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Using LEGO® SERIOUS® Play with stakeholders for RRI

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ABSTRACT

This paper discusses Responsible (Research and) Innovation (RRI) within a UKRI project funded through the Trustworthy Autonomous Systems Hub, **Imagining Robotic Care: Identifying conflict and confluence in stakeholder imaginaries of autonomous care systems.** We used LEGO® Serious Play® as an RRI methodology for focus group workshops exploring sociotechnical imaginaries about how robots should (or should not) be incorporated into the existing UK health-social care system held by care system stakeholders, users and general publics. We outline the workshops' protocol and some emerging insights from early data collection, including the ways that LSP aids in the surfacing of tacit knowledge, allowing participants to develop their own scenarios and definitions of 'robot' and 'care'. We further discuss the implications of LSP as a method for upstream stakeholder engagement in general and how this may contribute to embedding RRI in robotics research on a larger scale.

1. Introduction

The deployment of semi-autonomous, mobile robots for the delivery of health-related social care services is increasingly touted by governments around the world as the remedy for funding shortfalls and workforce shortages (Maibaum et al., 2021). Yet, of the extensive range of semi-autonomous prototypes or for-research-only assistive robots which have been trialled in care contexts over the last decade (e.g., Robinson et al.,2014) few have entered the market as accepted and widely-used devices (Aguiar Noury et al., 2021). We view this stalled development as a symptom of late-stage user testing, where valuable insights from stakeholders are arriving too late in the process to effectively shape design.

This paper discusses the potential of LEGO® SERIOUS® Play (LSP) as a tool for involving stakeholders in the early-design stages of engineering projects. Specifically, we reflect on its use in a UKRI project funded through the Trustworthy Autonomous Systems (TAS) Hub, **Imagining Robotic Care: Identifying conflict and confluence in stakeholder imaginaries of autonomous care systems** (IRC), which aimed to explore how care system stakeholders, care users and general publics imagine robots could (or should not) be incorporated into the existing UK health-social care system.

1.1. RRI and HRI

The last ten years have seen the emergence and codification of a multi-disciplinary field of theory and practice aimed at the development of frameworks for Responsible (Research and) Innovation (RRI). Although recently characterised by some of its foundational proponents as an 'unfinished journey' (Owen et al., 2021), RRI is nevertheless embedded with an increased focus on innovation in Horizon Europe (Robinson, Simone, & Mazzonetto, 2021) and, in a somewhat different form, within UK Research and Innovation (UKRI) funding for science and engineering programmes (cf. Owen, Pansera et al., 2021)

RRI stresses early and continual engagement to guide ethical as well as technological development throughout the life of an innovation (Stahl & Coeckelbergh, 2016). Ideally, anticipatory and reflexive activities should begin at the problem-definition (ie. proposal development) stage, involving a wide range of stakeholders beyond potential project partners. In practice, however, aligning this with existing funding and

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research paradigms in robotics can be difficult. Empirical studies of robots in care contexts often take the form of temporarily providing prototypes to elder-care facilities to observe the response (Abdi et al., 2018; Bradwell et al., 2019) or to record changes in attitude (Bemelmans et al., 2012; Irfan et al., 2019). Within the field of human-robot interaction (HRI), approaches using videos, photos of robots, or written scenarios are often used to achieve a more narrative, situated understanding (Lee 2017; Šabanovic 2015). However, all of these may be limited by researchers' or designers' assumptions about potential users and the types of robots or actions they would find of interest (Bradwell et al., 2019) and/or limit respondents to thinking only within predetermined categories, potentially creating incomplete or misleading outcomes (Compagna & Kohlbaher, 2015). Moreover, although trust is a key issue in all of these approaches, 'responsibility' is not considered as a component of trust, which is generally framed as a technical quality of reliability and safety. These studies also often come too late in the process for their insights to drive significant change.

Nevertheless, HRI and RRI do have areas of significant overlap: in the increasing emphasis on user-centric/participatory design within robotics, and in the need for social science input to help direct what are effectively collective experiments in innovation-driven social change (Nordmann 2019: 182). Recent arguments for taking a 'systems thinking', transdisciplinary approach to robotics and AI acknowledge that new technologies are situated in larger socio-technical systems and thus remain vulnerable to changes in non-technical aspects of the system (eg. Umbrello 2022). This approach is congruent with RRI's foundational emphasis on aiding the 'proper embedding' of technology in society (von Schomberg 2013) through ongoing monitoring and engagement, as well as with emerging scholarship in whole-systems approaches to health services design (eg. Speake et al. 2016). Thus, understanding the health-social care system from different positions within it is particularly crucial when discussing the development of robotic technologies for use with physically vulnerable people whose capabilities may be impacted by external events such as changes in the political structure, more than changes to their own health. .

