Smart Homes, Smarter Choices: The Role of Values and Perceptions in Tech Adoption and Energy Efficient Usage

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ABSTRACT

Smart-home technology can drastically increase residential energy efficiency. There are two main challenges toward this end: 1) achieving widespread technology adoption, and 2) energy efficient use of smart technology. Various psychological and social factors influence both decisions to adopt smart technology and efficient usage of those technologies. Understanding the role of individuals' values, perceptions, and identities in these behaviors can help utilities optimize the design of smart home programs to further energy efficiency goals. For example, correcting misperceptions about smart technology or framing technology as consistent with consumers' existing values could dramatically increase adoption and program energy savings. We surveyed a random selection of customers from a midwestern utility ($N = 391$) to assess perceptions of smart-home technology, how smart technology aligns with customer identities and values, and current levels of adoption. More than 75% of customers reported an interest in adopting smart technology, with 73% planning to within 3 years ($N = 391$). Additionally, associating adoption with the value in "reducing wasteful energy practices" may be a promising route to market smart technology across customer segments. We surveyed another random selection of customers ($N = 412$) who own smart thermostats to examine their mental models of smart thermostats and their typical usage patterns. We found that use patterns differ based on customer values. Taken together, these studies will provide an in-depth view of the customer experience in adopting and using smart-home technology, and how utilities can apply these insights to design effective smart technology programs.

Introduction

In the rapidly changing energy landscape, smart-home technology emerges as a promising avenue to improve residential energy efficiency. Smart-home technology refers to a system of interconnected devices and appliances within a home that can be controlled remotely or automatically through a central hub or smartphone app, enhancing convenience, security, and energy efficiency by allowing users to monitor and manage their environment (El-Azab 2021). By using smart-home technology, the average US residential home has the potential to reduce overall energy use by up to 17% (King 2018). That means if 50% of all US homes maximized their energy savings through smart-home technology, the reduction of CO_2 emissions would be equivalent of shutting down 25 coal-fired power plants[1]. Savings on heating and cooling alone through smart thermostats make up nearly 60% of total those potential savings. And with over 38 million smart thermostats estimated to be in US households by 2026 (Walton 2022), equating to 29% of all households, the potential for residential energy savings through smart-home technology, and smart thermostats specifically, is hard to ignore.

While the potential energy savings from smart-home technology is significant, actualizing this potential hinges on overcoming two paramount challenges: 1. achieving widespread adoption of smart-home technology and 2. ensuring energy-efficient usage at a large scale. The first challenge, widespread adoption, requires thinking outside of typical beliefs about what drives adoption – considering a range of motivations and barriers beyond monetary incentives and financial costs. The second challenge, efficient usage, similarly demands a nuanced understanding of the factors that drive individual and collective energy-related decisions within homes. Research on residential smart thermostat-related behavior overwhelmingly shows that adopting the technology does not necessarily result in energy savings and, in fact, can sometimes increase energy use (Brandon et al. 2022). The struggle to actualize estimated energy savings is precisely because engineering estimates are often overly optimistic – assuming that people behave rationally and failing to account for the complexities of human behavior.

In this paper, we attempt to push the boundaries of traditional approaches to motivating smart-home technology and energy-efficient behaviors through a broader lens that better captures the intricate fabric of human behavior. We present two survey research studies that examine social and psychological influences of smart-home tech adoption and usage of smart thermostats. We then draw implications and provide actionable recommendations for how energy utilities can meaningfully connect and motivate customers toward smart-home technology adoption and energy-efficient usage of those technologies.

Literature Review

The nuanced interplay between personal values, identity, and technology continues to play a powerful role in how we embrace and utilize advancements like smart homes. These intelligent systems, integrating features from automated energy management to healthcare devices, significantly impact our daily lives. They are not simply technological marvels; they influence and are influenced by our core values and self-perception.

