

Paradoxical Smart Home Affordances Through the Eyes of People with Vulnerabilities

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Abstract

Smart homes are increasingly adopted to enhance the quality of people's lives by bringing many benefits, such as energy savings, convenience, and increased security, especially empowering individuals with vulnerabilities. However, the adoption of smart homes also poses challenges for vulnerable people due to the increased complexity of living environments, introducing uncertainty, and potentially exacerbating their vulnerabilities. Given the potential misalignment between expected perceptions before and actual perceptions after the adoption of smart homes by vulnerable people, this development paper explores, through the lens of affordances and cognitive dissonance theory, how individuals with vulnerabilities can reach the full potential of smart home adoption and what factors influence their ability to leverage smart home technologies. The study contributes to both information systems management and inclusion literature, specifically regarding vulnerable individuals as a marginalized group in smart home device adoption.

Word count: 1906

Introduction

Smart homes are often believed to enhance the quality of life by automating home processes, improving safety and control, enabling energy monitoring, fostering interconnectivity, and providing practical, hedonic, and therapeutic functions (Wilson et al., 2017). These functions can empower individuals with vulnerabilities. Paradoxically, smart homes also create challenges for people facing physical and financial constraints, as well as cognitive and sensory impairments, thereby exacerbating their vulnerabilities. This is because the implementation of ambient smart technology increases the complexity of living environments and introduces uncertainty (White & Miller, 2024). Consequently, when the option to adopt smart home technology arises, individuals often exhibit adoption-avoidant behaviour to minimize uncertainty and disruption to their habitual behavioural patterns (White & Miller, 2024). Avoidance behaviours are particularly pronounced among people with vulnerabilities (Shirani et al., 2020; Sovacool et al., 2021), whose various constraints hinder their ability to realize the potential of the technology.

Although existing research has provided some insights into how smart homes benefit users who are vulnerable in some ways, such as having limited knowledge (e.g., Sovacool et al. 2021, Wright and Shank 2020), having constrained financial resources (e.g., Herrero et al. 2018, Wilson et al. 2017), or being elderly (e.g., Chen et al., 2015). Studies have found that smart homes enhance home care and prevent loneliness in elderly people (Liu and Guo, 2015). They can also anticipate elderly people's needs without human intervention (Miori and Russo, 2012). However, perceptions from the user perspective of individuals with vulnerabilities on the adoption of smart homes remain scarce. Therefore, in this study, we aim to pursue two objectives: first, exploring how individuals with vulnerabilities adopt the use of smart homes. Second, understanding how misalignment occurs between the expected benefits and the actual functionality of smart home adoption for venerable individuals. We believe that while people with vulnerabilities may initially hold positive attitudes toward smart home adoption, they are more susceptible to post-adoption failures due to their limited resources and abilities to fully realize the technology's potential. Thus, our research question for this study is: *How do individuals with vulnerabilities reach the full potential of smart home adoption, and what factors influence their ability to leverage the use of smart homes?*

Literature Review

A smart home is “a residence equipped with a high-tech network, linking sensors and domestic devices, appliances, and features that can be remotely monitored, accessed or controlled, and provide services that respond to the needs of its inhabitants” (Balta-Ozkan et al. 2013 a, p.234). The usage of smart homes can realise health-related, financial, environmental and psychological benefits (Marikyan et al. 2019, Nasr et al. 2025, Marikyan et al. 2024). Health-related benefits are available for elderly individuals and those with health conditions and vulnerabilities through services such as remote medical care, health monitoring and health condition management (Chan et al. 2009, Czaja 2016, Demiris 2004, Marikyan et al. 2019). Assisted functionalities such as the ability to use voice commands to operate smart homes can help compensate for the limitations faced by individuals with disabilities (Mtshali and Khubisa 2019, Das et al. 2015, Marikyan et al. 2019, Cleland et al. 2024, Ma-thi et al. 2024). Environmental benefits are made possible through the usage of energy-preserving solutions, such as smart thermostats, which automate heating schedules when it is necessary (Balta-Ozkan et al. 2013, 2014. Marikyan et al. 2019). The reduction of energy consumption is not only conducive to the reduction of the carbon footprint, but is also economically sustainable (Marikyan et al. 2019). Smart home technologies also make it possible for users to connect to people outside of their houses, which can increase individuals' psychological wellbeing by

overcoming the feeling of isolation (Chan et al. 2008, Percival and Hanson 2006, Demirir et al. 2004, Marikyan et al. 2019).

