

**INTERVENTIONS AND EXPECTATIONS OF ROBOT VACUUM CLEANER
USERS TOWARDS INTERIOR COMPONENTS IN THE HOME
ENVIRONMENT: A QUALITATIVE RESEARCH WITHIN THE
FRAMEWORK OF ADOPTION THEORY**

*Ev Ortamında İç Mekan Bileşenlerine Yönelik Robot Süpürge Kullanıcılarının
Müdahaleleri ve Beklentileri: Benimseme Teorisi Çerçevesinde Nitel Bir Araştırma*

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Article Information	Abstract
<i>Research Article</i>	Robot vacuum cleaners are increasingly being adopted in homes as alternatives to traditional electric vacuums. However, existing literature provides limited insights into how users adapt these devices to align with furniture, carpets, and thresholds. This study aims to explore the challenges users face when integrating robot vacuums into their home environments and the creative interventions they employ. Online interviews were conducted with 16 participants, and the data were analysed using thematic analysis. The findings reveal that users employ various strategies, such as adjusting furniture, carpet, and threshold heights, to enhance the efficiency of their robot vacuums. Moreover, users consider compatibility when selecting future furniture and carpets. These results indicate that users play an active role in the technology adaptation process, customizing new devices to fit their living contexts, thereby offering valuable insights for robot vacuum design and improvements in user experience.
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Makale Bilgisi	Özet
<i>Araştırma Makalesi</i>	Robot süpürgeler, geleneksel elektrikli süpürelere alternatif olarak evlerde giderek daha fazla benimsenmektedir. Ancak mevcut literatür, kullanıcıların bu cihazları mobilyalar, halılar ve eşiklerle uyumlu hâle getirmek için nasıl adapte ettiklerine dair sınırlı bilgi sunmaktadır. Bu çalışma, kullanıcıların robot süpürgeleri ev ortamlarına entegre ederken karşılaştıkları zorlukları ve uyguladıkları yaratıcı müdahaleleri araştırmayı amaçlamaktadır. Çalışmada 16 katılımcıyla çevrimiçi görüşmeler yapılmış ve veriler tematik analiz yöntemiyle incelenmiştir. Bulgular, kullanıcıların robot süpürgelerinin verimliliğini artırmak için mobilya, halı ve eşik yüksekliklerini ayarlamak gibi çeşitli stratejiler kullandığını ortaya koymaktadır. Ayrıca, kullanıcılar gelecekteki mobilya ve halı seçimlerinde uyumluluğu dikkate almaktadır. Bu sonuçlar, kullanıcıların teknoloji adaptasyon sürecinde aktif bir rol oynadığını, yeni cihazları yaşam ortamlarına göre özelleştirdiğini ve böylece robot süpürge tasarımı ile kullanıcı deneyiminin geliştirilmesine dair değerli bilgiler sağladığını göstermektedir.
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INTRODUCTION

One of the intelligent technologies used in homes, robot vacuum cleaners, is a technological product that does not require human assistance during usage. These vacuum cleaners, usually operated through an application, can autonomously clean the intelligent environment and can be configured by the user to perform automatic cleaning based on scheduled cleaning tasks or integration with other IoT systems (Ulsmåg, 2023). These vacuum cleaners are typically controlled through a mobile application. During the initial operation, they map the house's layout, allowing the user to decide which room or area needs to be cleaned based on this mapping. The ability to control them via an application eliminates the need to be in the same room as the vacuum cleaner to operate it. People can use the vacuum cleaner while they are away from home, and when they return, they can find a clean and tidy house. In this respect, Darling (2022), defines robot vacuums as a pet with which users have a strong bond. This animal description: states that it is due to the relationship between the animal detection abilities of humans and the behaviour of robot vacuums. The fact that robot vacuum users form psychological bonds with the device and personalize it, often by naming it, is a reflection of the tendency of people to transfer their sensory abilities to the device. On the other hand, beyond perceiving robot vacuum cleaners as pets, it is noted that users tend to give these devices human names and refer to them with gender labels such as male or female (Wellendorf et al., 2022; Sung et al., 2010; Forlizzi et al., 2006). Based on this, it is recommended to use personality models as a tool for developing robot behaviour in robot vacuum cleaners (Hendriks et al., 2011).