While traditional theories like the Technology Acceptance Model (TAM) (Davis 1986) and Diffusion of Innovations Theory (Rogers 1962) provide a foundation for understanding technology adoption by focusing on ease of use and the social spread of innovations, they offer a limited perspective. These models fail to capture the complex relationships between our inner world and our interactions with technology (Mashal, Shuhaiber, and Al-Khatib 2023). To gain a more comprehensive understanding, it is essential to incorporate broader social science theories. Social practice theory, for example, provides critical insights into how daily practices and social norms shape technology use (Adua 2020; Shove 2010). Shove (2010) has argued for moving beyond individual attitudes, behaviors, and choices (the ABC model) to consider the broader social and material contexts in which these technologies are embedded. These perspectives are essential for understanding the nuanced relationship between the adoption and use of technology, emphasizing that the practical integration of smart home technologies into daily life is as significant as the initial decision to adopt them. This contextualization is especially critical to determine the conditions under which smart home technologies are and are not used energy-efficiently, which they often are not (Brandon et al 2022).

Smart-home technologies often resonate with specific values like convenience, security, and environmental sustainability. Many theories of pro-environmental behavior provide a values-driven approach to understanding the motivation to adopt new behaviors (Ferreira, Oliveira, and Neves 2023; Schultz and Zelezny 1998; Stern 2000). People are drawn to smart-home technology not just for their practical benefits but also for their potential to contribute to a larger

societal good. When these technologies are seen as tools for not only enhancing personal comfort and safety but also fostering environmental responsibility, their adoption becomes more likely.

Furthermore, research by Chang and Nam (2021) emphasizes how perceived compatibility influences the intention to use smart-home applications. Compatibility, in this context, refers to how well the technology aligns with an individual's existing values and lifestyle, consistent with social psychological theories on the need for consistency and congruence between ones values, identity, and behavior (Cooper 2012; Soenes and Vansteenkiste 2011). This implies that users are more likely to embrace technologies that resonate with their sense of self. For instance, individuals who value improving their quality of life or conserving energy are more receptive to smart-home technologies when they see these technologies as fulfilling those needs. This highlights the importance of designing and marketing smart-home technologies in a way that clearly communicates their ability to cater to users' aspirations and values, going beyond mere technical specifications (Spandagos et al. 2021).

The relationship between values and identities also affects how individuals utilize smart-home technology for energy efficiency. Research by Chen et al. (2021) demonstrates that social influence and environmental awareness, both aspects of identity, are dominant factors in adopting energy-efficient practices within smart homes. Similarly, research by Shuhaiber and Mashal (2019) identifies utilitarian (practical benefits), hedonic (pleasure and enjoyment), and social responsibility outcomes as drivers for adopting energy-efficient technologies. Users who value economic savings, environmental conservation, or social status associated with cutting-edge technology are more likely to embrace energy-efficient solutions.

However, it is important to acknowledge that this interplay also presents challenges. Research by Al-Fuqaha et al. (2015) points out that security/privacy risks and trust in service providers significantly affect smart home adoption, reflecting a clash between the value of privacy and the perceived benefits of technology. Additionally, Balta-Ozkan et al. (2013) identify social barriers such as control, security, and cost, influenced by individuals' life stages, expertise, and location. These factors emphasize the importance of recognizing diverse identities and value systems when promoting smart home technologies. A one-size-fits-all approach that ignores these diverse needs might not only fail to address concerns but might also exacerbate existing inequalities in access and utilization (Ha and Janda 2012).

Ultimately, understanding the complex interplay between values, identity, and smart homes is crucial for promoting their widespread adoption and responsible use. By acknowledging the diverse perspectives and motivations of users, we can build a future where smart homes serve as tools for individual empowerment, environmental sustainability, and collective well-being.

Current Research

Through two survey research studies with residential customers of a midwestern electric utility, we gather insights on relevant psychological and social factors relating to smart-home technology adoption and energy-efficient usage of smart thermostats, specifically. We approached this work with two primary research objectives:

1. *Study 1 Perceptions of Smart-home Technology Adoption:* Assess customer perceptions of smart-home technology, how smart technology aligns with customer identities and values, and current levels of adoption.
2. *Study 2 Factors Influencing Energy-Efficient Use of Smart Thermostats*: Examine values, perceptions, and typical usage patterns of customers who own smart thermostats.