The perceived benefits of smart home technologies have driven research on smart home adoption based on the assumption that these benefits are realised upon technology adoption (Hubert et al. 2019; Marikyan et al. 2021; Zhou et al. 2024; Nasr et al. 2025). Moreover, these benefits act as key motivational factors for their use (Marikyan et al. 2019; Hubert et al. 2019; Nasr et al. 2025). While these technologies afford the ability to realise these benefits, the actual utilisation may fail to live up to users' initial expectations. For example, prior research (e.g. Marikyan et al. 2023) sheds light on users' dissatisfaction with technology as its actual performance does not match their pre-adoption beliefs. These may be because the realisation of the technology potential is contingent on individual situational conditions, such the ability of users to recognise technology use cases, complexity and smart home's utility for users' needs (White & Miller, 2024; Wright and Shank 2020; White & Miller, 2024). Consequently, actual functionality may not always align with expected benefits. However, there is limited understanding of why these misalignments occur and how individuals, particularly those with vulnerabilities, cope with them.

To address these limitations in the current body of literature on smart home utilisation by people with vulnerabilities, we took functional affordances and cognitive dissonance theory as the theoretical lenses in this study. Affordance originally refers to what is offered, provided, or furnished to someone or something by an object from an ecological psychologist perspective (Gibson, 1986). According to Gibson (1986), instead of humans and animals directly receiving the information that is associated with their needs from the objects in their environment, humans and animals perceive what the objects could offer, rather the property of the objects: this is so called "*affordances*". Affordances, hence, are defined as "*the acts or behaviours that are afforded or permitted by an object, place, or event*" (Michaels and Carello, 1981, p.17). In the Information System Management (ISM) field, affordances are adopted to define the relationship between an IT artifact and a specified user or user group (Markus and Silver, 2008). Such a relationship is termed functional affordances, which identify what users are able to do through the use of a digital artifact based on their capabilities and goals (Markus and Silver, 2008).

Affordances exist independently, regardless of whether individuals perceive them or not, and individuals may perceive different affordances based on their capabilities and goals (Volkoff and Strong, 2013). Affordances can be actualised. The actualised affordance is defined as "actions taken by actors as they take advantage of one or more perceived affordances through their use of technology to achieve outcomes in support of goals" (Pozzi et al., 2014, p.7). This indicates that an actor must have the ability to perform the actualisation.

Through the lens of affordances, we aim to explore the affordance gap between the affordances that individuals with vulnerabilities perceive and the adjusted affordances after adopting smart home devices. We believe that while individuals with vulnerabilities may initially hold positive attitudes toward smart home adoption, they are more susceptible to post-adoption failures due to their limited resources and abilities to fully realize the technology's potential. Thus, it is crucial to understand the factors influencing the gap between the perceived affordances of smart homes by vulnerable individuals and the adjusted affordances after actualising the adoption of smart home devices.

Cognitive Dissonance Theory can further be applied to understand how perceived affordances are adjusted following actualization. This adjustment (a cognitive dissonance reduction strategy) occurs when perceptions of affordances are shaped by actions involving the technology and when those perceptions conflict with expected affordances. Based on prior research (e.g., Cole

et al., 2013; Nevo et al., 2021; Tillas et al., 2017), we argue that individual and situational factors influence affordance perception, the motivation to act on those perceptions, and the adjustment of perceived affordances through coping mechanisms aimed at addressing smart home challenges to achieve actualised affordances and the full potential of smart home adoption. Figure 1 is the conceptual framework for this study.