When looking at research conducted on robot vacuum cleaners, it can be observed that the subject focuses primarily on robot vacuum technology rather than other aspects. Unlike software tools that control sensors and effectors with specific physical characteristics, robots work under real-world conditions and real-time constraints (Kramer & Scheutz, 2007). Robot vacuum cleaners, when they can detect large and small particles of dust separately, the quality of cleaning has been observed to be associated with the number and characteristics of the sensors performing this detection (Rapa et al., 2022). In a study conducted by Quigley et al. (2009), the importance of software was emphasized as a factor determining the performance of robot vacuum cleaners parallel to their form. Robot vacuum cleaners' rapid growth in scale and scope makes software development more challenging. In parallel, Yarıcı (2022) emphasizes the importance of intelligence perception in robot vacuum cleaners for users. Therefore, a human-centred perspective is needed in robot vacuum cleaner design.

On the other hand, other studies in the field focus on the design features of robot vacuum cleaners. In a study conducted by Ulrich et al. (1997), the question of which form of robot vacuum cleaners enhances cleaning performance during the development process was examined. The study found that round and arm-shaped robots had the highest performance compared to other forms. However, the disadvantages of the round form are also mentioned in the report. It is stated that round robots struggle to clean corners and around legs effectively and may have decreased performance due to insufficient contact with walls. Li et al. (2022) worked on designing wireless charging stations with power repeaters for high compatibility for the charging unit designs of robot vacuum cleaners.

Many robot vacuum cleaners have recently entered the market to perform daily tasks. The first companies to introduce these products were Electrolux (Sweden) and Karcher (Germany) in early 2001. Both companies have worldwide sales networks.

Electrolux, a company, introduced a robot vacuum cleaner named Trilobite, which uses sensors to navigate and avoid obstacles to vacuum a room. Trilobite had limited success in the market due to its high price when it was first released (Prassler et al., 2000). With the increasing popularity of robot vacuum cleaners, an American company called iRobot introduced the Roomba to the market. The Roomba is considered a milestone in the development of robot vacuum cleaners due to its affordability and effective cleaning capabilities (Hisahara, 2014). Undoubtedly, robot vacuum technology continues to evolve. These advancements appear as a situation that both users and their environments and components will also need to adapt to.

Adoption theory provides a significant framework for understanding how individuals and organizations adopt new technologies and effectively use these innovations (Rogers, 2003; Surry, 2015). In the technology adoption literature, adoption theory is used to deeply examine processes of how innovations are accepted, implemented, diffused, and institutionalized (Surry, 2015). This theory offers a perspective on how innovations are initially accepted and then integrated into daily business processes. Additionally, adoption theory provides a comprehensive framework for understanding the challenges, successes, and transformations that occur at different stages of the change process (Surry, 2015). According to Straub (2009), adoption theory is traditionally used to understand whether an innovation is adopted or not in the context of behaviour change. Adoption represents the initial decision to fully use an innovation (Rogers, 2003; Surry, 2015). Subsequently, there are processes of implementation, diffusion, and institutionalization. The implementation process is defined as the effective use of the innovation in daily life (Surry, 2015). Rogers (2003) defines diffusion as the process through which the innovation is communicated over time among members of the social system. Institutionalization, the final transition, is when the innovation becomes a routine, accepted as a norm within the organization, moving beyond its novelty (Surry, 2015).

When examining the literature on robot vacuum cleaners, it is observed that the focus is on their technology, design, and user interactions but not on their relationship with existing home environments and users' expectations from this perspective. According to Surry (2015), it is indicated that it is common for users to inappropriately or ineffectively use newly acquired technologies. Therefore, robot vacuum cleaners become a component of the household, raising the question of how compatible the existing visible and invisible components and interior arrangements in homes are with this new addition, which forms the essence of this study. The core of this study is the question of how suitable the existing furniture and interior arrangements in homes are for the use of robot vacuum technology, a new technology, and what users do to increase this compatibility. In this context, this research aims to elucidate the impact of technological advancements on residential interior components through the example of robot vacuum cleaners, employing adoption theory.

METHOD

Participants

The snowball sampling technique was used in selecting the user sample for the robot vacuum. The interviews continued until the data obtained reached saturation point, and it concluded with the 16th participant. Since the research aimed to collect data from primary users, the participants were asked who actively used the robot vacuum cleaner in their household, and based on their responses, the person to be interviewed was selected.

Another interview criterion was that the participants should have at least six months of experience using a robot vacuum cleaner.