Study 1: Perceptions of Smart-home Technology Adoption

Participants and Procedure

Study 1 utilized a quantitative approach by conducting a web survey targeted at a randomly selected group of utility customers who were homeowners aged 18 years or older, with the objective of gaining insights into their perceptions of smart-home technologies. The 10-minute survey, programmed in Voxco, sought insights into customer sentiments, adoption rates, usage patterns, and preferences concerning smart devices, as well as the potential role of the utility in facilitating smart device technology adoption. Participants were recruited via email, with two subsequent reminders, to ensure a comprehensive collection of data. Out of the 25,000 utility customers who received the survey invitation, a total of 391 completed the survey, resulting in a response rate of 1.6%. Survey completes were analyzed in aggregate using the statistical software, SPSS. Participant demographics are presented in Table 1.

Measures

Energy-related values. Participants were asked the following three questions about their values related to energy usage: On a scale of 0 (not concerned at all) to 5 (very concerned), participants were asked "How concerned are you about your current energy consumption?", on a scale of 0 (very unimportant) to 5 (very important) "How important is it for you to reduce wasteful energy practices in your home?", and on a scale of 0 (completely uninterested) to 5 (very interested), "How interested are you in making your home more energy efficiency through the use of smart-home technology?"

Motivations to adopt smart-home technology. Participants were asked "What are the reasons you use smart home devices in your home?" and selected all that applied from the following: Entertainment, Reduce energy use/energy bill, Convenience, Safety and monitoring, Help with scheduling, Home/appliance maintenance, Design, and Other. After participants answered this question, they were then asked, "Which of the reasons that you use smart devices in your home is most valuable to you?"

Smart-home technology adoption. Participants were asked the following questions about their awareness and current adoption of smart-home technology: "Besides a smart phone, which of the following smart devices have you heard of before today?" and "Besides a smart phone, what smart devices do you have in your home?" and selected all that apply from smart home assistant (e.g., Google Home, Amazon Alexa), smart TV, smart security devices, smart thermostat, smart cleaning devices, smart lightbulbs or other lighting, smart appliances, smart plugs and outlets, home automation systems, smart window shades, smart water heaters, other, or none of the above. Additionally, participants were asked about their interest and future plans about smart

technology through the following questions: On a scale of 0 (completely uninterested) to 5 (very interested), “If cost were not an issue, how interested would you be in using more smart technology in your daily life?” and “Completely this statement: In the next 3 years, I am most likely to have…” with the response options, “A lot more smart-home technology than I have now, A little more smart-home technology than I have now, The same amount of smart-home technology that I have now, Some smart-home technology but less than I have now, No smart-home technology, and Don’t know.”

Results

Energy-related values. On average, participants reported some concern with reducing their energy consumption ($M = 3.80$), with 70% being either somewhat (46%) or very concerned (24%). Significantly more participants placed value on reducing their energy waste ($M = 4.30$), with 87% believing it is either somewhat (35%) or very important (52%). The high value placed on reducing energy waste was primarily among younger (45 years old and younger) and older (66 years old and above) participants and less so among middle-aged participants (46 to 55, and 56 – 65 years old).

Motivation to adopt smart-home technology. The top three reasons participants reported using smart devices were for entertainment (76%), reducing energy use (48%), and convenience (41%). When asked about the most important benefit of smart devices, the most common responses were the ability to control things remotely (73%), reduce energy consumption (64%), and saving money (63%). Though roughly equal proportion of participants viewed reducing energy use and saving money as beneficial, saving money was reported as a significantly more important benefit than reducing energy use, with only 13% of participants reporting reducing energy use as the most important benefit compared to the 24% who reported saving money as the most important benefit and 23% who viewed convenience as most important, $X^2(16, N = 343) = 25.94$, $p < .10$.

