Incorporating the Public Perspective into the Future Design of Smart Home Living'

Valentine Seymour[1](✉), Maria Xenitidou[2], Lada Timotijevic[1], Charo Hodgkins[1], Eleanor Ratcliffe[1], Birgitta Gatersleben[1], Nigel Gilbert[2], and Chris R. Jones[1]

[1] School of Psychology, University of Surrey, Guildford GU2 7XH, UK
v.i.seymour@surrey.ac.uk
[2] Department of Sociology, University of Surrey, Guildford GU2 7XH, UK

Abstract. User-Centred Design (UCD) researchers have been investigating smart homes for 20 years and have highlighted the approaches' effectiveness in identifying the requirements of users. Despite the growing interest in smart homes, research has shown that its adoption remains low. This owes to the tendency for research to often use a technological-centred approach to improve a pre-existing product or tailor it to target users. Visions of smart homes may therefore not have been fully based on a clear understanding of users' needs and sociotechnical issues of concern.

Enabling the public to have a role in shaping the future of smart home technologies and related sociotechnical issues of concern in the early stages of the UCD process have been widely recommended. Specifically, there have been calls to engage the public in sharing responsibility for developing data privacy agreements, data governance frameworks, and effectively domesticating technologies into life and 'home' systems.

This paper introduces the citizens' jury method to enable the public to have a role in shaping the future of smart homes and related sociotechnical issues. This is an understudied area of research that would be considerably valuable for practitioners in the usability and smart technology sectors. Findings from this paper are based on a cross-section of UK citizens', exploring their opinions on sociotechnical issues of data security, accessibility to and control over use of devices and technological appliances associated with smart homes. A set of recommendation are developed to provide guidance and suggested actions on approaching these issues in the future.

Keywords: Smart homes · Citizens jury method · Data security · data governance · Public involvement

1 Introduction

'Smart homes' is a widely used concept. It is, however, beyond the scope of this article to review the many ways this concept has been previously explored [1]. Instead, we adopt the view that a 'smart home' is one that is equipped with a layering together of different technological features aimed at providing tailored services for the people using them.

This makes it possible to monitor, control and support people using smart technologies, thus enhancing the quality of life and promoting independent living [1].

Economic forecasts suggest that the ownership of smart home devices will climb to an estimated 25.4 million UK users by 2026 [2]. This drive towards smart home technologies is partially motivated by the underlying purpose "to improve people's living experience" [3: 463]. Despite this, some research has shown that agreeing to live in smart homes remains low [4].

The barriers to opting for smart homes have been linked to various sociotechnical issues of concern to users. Others also highlight the need for a clearer understanding about the relationship between users' perceived risks associated with data sharing and trust towards the smart home industry [4]. Instead, research to date has tended to focus on technological features of smart homes [3]. It is easy therefore to see how visions of smart homes and their technological features may not have been fully based on a clear understanding of users' needs and sociotechnical issues of concern. As such there have been calls for more research activity to address these concerns [4].

Understanding both the benefits and challenges of smart homes is critically important given that their overall success hinges on their adoption [5]. The inclusion of public interventions in future research, such as those involving a deliberative decision-making process, have been widely recommended [6]. The citizens' jury is one such method that has not yet been applied to enable the public to have a role in shaping the future ethical issues and governance practices in data-driven smart environments [7].

The contribution of this article is that it applies a citizens' jury method to create a set of recommendations that can be used to provide guidance and suggested actions on approaching these ethical and governance issues associated with smart home living in the future. Specifically, the study aims to:

- explore the UK public's opinions on data security and governance issues associated with smart homes using a deliberative decision-making method (i.e., the citizens' jury method); and,
- create a set of recommendations to provide future guidance on data security and governance issues associated with smart homes.

2   Method

2.1   Participants

20 members of public volunteered to participate in this study. Participants were organized into four groups, controlling for age (e.g., younger, and older adults) as well as their orientations to smart technologies (e.g., techno-sceptic).