Data Collection Process

Data were collected after ethical permissions were obtained in April 2021. Due to the pandemic conditions, the data was collected through online interviews. At the beginning of each interview, the study's purpose, scope, significance, and the voluntary nature of participation were explained to the participants, and informed consent for their voluntary participation was obtained from each participant. Informed consent was obtained from all participants prior to their involvement in the study, and they were made aware that they could withdraw from the study at any point without any consequences. The duration of the interviews ranged from 18 to 25 minutes, with an average interview time of 20 minutes.

Data Collection Tools

The researcher developed a socio-demographic data form and a semi-structured interview form related to robot vacuum usage and interior arrangements for data collection. The interview form consists of two sections. The first section focuses on user experiences with robot vacuums, while the second focuses on furniture and interior expectations.

Data Analysis

Theme analysis, one of the qualitative research methods, was used in the study. Data were collected by interviewing 16 robot vacuum users via digital platforms. In-depth interview techniques were used to collect data. The data obtained from the 16 participants of the study was recorded through Zoom Video Communications during the interviews. The recorded interviews were transcribed and converted into text format during the analysis. At this stage, numbers were assigned to each participant in order to keep their identity information confidential. The data analysis was done manually, and the transcribed texts were read and scanned repeatedly throughout the data analysis process. Following this, key themes were identified to develop a comprehensive understanding. This process identified and coded significant concepts and themes that emerged in the data analysis. The generated codes were utilized in categorizing similar themes. This analysis aims to elucidate the expectations and interventions expressed by users of robot vacuums regarding their living spaces and furniture.

FINDINGS

The demographic profile of the participants provides a comprehensive view of the user base for robot vacuum cleaners. The average age of the participating users is 33.6, and the users are between the ages of 27 and 55. Out of the participants, five were male, and 11 were female. Among the participants, 75% stated that they are actively employed, 12,5% are on unpaid leave, 6,25% are retired, and 6,25% are unemployed. 50% of the users have an undergraduate degree, while the other 50% have a postgraduate education level. 87.5% of the users mentioned that they have children. Regarding the frequency of robot vacuum usage, 37.5% of the users stated that they use the robot vacuum cleaner every day, 18.75% use it every other day, 18.75% use it twice a week, 18.75% use it once a week, and 6.2% stated that they do not use it regularly (Table 1).

Table 1. Demographic profile of participants.

	Participants	Frequency	Percent
Gender	Female	11	68,75%
	Male	5	31,25%
Age	21-30	6	37,5%
	31-40	8	50%
	41-50	1	6,25%
	51-60	1	6,25%
Marital status	Married	13	81,25%
	Single	3	18,75%
Education Level	Bachelor's degree	8	50%
	Master's degree	1	6,25%
	PhD degree	7	43,8%
Employment status	Actively employed	12	75%
	Unpaid leave	2	12,5%
	Retired	1	6,25%
	Unemployed	1	6,25%
Frequency of robot vacuum usage	Every day	6	37,50%
	Every other day	3	18,75%
	Twice a week	3	18,75%
	Once a week	3	18,75%
	Irregularly	1	6,25%

Previous studies on robot vacuum cleaners have focused mostly on technical aspects of these devices, such as navigation algorithms or cleaning efficiency. However, this study delves into the user experience aspect, specifically how users interact with and adapt their home environments to accommodate robot vacuum cleaners. It sheds light on the challenges users face and the creative solutions they devise, as well as their expectations for future purchases. Additionally, the study suggests a novel perspective by proposing that the requirements of robot vacuums can inform both interior and product design, emphasizing the importance of considering these devices in the broader context of domestic environments. Accordingly, the research was evaluated based on six main themes. These themes were identified as the purchasing decision, changes made in the home before cleaning, interior space issues that hinder efficient cleaning, solutions generated for encountered problems, and expectations related to unresolved issues. The themes of the study are visualized in Figure 1.