Smart-home technology adoption. A significant majority of participants report having a smart TV in their home (80% of participants), followed by a home assistant (55%), and a smart thermostat (44%). The adoption of other smart home technologies related to energy efficiency was relatively low, including smart lighting (33%), smart appliances (20%), and both smart window shades and water heaters (2%). Though smart lighting and smart appliances have low levels of adoption, most participants have heard of these technologies (74% and 65%, respectively). However, over 70% of participants had never heard of smart window shades or water heaters.

Current levels of smart technology adoption varied across age groups, with those 45 years old and younger significantly more likely to have four or more smart home devices in their homes compared to older age groups, $X^2(9, N = 352) = 17.44$, $p < .05$. Interest in adopting smart home technologies for energy efficiency differed across energy-related values. Those who believe reducing their energy use is very important, compared to others, expressed greater interest making their home more energy efficient with smart home technologies $X^2(8, N = 391) = 63.57$, $p < .01$.

Discussion

Our survey results shine a light on key motivations for adopting smart-home technology while suggesting how these motivations and energy-related values may influence technology adoption. Saving money, energy, and increasing convenience were the top self-reported motivations for adopting smart-home technology. Both convenience and saving money were viewed as more important to participants than reducing energy consumption. This suggests that an emphasis on convenience and saving money may be more successful at motivating people to adopt smart home technologies than an emphasis on saving energy. When emphasizing saving energy through smart home technologies, our results indicate that marketing strategies focusing on reducing energy waste are more effective than those emphasizing reducing energy consumption.

Current adoption levels of energy-related smart home technologies (e.g., thermostats, shades, water heaters, appliances) are low, except smart thermostats. With such high levels of familiarity and strong adoption rates, smart thermostats appear as a great entry point for customers to adopt smart home technologies that save energy. Additionally, given that smart thermostats have the highest potential to save energy in the home out of all other smart home technologies (King 2018) and their relatively easy connectivity to utilities' electric demand-response programs, examining the values, perceptions, and behaviors of smart thermostat owners would be particularly advantageous to any utility or other entity with an interest in increasing smart thermostat adoption. As such, our second study focuses on this topic and digs deeper into customer values, perceptions, and behavior around smart thermostats.

Study 2: Factors Influencing Energy-Efficient Use of Smart Thermostats

Participants and Procedure

The second study mirrored the methodology of the initial study, "Perceptions of Smart-home technology Adoption," employing a similar quantitative approach to explore customer opinions on smart thermostats. Utilizing a comparable framework, the survey was disseminated to a distinct segment of utility residential customers, specifically targeting individuals over 18 years of age who are homeowners and have previously participated in a smart thermostat utility program. The sampling for this study comprised of 16,000 customers, who received the survey invitation and up to two reminders. Out of these, 412 respondents completed the survey, resulting in a response rate of 2.6%. Participant demographics are presented in Table 1.

Measures

Values and attitudes. In assessing participants' normative attitudes about energy-efficient thermostat usage, they were asked the extent to which they agree with the statement "Many households in [midwestern state] are trying to reduce their energy consumption" on a scale of -2 (strongly disagree) to +2 (strongly agree).

Perceptions and beliefs. Participants were asked a range of questions that assessed their perceptions of their smart thermostat and beliefs about using it energy efficiently. Participants