1.2. LEGO® serious play® as a tool for RRI

While LEGO® will be familiar to most people as a children's building toy (consisting of a wide variety of plastic bricks which can be repeatedly clicked together and taken apart), LEGO® Serious Play® (LSP) is a facilitated hands-on workshop method initially developed for corporate strategizing within the LEGO® group (Executive Discovery Llc. 2002). Although its main use tends to be for team building, problem-solving and product development within industry (McCusker, 2014), within academia it has also been used for classroom teaching, programme development, and as a tool for qualitative research (James 2013, Peabody & Noyes 2017). As a certified LSP facilitator, the lead author has for several years been using it to develop bespoke RRI workshops for specific projects (eg. McLeod et al., 2018), and as a means of helping doctoral students in science and engineering understand how ethics and values can guide their own technical decision-making.

As a method, LSP is simple: a challenge is posed, participants use the bricks to build a model to illustrate a narrative response, each builder shares the story of their model with the rest of their group, then a guided discussion ensues to explore these ideas more deeply. This process is repeated in successive rounds which move participants towards the workshop's intended outcome. Thus, LSP requires everyone to participate equally, listen attentively and contribute to building the group's collective knowledge (Rasmussen, 2006), which makes it an ideal tool to mitigate the common phenomenon of a small number of people dominating a group discussion while others remain relatively silent. Its use in HRI has so far been limited to a handful of studies, largely around the introduction of social robots into tourism contexts (eg. Simon et al., 2020; Tuomi et al., 2019; Wengel et al., 2016). However, it has also been used for enhancing user involvement in participatory design (Frick et al., 2014; Hinthorne & Schneider, 2012), as part of a design thinking approach (Lee et al., 2018; Primus & Sonnenburg, 2018) and for developing a whole-service approach to service change (Heath et al., 2014), all of which are relevant to responsible introduction of robots into existing care systems. In what follows we discuss the particular protocol used in the IRC project, as a means of illustrating how LSP may be used as a narrative elicitation tool for engaging and incorporating diverse stakeholder knowledge, with or without specific developmental goals.

2. Imagining robotic care

Taken collectively, the body of HRI research hints at a complex relationship between the form of the robot, the task it performs, and the larger context in which this takes place (Naneva et al., 2020; Whelan et al., 2018). However, the personal experiences, values and expectations that mediate a participant's response, particularly where respondents have situated expertise as stakeholders within the larger system in which the robot might be deployed, is generally not explored in HRI research. This can potentially lead to erroneous assumptions about the participants and how they may imagine 'robot' or 'care' (let alone robots *for* care) when answering questions during the research. To explore this gap and its potential effect on stakeholder response, we employed LSP as a method of eliciting detailed, contextualized narratives, deliberately allowing respondents to define both the scenario and end user, as well as their own understandings of 'robot' and 'care', in order to create a complex *sociotechnical imaginary* in response to the questions posed.

A concept borrowed from science and technology studies, a sociotechnical imaginary (STI) is the projection of a collectively achieved future enabled by the development of a specific technology, often tied to national economic goals (Jasanoff & Kim 2009); in this case, the introduction of automation into the delivery of health-related social care. Because STIs are high-level abstractions informed by normative beliefs and values systems, they often rely on tacit knowledge and assumptions which may be difficult for an individual to articulate in a classic interview or focus group session, particularly where scenario materials have been predetermined (Compagna & Kohlbacher, 2015). Our purpose here was not to aid in the development of a particular robot, but to a) make visible the STIs held by stakeholders who may be impacted by the integration of robots into the existing health-social care system (including publics not presently needing care), b) elucidate what might challenge the positivity (or negativity) of the scenarios imagined and c) explore convergent and divergent aspects of a and b.