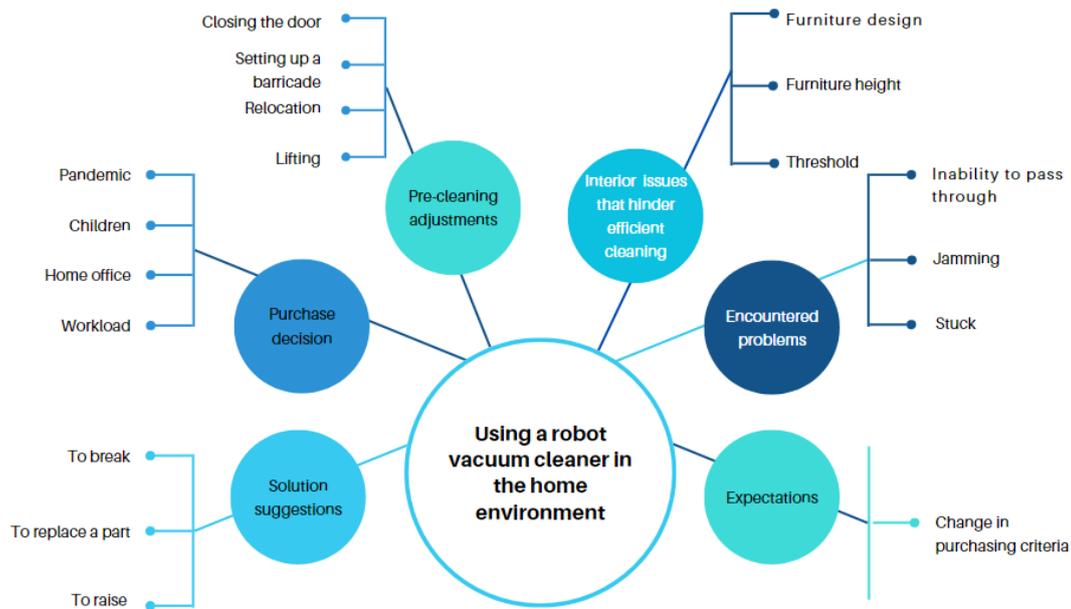


Figure1. Visualization of themes in a diagrammatic form

Purchase Decision

It has been revealed that users participating in research have different reasons for their purchase decisions. Some users interviewed indicated they switched to remote work due to the Covid-19 pandemic. Spending long hours working from home during the day has resulted in insufficient time for household responsibilities, thus creating a need for a robot vacuum cleaner. Users who reduce the time allocated to cleaning responsibilities by using a robot vacuum cleaner express their happiness as they can dedicate the remaining time to their children.

"There used to be a cleaning lady who would come to our house for cleaning before the pandemic, but we had to take a break from working with her due to fear of the virus. During this period, being constantly at home, having two young children, and working from home made us realize the need for this product." Participant 1.

"We started to think that we spend too much time on cleaning. When we thought about how to shorten this time, we decided to make a purchase, but I think I was also influenced by the posts on social media when making the purchase." Participant 5.

"There were some disruptions in cleaning during the pandemic. Due to security reasons, we couldn't constantly call the housekeeper to our home. However, with a baby at home, we still needed to maintain cleanliness but couldn't allocate enough time. That's why we thought a robot vacuum cleaner would make our lives easier." Participant 11.

"Normally, when we switched to flexible work, we started spending more time at home with our two children. The household responsibilities increased, and we tried to solve the cleaning part this way. Now I can say that it has become one of my essentials. Just like a dishwasher is important at home, a robot vacuum cleaner holds the same importance for me, even more so." Participant 12.

Another factor influencing the purchase decision is the shift of cleaning responsibilities to males. Due to their spouses' pregnancy, taking care of young children, and cooking responsibilities, the cleaning task is left to men. Men who do not want to

allocate time for cleaning minimize this responsibility by purchasing a robot vacuum cleaner. One of the users explains this situation as follows:

"We have a cat that sheds much fur at our home, requiring daily cleaning without fail. When I became pregnant, this became an even more serious need. When I left the tasks to my husband due to pregnancy, he found the solution by purchasing a robot vacuum cleaner." Participant 6.

"We have a daughter, and now I'm three months pregnant. When these two factors came together, the cleaning task fell to my husband. He researched online, and we also had friends who were using it. So, we just bought it." Participant 16.

Another notable point influencing the purchase decision is that some users mention the disadvantages of traditional cleaning methods regarding both time and performance. Users express some of these disadvantages as finding the time allocated for daily cleaning routines to be long, the cleaning devices used being bulky and heavy and requiring physical effort. The decisive factor in the purchase decision of a robot vacuum cleaner is stated to overcome these mentioned disadvantages.

"The advertisements influenced me, and I also wanted to eliminate the difficulty of turning on and off the vacuum cleaner at home. The vacuum cleaner at home is a professional machine, so it is very heavy. It was exhausting to open and use it every time. Using this one is easier. We thought about it that way and decided." Participant 9.