indicated the extent to which they agreed with the statement “My thermostat helps me save on my utility bills”, on a scale of -2 (strongly disagree) to +2 (strongly agree). To assess participants perceptions of their smart thermostat’s features, they were asked “Which of the following features of your smart thermostat do you value the most?” and provided the following response options: “My ability to control the thermostat remotely”, “My ability to program temperature settings”, “My ability to manually override the temperature settings”, “The smart sensors (automatically adjust settings when you’re not home)”, “Maintenance reminders and alerts”, “My thermostat’s ability to learn my temperature preferences”, “Its capability with other smart devices”, and “Weather tracking”. To assess participants’ perceptions of their own usage, they were asked the extent to which they agree with the statement “My thermostat is set to energy-efficient settings” on a scale of -2 (strongly disagree) to +2 (strongly agree). Additionally, participants were asked about the extent to which they believe a common myth about energy-efficient thermostat usage stated as “Please indicate whether you agree or disagree with the following statement: In the winter, it is more energy efficient to always have the thermostat set at the same temperature throughout the day rather than program the thermostat to cooler temperature settings when I am away from home or sleeping”, on a scale of -2 (strongly disagree) to +2 (strongly agree).

Smart thermostat usage patterns. Participants were asked a range of questions about how they typically use their smart thermostat. To understand how they approach energy-efficiency with their smart thermostat, participants were asked: “What are some of the ways that you use your thermostat to use energy more efficiently?” with the ability to select all that apply from the options, “Change the temperature settings remotely (when away from home)”, “Program the thermostat to maximize energy efficiency”, “Allow my utility to adjust the temperature during peak periods”, “Use automatic reminders to remember to change filters”, “Track my energy use patterns”, “Use motion sensors to reduce usage when away from home”, “other”, and “none of the above”. Participants were also asked, “When heating your home in the winter, what are your typical thermostat settings when you are awake, asleep, and away from home”, with an open entry to indicate the number. A parallel question was asked about their approach to cooling their home in the summer.

Results

Values and attitudes. When asked about their household's views on energy consumption, 36% of participants said they prioritize managing their energy use to save energy. Meanwhile, 21% consume as much energy as needed for comfort, an equal 21% manage energy to reduce waste, 15% do so for a healthier environment, and 6% manage their consumption to ensure other households have a reliable energy source. Additionally, 62% either agreed or strongly agreed that it's important to save energy even if it doesn't result in significant monetary savings, while 51% express a willingness to spend more on their energy bill for added comfort. Notably, even though most participants appear to value saving energy, 57% also believe that other households are not trying to reduce their energy consumption.

Perceptions and beliefs. Most participants believe that their smart thermostat saves them money, with 68% either agreeing or strongly agreeing and 26% as unsure. A significant majority

of participants believe that their smart thermostat is set to energy-efficient settings, with 77% agreeing or strongly agreeing and 19% as unsure. When asked what features they value the most in their smart thermostat, the top three responses were the ability to "control the thermostat remotely" (82%), "program temperature settings" (74%), and "manually override the temperature settings (53%). When asked whether it was more energy efficient to always have their thermostat set to one constant temperature, as opposed to programming the thermostat to a cooler setting when away from home (in the winter), a sizeable 43% either agreed or were unsure. Conversely, 57% disagreed indicating they believed programming the thermostat to a cooler setting when away from home was more energy efficient.

Smart thermostat usage patterns. To use their thermostat more energy efficiently, a majority of participants (68%) report changing the temperature settings remotely when away from home. Results showed that 52% do not use programmed settings to maximize energy efficiency. We found that participants on average tend to set their heating season temperatures at 69 degrees F while awake, which is consistent with ENERGY STAR guidelines. However, average temperatures set for when participants are asleep (M = 66 degrees F), and away from home (M = 64 degrees F) are higher than energy efficient heating recommendations (<70 degrees F) (Energy Star, 2009). Participants' cooling season temperatures are even less efficient, with settings on average at 72 degrees F while awake, 71 degrees F while asleep, and 74 degrees while away from home (>78 degrees F).