2.2   Expert Witnesses

4 expert witnesses were chosen to provide relevant information about socio-technical issues associated with smart homes. Witnesses were identified through author's existing contacts and cross-referencing methods from publicly accessible online sources.

2.3 Citizens' Jury Design

A two-day online citizens' jury was held in June 2021 and consisted of two 2-h sessions held each day (n = ten hours). Participants were provided with pseudonyms to protect their identities and an audio recorder was used to record the sessions [8].

Two witness talks occurred at the start of each day. On the first day, participants listened to witnesses 1 and 2 on issues of sense of control, accessibility of smart homes and the 'meanings of home' associated with smart home living. On the second day, jury participants listened to expert witnesses 3 and 4 on issues of data sharing, data management and ethical issues associated with smart home living.

Following this, small group discussions were used immediately after the witness talks. Participants were encouraged to deliberate, listen, and respond to the thoughts expressed by other participants in response to the issues presented in each of the with talks.

At the commencement of each day, participants were presented with three statements put to the jurors for deliberation were as follows:

Overarching statement: "Smart homes will are rapidly changing the way we live at home and what we mean by home".

Sub-statement 1: "Smart homes could monitor your lifestyle and living environment and identify areas for improvement. We should be willing to cede control to our home to make more decisions about how we should live our lives".

Sub-statement 2: "Smart living will require data-sharing. The benefits of living in smart homes outweigh the risks of data-sharing".

The design of these statements and small group discussions was informed by a literature review exploration. Participants were asked to individually vote either "yes" or "no" based on whether they 'agreed' or 'disagreed' with these two statements, discussing reasons for their vote afterwards. After the voting sessions, participants developed recommendations relevant to data security and governance issues discussed within their small groups.

2.4 Data Analysis

Citizens' jury discussions were transcribed and analyzed using thematic methods as outlined by Braun and Clark [9], identifying key themes that evidently emerged relevant to the study's aim.

3 Results

Participant's grouped aggregated voting responses to the two statements are shown in Table 1. Overall, most participants disagreed with the two statements. These voting outcomes reflect underlying discussions points, opinions, arguments, and issues raised during the citizens' jury.

Participants acknowledged various public benefits, associated with data sharing in smart environments, both individual and on society. These include providing assistive living, improvements in technology performances, and healthcare support to ensure vulnerable people (e.g., elderly and those with disabilities) remain autonomous, independent, safe, and well at home.

Table 1. Participant responses to the statements they were asked to vote on.

Statements	Participant responses			
	Group 1	Group 2	Group 3	Group 4
Overall statement: "Smart homes are rapidly changing the way we live at home and what we mean by home"	Majority agreed [4 = Yes, 1 = No]	Majority disagreed [4 = No, 1 = Yes]	Majority disagreed [2 = Yes, 3 = No]	Majority disagreed [4 = No, 1 = Yes]
Sub-statement 1: "Smart homes could monitor your lifestyle and living environment and identify areas for improvement. We should be willing to cede control to our home to make more decisions about how we should live our lives"	All disagreed [0 = Yes, 5 = No]	Majority disagreed [1 = Yes, 4 = No]	All No [0 = Yes, 5 = No]	All No [0 = Yes, 5 = No]
Sub-statement 2: "Smart living will require data-sharing. The benefits of living in smart homes outweigh the risks of data-sharing"	All No [0 = Yes, 5 = No]	Majority Yes, [4 = Yes, 1 = No]	All No [0 = Yes, 5 = No]	Majority no [1 = Yes, 4 = No]

Participants also expressed concerns over existing ethical procedures and data governance practices in data-driven smart environments, highlighting challenges associated with data protection responsibilities, accessibility of existing information about data sharing, consent management tools, and the appropriateness of data shared.

Generational and technological orientational differences were also identified and mattered when weighing up the risks and benefits of living in smart homes. The majority felt the risks of data sharing outweighed the benefits; this view was not shared by younger techno-enthusiasts who instead expressed their acceptance of intrusive data sharing as an inevitable part of our lives.