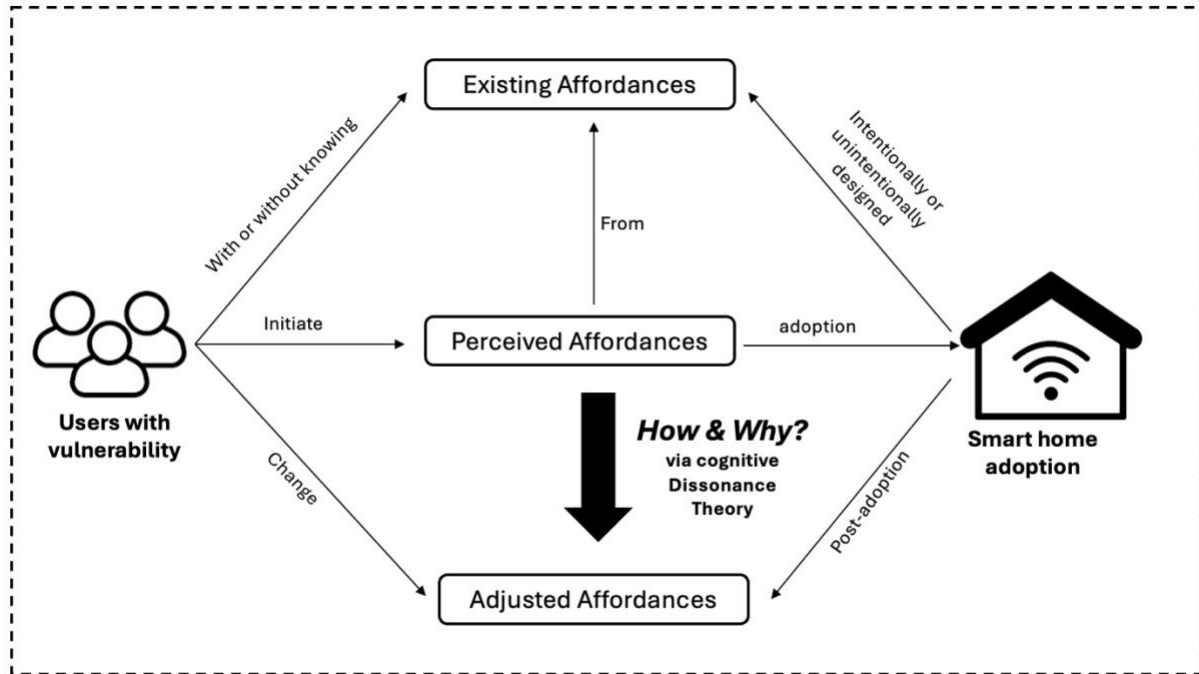


Figure 1. Conceptual framework.

Methodology

To answer our research question, we will take a qualitative approach. A qualitative approach enables us to explore “*complex textual descriptions of how people experience a given research issue*” (Creswell et al., 2007, p.1), which we believe is the most suitable research approach to understand the perceptions of individuals with vulnerabilities. Semi-structured interviews will be our main data collection method. Through semi-structured interviews, we can “*elicit participants’ views of their lives, as portrayed in their stories*” (Fossey et al., 2002, p.727). We aim to conduct 25 interviews with selected informants. The selection of our informants is: a) individuals who are vulnerable in physical, knowledge, and financial situations; b) individuals who have experience of using smart homes. We will recruit our informants through a consumer panel.

The semi-structured interviews will follow a detailed interview protocol. We aim to ask questions about: a) the initial affordances perceived by people with different vulnerabilities; b) the adjusted and actualized affordances after using the smart home device; and c) the underlying individual and situational conditions that influenced how they perceive affordances differently. These factors could include individuals’ motor competencies (Tillas et al., 2017), physical capacity, knowledge/skills (Volkoff & Strong, 2017), goal orientation (Nevo et al., 2021), agency, and locus of control (Tanner & Singh, 2021). We believe these factors could play a role for people with vulnerabilities. However, we believe more detailed exploratory research needs to be conducted to offer a more comprehensive understanding of the issue with practical evidence. We will use an inductive approach (Patton, 2002) in our data analysis. Two reviewers will be included in the data analysis process to ensure rigour in

generating the themes and findings (Johnson et al., 2020). We also complement our data by collecting archival data. This includes publicly available news, and user stories.

Contributions

We make both theoretical and practical contributions with this study. Theoretically, we contribute to the smart home and IoT literature by addressing the adoption challenges faced by people with vulnerabilities through the lenses of affordances and cognitive dissonance. We also contribute to the inclusion literature on how marginalized groups (i.e., vulnerable individuals) adopt technology by exploring the factors that influence them in smart home adoption. This study also has practical implications, especially for the inclusive design of smart home devices that cater to individuals with vulnerabilities.

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