Typical usage patterns tended to differ based on participants' energy-related values. Those who value consuming as much energy as they want to feel comfortable are less likely to report having energy-efficient settings compared to those who value trying to manage their energy use to save energy, with 64% of those who value comfort over saving energy reporting they have energy-efficient settings and 80% of those who manage their energy use reporting energy-efficient settings. When looking at specific heating and cooling temperature settings participants reported, a similar pattern emerged. Those who set their heating temperatures at or below participants' average reported temperature when away from home, were more likely to value managing their energy consumption, while those who set their heating temperatures higher were more likely to value consuming as much energy as they need to feel comfortable in their home, $X^2(8, N = 399) = 22.66$, $p < .01$. Similarly, those who set cooling temperatures at or above the participants' average reported temperature were more likely to value managing their energy consumption while those who set their cooling temperatures below the average were more likely to value consuming as much energy as they need to feel comfortable in their home, $X^2(8, N = 361) = 18.09$, $p < .05$.

Discussion

Results from this study provide insights on utility customers' values, attitudes, perceptions, and usage patterns around smart thermostats. We found that while although a significant proportion of participants report valuing using their smart thermostat energy-efficiently, many also value consuming as much energy as they desire to feel comfortable in their home. Similarly, most participants believe it is important to save energy even if it does not result in monetary savings but, at the same time, are willing to spend more on their energy bill for the

sake of comfort. Even while most customers value saving energy, most believe that other similar households do not. Because perceptions of social norms drive individual action to reduce energy consumption (Hunt 2011; Schultz et al. 2007; 2018), this misperception may be a key factor significantly limiting energy-efficient behavior in the home.

We also observed that a significant proportion of participants believed another common misperception that keeping their thermostat at one constant temperature is more energy-efficient than setting different temperatures for when they are awake, asleep, and away from home. Though many participants believe this, most do report setting different temperatures throughout the day and when they are away. However, on average, their temperature settings during both heating and cooling seasons are not in line with common energy-efficient recommendations. We found that these usage patterns differ based on participants' values such that those who believe in consuming as much energy as needed to feel comfortable have more inefficient temperature settings compared to those who value managing their energy use.

In the next section, we further synthesize and contextualize the results from our two studies, provide recommendations for utility program managers and marketers, and discuss the limitations of our research.

General Discussion

Examining the psychological and social factors related to energy-efficient usage of smart technology, and smart thermostats specifically, is critical to the success of efforts to reduce residential energy use at a large scale. Our two studies add a piece to the rapidly growing research in this area. The first study focused on values and motivations for adopting smart-home technology, finding that saving money, energy, and increasing convenience were the most critical motivations. Importantly, convenience and saving money tended to be higher priorities than saving energy. Additionally, we found that framing energy-efficiency as reducing energy waste would likely be a more effective marketing strategy than framing energy-efficiency as reducing energy consumption. The second study further examined values, attitudes, perceptions, usage patterns around smart thermostats specifically, finding dualities in how people value and perceive energy efficiency and comfort and illuminating misperceptions about what similar households value and how to use thermostats energy-efficiently.

A large majority of participants in Study 1 reported an interest in adopting more smart energy-efficient home technologies in the future (83%), and plan to do so in the next year years (73%). This raises the question of which technologies people may be most likely to adopt. Though we found low levels of adoption of energy-reducing smart home technologies, such as smart lighting and appliances, a significant majority of participants had heard of them before. This is opposed to the strong majority of participants who had never heard of smart window shades and smart water heaters. As such, guiding customers toward smart appliances may be more successful than guiding them toward technologies smart window shades because there is less need to overcome knowledge barriers.

Another consideration for determining what smart home technologies to guide customers toward involves the psychological concept of behavioral spillover. When someone purchases one type of smart-home technology aimed at reducing energy use, what is the likelihood that they will (or will not) purchase another one? That is the question driving research on behavioral

spillover. The key factors that increase the likelihood of positive behavioral spillover (e.g., buying a smart thermostat and then later also installing smart lights) are viewing the first purchase or behavior as consistent with one's identity, experiencing positive emotions associated with the first purchase or behavior, and perceiving the first purchase or behavior as similar in some relevant way to the subsequent purchase or behavior (Jia, Evans, and van der Linden 2019; Kneebone, Fielding, and Smith 2018; Maki et al. 2019; Truelove et al. 2014; 2021). In thinking about how smart thermostats may be a helpful entry point for customers to adopt more smart home technologies, relevant future questions are then: What identities does owning a smart thermostat speak to? How do people feel after they purchase, install, and use smart thermostats? And what other smart technologies do people view as similar to smart thermostats? These questions may guide future research and marketing decisions.