As an RRI project, we examine these phenomena by blending the process orientation of the UK Engineering and Physical Sciences Research Council's AREA framework (Anticipate, Reflect, Engage, Act) with the normative values embedded in the European Union's original 'six keys' (EC, 2012) of RRI (ethics, gender equality, science education, open access, public engagement and new forms of governance). Developed as a result of the workshops discussed in McLeod, de Saille & Nerlich (2017), the ARIA-in-Six-Keys approach (Anticipate, Reflect, *Include*, Act, where 'include' is operationalised to bring forward a whole-systems approach) draws from both AREA and the framework discussed by Stilgoe et al. (2013), but goes further in problematizing the role of the market and the growth imperative in determining the development and take-up of innovation. As "pump-priming" research carried out without a specific technical goal, ARIA allows us to query more broadly how systemic conditions affect the distribution of harm and benefit in automation of social care in the UK, and identify potentially incommensurate goals as well as potential risks to 'care' as a crucial part of social relations while developmental pathways are still relatively open and amenable to change. Here we find useful Nordmann's (2019: 185-86) wider definition of design, which includes 'the internal organization of a socio-technical system that performs some task or solves a problem', as well as design of the specific technology in question. We consider the LSP data-gathering element of this project as aligning with ARIA's anticipatory stage, proceeding to reflective exploration (analysis) of the ethical, social, legal and *service design* implications of care robotics as an emergent technological domain (eg. Kipnis et al. 2022), to be followed by inclusion of further relevant knowledge (targeted interviews and textual analysis of policy documents). Our final analysis will provide insight to be shared with the TAS Hub as a means of helping to guide its own actions towards development of project-relevant RRI.

2.1. Protocol

Because of COVID-19, our workshops were designed to be carried out and recorded over Zoom, as a previous project had shown this to be feasible (de Saille et al., 2022); the protocol itself had been developed in an earlier, face-to-face pilot (de Saille et al. 2022). Materials were the 56-piece Window Exploration Kits which LEGO® makes specifically for LSP, sent to the participants by mail to keep (see Fig. 1). The groups consisted of six general public divided into two groups each of under 40 (13 people total), 40-60 (14) and over 60 (13); care users under 50 (6) and over 50 (5); two groups of care commissioners (5 in each); and one each of roboticists/designers (4), HRI academics (4), care/disability academics (6), professional carers (5), and social workers (5) for a total of 85 participants.

The workshops begin by asking participants to direct the facilitator's assistant in placing a token along a continuum from relatively negative to relative positive on a screenshared slide. This is to indicate how they feel, in general, about the idea of using robots to deliver aspects of social care, and to elicit explanation of why they chose that position. The same task is repeated on a new board at the end. This gathers baseline entry and exit positions for in-group and cross-group comparison as well as detailed narrative data on how they imagine 'robots for care' before commencing the LSP activities. These begin with a series of warm-up exercises designed to familiarise participants with using the bricks as metaphors before moving to the core questions, which are meant to illuminate the contextual nature of both 'robot' and 'care' (See Table 1 below). In the final activity, participants make a series of small models illustrating qualities they would find essential if using a robot for care *for themselves*. These are represented as post-its on a screenshared Miro whiteboard and ranked in importance by the group as a whole, allowing capture of the new scenarios and values that emerge when participants must reposition themselves as the cared-for person (which is rarely the case in their responses to Q1 and 2).

The anonymised audio transcripts have been thematically analysed through Nvivo using an inductive approach (Charmaz, 2008), with the position slides and Miro boards providing additional group-level visual

Fig. 1. A window exploration kit.

Table 1
Protocol for IRC workshops

Task	Purpose	Challenge
Skills building	Familiarity with bricks Using bricks as metaphors Exploring values and context in design choices	Build a tower with only green and orange bricks. What does it make you think of? Use any 10 bricks to build anything you like. Now choose a term from this card [of concepts such as responsibility, success, etc.] and tell us how your model represents that. Build a device that can travel over snow. It doesn't need to look real, let your imagination go wild. Then tell us what you made and why.
Core questions	Q1 - What kind of robot is imagined, what is it doing, who receives the care and in what context? Q2 – Identify aspects critical to a robot's ability to improve current care provision.	Build a model that helps you tell a story about a robot giving care to someone. Think about what kind of robot it might be, who made it or where it might come from, why this person has a robot, where they are, what the robot is doing and why. Maybe that person is you, maybe it's not. Maybe it's a happy story, maybe it's not. Using the same model, I'd like you to modify it to tell the opposite story. If the person felt comfortable with the robot in that scenario what might make them feel uncomfortable? Or if it was not a pleasant story, what might make it better for that person?
Validation	Q3- Personalising and ranking key elements	Using just a few bricks per model, I'd like you to build as many models as you can, each representing one thing you think is absolutely essential to make using robots in care something you might consider for yourself.

