tanenbaum, J. G., Desjardins, A., & Wakkary, R. (2014, April). Alternate endings: using fiction to explore design futures. In *CHI'14 Extended Abstracts on Human Factors in Computing Systems* (pp. 45-48). ACM.

22. Markussen, T., & Knutz, E. (2013, September). The poetics of design fiction. In *Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces* (pp. 231-240). ACM.

23. Pasman, G. (2016, May). Design Fiction As a Service Design Approach. In *Service Design Geographies. Proceedings of the ServDes. 2016 Conference* (No. 125, pp. 511–515). Linköping University Electronic Press.

24. Petersen, A., Anderson, A., & Allan, S. (2005). Science fiction/science fact: medical genetics in news stories. *New Genetics and Society, 24*(3), 337–353.

25. Rice, M., Newell, A., & Morgan, M. (2007). Forum Theatre as a requirements gathering methodology in the design of a home telecommunication system for older adults. *Behaviour & Information Technology, 26*(4), 323–331.

26. Sanders, E. B. N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *Co-design, 4*(1), 5–18.

27. Schmitz, M., Endres, C., & Butz, A. (2008, January). A survey of human–computer interaction design in science fiction movies. In *Proceedings of the 2nd international conference on INtelligent TEchnologies for interactive enterTAINment* (p. 7). ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering).

28. Shedroff, N., & Noessel, C. (2012). *Make it so: Interaction design lessons from science fiction.* " O'Reilly Media, Inc.".

29. Smith, S. (2016). 'Limbitless Solutions': the Prosthetic Arm, Iron Man and the Science Fiction of Technoscience. *Medical Humanities*, medhum–2016.

30. Steen, M., Manschot, M., & De Koning, N. (2011). Benefits of co-design in service design projects. *International Journal of Design, 5*(2), 53–60.

31. Sterling B. (2009). Design fiction. *Interactions, 16*(3), 20–4.

32. Tanenbaum, J., Tanenbaum, K., & Wakkary, R. (2012, May). Steampunk as design fiction. In *Proceedings of SIGCHI Conference on Human Factors in Computing Systems* (pp. 1583–1592). ACM.

33. Tonkinwise, C. (2014). How We Intend to Future: Review of Anthony Dunne and Fiona Raby, Speculative Everything: Design, Fiction, and Social Dreaming. *Design Philosophy Papers, 12*(2), 169–187.

34. United Nations. (2015). Department of Economic and Social Affairs, Population Division. World Population Ageing 2015 – Highlights (ST/ESA/SER.A/368). Retrieved Feb 26, 2016, from:http://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2015_Highlights.pdf.

35. Visser, F. S., Stappers, P. J., Van der Lugt, R., & Sanders, E. B. (2005). Contextmapping: experiences from practice. *CoDesign, 1*(2), 119–149.

36. Voros, J. (2001). A primer on futures studies, foresight and the use of scenarios. *Prospect: The Foresight Bulletin, 6*(1).

37. Voss, G., Revell, T., & Pickard, J. (2015). Speculative Design and the Future of an Ageing Population Report. *Government Office for Science*. Retrieved July, 2015, from https://www.gov.uk/government/publications/future-of-ageing-speculative-design-workshops.

38. Wohlmann, A., & Steinberg, R. (2016). Rewinding Frankenstein and the body-machine: organ transplantation in the dystopian young adult fiction series Unwind. *Medical Humanities*, medhum–2016.

39. Xie, B., Druin, A., Fails, J., Massey, S., Golub, E., Franckel, S., & Schneider, K. (2012). Connecting generations: developing co-design methods for older adults and children. *Behaviour & Information Technology, 31*(4), 413–423.