Saving money, energy, and increasing convenience were the top self-reported motivations for adopting smart-home technology and smart thermostats specifically. While participants do value saving energy, convenience and comfort appear equally, if not more, important. Customers seemingly exhibit a duality of believing it is important to save energy even if it does not save money while being willing to pay more on their energy bill for the sake of comfort. Utility program managers and marketers would do well to focus on targeting all of these motivations in their messaging and outreach, framed in the context of reducing energy waste as noted previously. Additionally, messages that position comfort and saving energy and money as compatible with each other may help break down the perception that using more energy and spending more money on energy bills is a tradeoff for feeling more comfortable at home.

While our studies have provided useful insights on the psychological and social factors related to smart-home technology, it is important to note that people are not always reliable sources of information on their own perceptions and motivations (Grimm 2010; Mortel 2008). Indeed, even though social influences like social norms are one of the strongest predictors of energy-related behavior (Abrahamse et al. 2005; Schultz et al. 2018), most people believe that they are not influenced by the behavior of others (Nolan et al. 2008). We found in Study 2 that participants believe similar households do not value saving energy as much as they do, which is likely inhibiting energy-efficient behaviors in the home. Research on pluralistic ignorance has overwhelmingly demonstrated the power of correcting perceptions of social norms on a host of environmentally related behavioral outcomes (Geiger and Swim 2016). Should marketing approaches attempt to correct the social norm misperception identified in this study, we would expect an increase in energy-efficient behaviors.

Studying the psychological and social influences of energy-efficiency behavior in the home, especially unconscious influences like social norms perceptions that people often reject when asked about directly, is not often easy or practical in the context of utility customer research. As such, a holistic approach to applying customer insights toward utility programs requires leveraging a combination of customer research, like the present studies, and expertise in the social and psychological influences of behavior rooted in evidence-based behavioral science.

Recommendations

In this paper, we explore the nuanced interplay of social and psychological elements that influence consumers' decisions to adopt smart home technologies, with a particular emphasis on smart thermostats, guided by insights derived from two comprehensive survey research studies. The findings from these studies provide a rich foundation for developing targeted marketing strategies that can significantly enhance the adoption rates of smart home technologies. Based on the gathered data, we propose a set of focused recommendations for marketing teams aiming to amplify smart technology adoption through informed, strategic initiatives.

Firstly, the data illuminates the paramount importance of highlighting the financial and convenience benefits of smart home technologies in marketing narratives. Consumers are primarily motivated by the tangible benefits that these technologies offer, notably the potential for cost savings and enhanced convenience. Marketing teams should craft compelling messages that clearly articulate these benefits, showcasing real-life examples, testimonials, or case studies that depict how smart technologies like thermostats, can lead to significant energy and financial savings while also simplifying daily routines. Given that participants misperceive social norms on valuing energy efficiency, testimonials and messaging that emphasize the social desirability and normative beliefs about energy efficiency would do well to motivate customers.

Secondly, it's evident that personalization in marketing campaigns can deeply resonate with potential customers. The varied motivations and values observed across different demographic groups suggest that one-size-fits-all marketing strategies may not be as effective. Instead, marketing teams should segment their audience based on their distinct characteristics and preferences, developing tailored messages that speak directly to the specific interests, motivations, and values of each segment. For instance, younger demographics might be more attracted to the innovative, tech-savvy aspects of smart home devices, while older consumers might prioritize the practical, cost-saving benefits.

Moreover, the findings highlight an opportunity for marketing teams to educate consumers about the broader implications of smart technology adoption, beyond individual benefits. Given the increasing consumer interest in sustainability, marketing campaigns can also emphasize the environmental impact of smart home technologies. By illustrating how these technologies contribute to energy conservation and help reduce the household's carbon footprint, companies can tap into the growing consumer segment that values environmental responsibility.