Discussions revealed a relationship between participants' sense of trust towards actors in the smart technology industry and participants willingness to share data. Most participants owed their distrust on a lack of transparent and inaccessible communications presented to users by industry developers for user guidance, clarity of 'data ownership', and consent management purposes.

At the end of the 2-day citizen jury, participants created a list of 'data privacy and governance' recommendations for future data-driven smart environments based on group discussions (Table 2).

Table 2. Participant recommendations.

Recommendations
1. Improve the transparency and accessibility of information on issues around data sharing, privacy, and security to ensure smart users are better informed to make decisions
2. Develop a representative and independent governing body that regulates and oversees decisions on future smart home technology use
3. Improve and regularly seek consent management practices from 'all' smart users (e.g., multiple users and capacities) to use their data
4. Provide assurances that any data sharing will be done responsibly and appropriate to fulfil the purpose for which it is used as well as user needs
5. Create further opportunities for the inclusion of smart users in data governance framework and decision making
6. More research is needed to address future issues on data sharing, privacy, governance, and security

4   Conclusion

Understanding the relationship between smart users' perceived risks and distrust towards the smart home industry is of central importance when planning an effective ethical and data governance practices response for future data-driven smart environments.

The research also revealed various public benefits associated with data sharing in smart environments, both individual and on society, such as assistive living and healthcare support. We also found that there were diverging views associated with smart technology adoption, with further research needed to address privacy concerns and other ethical issues which remain the main obstacles to smart technology adoption (e.g., accessible communications, responsible data sharing, consent management, and clarity over data ownership).

Our research highlighted the potential for using the citizens; jury method as a novel contribution, to explore public opinions on data security and governance issues. This approach also allowed the public to have a role in shaping the future of smart homes. However, it is important to note that due to the COVID-19, the citizens jury was held using an online video conferencing approach. Further research is therefore needed to explore these methodological implications on citizens jury discussions.

References

1. Sovacool, B.K., Turnheim, B., Hook, A., Brock, A., Martiskainen, M.: Dispossessed by decarbonisation: Reducing vulnerability, injustice, and inequality in the lived experience of low-carbon pathways. World Dev. **137**, 105116 (2021)

2. Koolen, C.: Transparency and Consent in Data-Driven Smart Environments. Intersentia, Antwerpen, Cambridge (2020)
3. Wilson, C., Hargreaves, T., Hauxwell-Baldwin, R.: Smart homes and their users: a systematic analysis and key challenges. Pers. Ubiquit. Comput. **19**(2), 463–476 (2015)
4. De Ruyck, O., Conradie, P., De Marez, L., Saldien, J.: User needs in smart homes: changing needs according to life cycles and the impact on designing smart home solutions. In: Lamas, D., Loizides, F., Nacke, L., Petrie, H., Winckler, M., Zaphiris, P. (eds.) INTERACT 2019. LNCS, vol. 11747, pp. 536–551. Springer, Cham (2019). https://doi.org/10.1007/978-3-030-29384-0_33
5. Martins, F., Almeida, M.F., Calili, R., Oliveira, A.: Design thinking applied to smart home projects: a user-centric and sustainable perspective. Sustainability **12**, 10031 (2020)
6. Ghaffarianhoseini, A., et al.: Intelligent or smart cities and buildings: a critical exposition and a way forward. Intell. Build. Int. **10**(2), 122–129 (2018)
7. Devaney, L., Torney, D., Brereton, P., Coleman, M.: Ireland's citizens' assembly on climate change: lessons for deliberative public engagement and communication. Environ. Commun. **14**(2), 141–146 (2020)
8. Patton, M.Q.: Qualitative Research and Evaluation Methods, 3rd edn. Sage Publishers, London (2002)
9. Braun, V., Clark, V.: Using thematic analysis in psychology. Qual. Res. Psychol. **3**(2), 77–101 (2006)