data. At the time of writing, analysis is still ongoing, however, some early insights can be drawn. Given the small sample size and the nature of the study, we cannot generalise, but the narrative depth of LSP does allow us to begin to explore how participants' different positions in the health-social care ecosystem create different imaginaries of different robots and care scenarios, as well as different conceptions of benefit and risk. An illustrative example is given in Fig. 2 below, where a social worker has drawn upon their own experience with a real client, imagining the robot's potential for solving what they identified in the ensuing discussion as one of the most pressing problems they saw in social care, which is assisting people in and out of bed and to/from the toilet at times convenient for the client, rather than to fit the care worker's schedule (which carers may have no control over either). This surfacing of tacit knowledge and experience is part of what LSP helps enable as a method (Rasmussen, 2006) and could be seen in the responses of most participants, even younger members of the public with no direct experience of needing social care, who often – deliberately or subconsciously – placed older relatives or friends who had needed rehabilitation after injuries into their scenarios as the care receiver.

Overall, participants imagined the robots as able to communicate with the user, understand their environment, and exhibit a high level of machine intelligence. Although many participants desired the robot to perform household chores (cleaning, hoovering etc.), there was a lack of consensus, particularly in the public groups, as to whether a robot should also provide personal care (helping someone get dressed, go to the toilet etc.) Positions within this debate were mostly determined by tension between the values of human touch and privacy, with some preferring a machine as the more dignified option for intimate tasks. Similarly, participants debated whether a robot could indeed provide companionship, and whether a robots' inability to pass judgement might be a benefit, providing a simply 'transactional' form of care. Surprisingly to us, both social workers and carers were extremely positive about the potential for benefit in their scenarios, although carers began almost uniformly in a neutral (i.e. undecided) position on their entry slide. Drawing on their professional and lived expertise, both of these groups were also more likely to imagine the cared-for person as young, disabled but otherwise independent, rather than elderly, lonely and frail.