Additionally, the low awareness and adoption rates of certain smart home technologies, such as smart window shades and water heaters, signal a valuable opportunity for educational marketing. By increasing awareness about the range of available smart home technologies and their specific benefits, marketing teams can help demystify these innovations and encourage broader adoption. Informative content, interactive online platforms, or engaging social media campaigns can be effective tools in educating consumers about the latest advancements in smart-home technology and their potential impact on energy efficiency and household management (Moezzi 2015). Because customers are already aware of smart lighting and smart appliances, motivating customers to adopt these technologies may be a natural next step for customers who have already adopted smart thermostats as there are fewer barriers to overcome.

By emphasizing the practical benefits of smart home technologies, personalizing marketing approaches, aligning with consumer values like sustainability, and enhancing consumer education on the available technologies, marketing teams can effectively drive the

adoption of smart home technologies and contribute to the widespread promotion of energy-efficient living.

Limitations

The two studies, while comprehensive in their scope, encompass several limitations that merit consideration. Firstly, the response rates of 1.6% and 2.6% for the respective studies are relatively low, which raises concerns about the representativeness of the survey data. Such low participation rates might limit the generalizability of the findings, as the views of the respondents may not accurately reflect the broader population of customers.

Another limitation is the demographic constraint, as both surveys targeted a specific demographic group — homeowners aged 18 and above who are utility customers, with the second survey further narrowed to past participants in a smart thermostat program. This demographic focus restricts the breadth of the studies' applicability to other groups, potentially overlooking diverse customer experiences and perceptions. Furthermore, the data collection method, employing a web-based survey, may also exclude certain segments of the population less inclined or able to participate in online surveys, such as older adults or individuals without reliable internet access, thus not capturing their perspectives.

Lastly, the studies' design did not account for longitudinal tracking, limiting the ability to assess changes in perceptions or behaviors over time. This cross-sectional approach provides a snapshot of customer opinions at a single point in time, without considering potential shifts in consumer attitudes or market dynamics that could influence smart technology adoption and usage. These limitations underscore the importance of cautious interpretation of the study findings, recognizing that they represent specific customer segments under particular conditions and may not encompass the full spectrum of customer experiences or attitudes towards smart home technologies.

Table 1. Demographics

Category	Subcategory	Study 1		Study 2	
		N	Unweighted %	N	Unweighted %
Gender (N = 391)	Female	183	46%	176	50%
	Male	178	47%	208	43%
	Non-binary	0	0%	3	1%
	Other or prefer not to say	29	7%	25	6%
Race (N = 390)	White	311	80%	339	82%
	Black or African American	20	5%	7	2%
	Asian	10	3%	12	3%
	Other or prefer not to say	13	3%	44	11%
Ethnicity (N = 357)	Hispanic, Latino, or Spanish origin	11	3%	8	2%
	Non-Hispanic, Latino, or Spanish origin	346	97%	402	98%
Age (N = 373)	25 and under	7	2%	19	2%
	26 to 35	30	8%	134	16%
	36 to 45	60	16%	215	26%
	46 to 55	82	22%	141	17%
	56 to 65	84	23%	132	16%
	66 and above	110	30%	188	23%
Household Income (N = 391)	Less than $20,000	22	6%	11	3%
	$20,000 to less than $50,000	68	17%	53	13%
	$50,000 to less than $100,000	107	27%	121	29%
	$100,000 to less than $150,000	59	15%	68	17%
	$150,000 to less than $200,000	34	9%	45	11%
	$200,000 to less than $250,000	4	1%	19	5%
	$250,000 and above	8	2%	12	3%
Education (N = 391)	Less than HS Diploma	2	1%	1	0%
	HS Diploma or GED	39	10%	46	11%
	Some College	148	38%	96	23%
	4-year college graduate	126	33%	137	33%
	Graduate degree	76	19%	119	29%

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