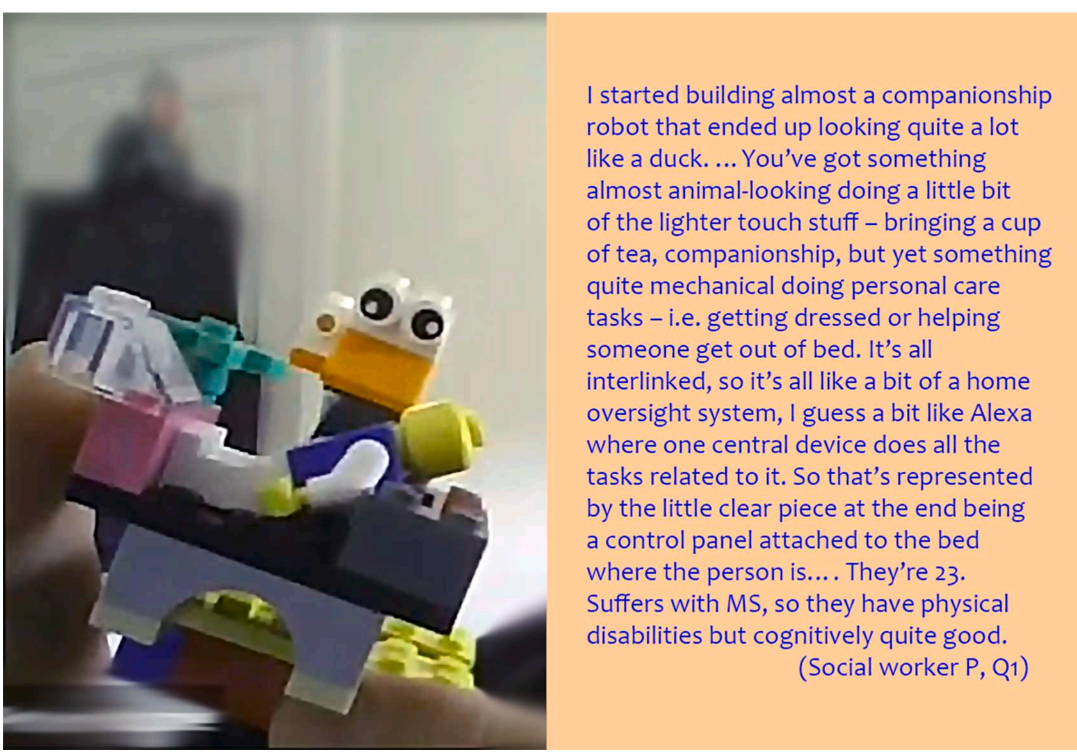

Fig. 2. An LSP model and its story

3. Reflections on using LSP for RRI

Forsberg et al. (2021) have noted a mismatch of logics when attempting to integrate RRI at the project level, one which tends to keep RRI academics separate from the actual technological development, which remains market and/or government driven. We have experienced the same mismatch, hence our desire to develop our own research trajectory outside of, but closely connected to, the technical research within the TAS Hub. Moreover, it is common in this application area for market-driven "innovation" to be seen as the solution for the "problem of aging populations", without investigating either the organisational requirements for embedding that innovation to create real public benefit (rather than just private wealth), or what kinds of sociotechnical imaginaries such statements bring forward (Bechtold et al. 2017). There is certainly the potential for mismatch in the sociotechnical imaginary of robotic care presently being pursued by policymakers, research funders and investors seeking to develop a 'silver market', as adaptable, multi-purpose robots are both a long way from viability and likely to be too expensive to deploy at scale on public budgets (or for most people to purchase privately). Similarly, robots developed with frail elderly users in mind may be uninteresting to more active older people (Bradwell et al., 2019), or to younger disabled people with different lives, needs and expectations.

For this, among other reasons, RRI envisions the inclusion of a diversity of stakeholder knowledge and perspectives at the earliest opportunity and throughout a development trajectory, as part of better anticipating risk and benefit and refining the goals of a particular project. In our case, our purpose was only to see what was imagined when respondents were not pre-supplied with a form, purpose or definition of the robot, nor of the potential user or care setting involved. LSP is not the only tool which could be used for this kind of narrative solicitation, but we continue to find it more useful than techniques such as roleplay or drawing, where people may feel uncomfortably unskilled in a group setting and thus spend more energy on mitigating their discomfort than creatively exploring the topic. No prior acquaintance with LEGO is required in an LSP workshop as the warm-up challenges are meant to assure that sufficient skill can be built very quickly, even for those who have never used the bricks before. Moreover, LSP is actively participatory, with the potential for upending power relations through its playful (yet purposeful) approach (Hinthorne & Schneider, 2012).

On the use of LSP in virtual contexts, we did not find a difference in quality of narrative between online and face-to-face workshops, although the models themselves were only visible during the storytelling, when respondents held them up to the camera. In the building of small models for principles (Q3), these would normally be arranged on the table through group negotiation, however, the Miro board served as a reasonable substitute as it is the discussion of values which provides the real data. Therefore, while virtual LSP was sufficient for the needs of this project (which was designed with the limitations produced by the Covid-19 pandemic in mind) it should be noted that some workshop formats are unlikely to be possible in an online environment, in particular the shared modeling and landscape-building which would be required to further explore relationships between different aspects of the health-social care ecosystem or to co-develop a proposal for creating a specific robot with critical stakeholders, as part of the inclusion phase of an ARIA approach.

4. Conclusion

While our current research explores a specific application area, the rich data elicited by an LSP methodology suggests that this technique could be applied to other autonomous systems contexts. Participatory processes, where responsibility for decision-making is shared between users, critical stakeholders and the design team all the way from problem definition to producing solutions (eg. Čaić et al., 2018), are slowly gaining traction, providing potential spaces for the ongoing and inclusive engagement with emerging technology envisioned by RRI. LSP as an inexpensive, accessible means of exploring divergent needs, assumptions, capacities and constraints presents a proven way to bring lesser-heard voices into the processes of innovation, and focus not necessarily on what the robot should do, but rather on what values should govern its design. RRI in that sense functions as a kind of sociotechnical imaginary in its own right, one in which a variety of publics (who should *not* be characterised as potential consumers but as interested citizens) can be enrolled as stakeholders, and accorded if not an equal place at the table, then at least a voice in the room where our technological future is being decided.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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