Changes Made at Home Before Cleaning

Users of robot vacuum cleaners do not actively participate in the cleaning process with this method. However, there is a common statement regarding the need to prepare the house for cleaning before using this method. Users provide different answers when asked why a preparation process is necessary before cleaning. Some of these different answers focus on the fact that the preferred furniture in the indoor space may not be compatible with the working principle of the robot vacuum cleaner. Therefore, users mention that they prepare the house for cleaning by rearranging the furniture before cleaning.

"I remove the single armchairs in the living room, lift the coffee table, and place the kitchen chairs on top of the table before cleaning." Participant 3.

"I have to remove all the chairs in the house without fail." - Participant 14.

"We have nested coffee tables in the shape of 'C' that can be attached to the sofa, and the kitchen chairs are also in the same shape. I always remove them before starting the cleaning." Participant 6.

"The coffee table consists of two pieces; one part is a movable ottoman. I place it on top of the coffee table before cleaning so that it can fit easily underneath, but when it enters, it often hits its legs, causing damage to itself and making a lot of noise." Participant 9.

"I take all the items that could get stuck inside the room and place them on top of the couches or the table before starting the cleaning." Participant 1.

Users in houses with open-plan living rooms mention that they set up barricades at the living room's entrance before cleaning when they do not want the robot vacuum cleaner to enter the room. In applying the robot vacuum cleaner, they share that they can

prevent this by placing virtual walls. However, they find this method more practical due to frequent mapping disruptions and the lengthy remapping process.

"Our living room is an open-plan space, and it doesn't have a door. It's not an area we constantly use, so I don't feel the need to vacuum it frequently. Our vacuum cleaner doesn't have mapping capabilities, so I put cushions as barricades at the living room entrance to prevent the robot vacuum from entering." Participant 5.

Another interior element that requires preparation before cleaning is the curtains. If the curtains reach the floor, users describe it as a problem because the vacuum cleaner perceives them as walls and cannot clean the space behind them. To overcome this issue, it is shared that curtains are positioned higher than the floor before cleaning.

"The curtains in our house reach the floor but don't touch it. However, the vacuum cleaner still perceives them as walls and passes by." Participant 1.

While robot vacuums are commonly used for daily cleaning, some users mention using them to clean hard-to-reach areas during detailed cleaning. Therefore, they indicate they assist the robot vacuum in accessing these areas before cleaning.

"If I want to clean places that I can't access, such as the top of the wardrobe, I go up on the chair and leave the robot vacuum cleaner on the wardrobe. Because it has sensors, it doesn't fall. It already wipes and sweeps over the wardrobe." Participant 14.

Interior Problems Hindering Thorough Cleaning

Robot vacuum cleaner users have expressed satisfaction with using the product. However, they have reported difficulties in achieving thorough cleaning due to problems arising from interior components during usage. One of these problems is furniture heights.

"When cleaning the living room, it can pass under the armchairs, but it can't pass under the three-seater sofa. The legs of the sofa are too short." Participant 10.

"There used to be a lot of trouble with cleaning the bedroom. It would go under the bed and get stuck somewhere, unable to come out. We had to take it out, but reaching the middle of a double bed was quite a hassle." Participant 6.

"The robot vacuum cleaner has a remote cleaning feature through the app, but I can never use it. It goes under the bed and then gets stuck, and I receive a notification on my phone. Because of this, I can't run it when I'm not at home. Not being able to use the remote access feature is a big problem. Who wouldn't want to clean the house while you're away and return to a spotless home? But the furniture prevents it from doing so, even though it has potential." Participant 3.

Furniture heights unsuitable for the robot vacuum cleaner to pass under were reported to cause problems such as the device getting stuck and disruptions in the mapping process. Users stated that these issues required manual intervention and prolonged the cleaning process. Participants reported that cleaning sessions took longer and were frequently interrupted due to these issues.

Another obstacle to achieving quality cleaning is the design of furniture legs. One of the problems in leg designs is described as the lack of sufficient clearance for the vacuum cleaner to pass through.

"The robot vacuum cleaner can pass through our kitchen chairs from only two sides instead of all four sides. It takes a lot of time to find the passage, so we prefer to lift the chairs." Participant 15.

One of the other problems related to foot designs is that the shapes of the feet hinder effective cleaning. Due to the lack of compatibility between the furniture's foot designs and the working principle of the vacuum cleaner, the mapping of the vacuum cleaner gets disrupted, the cleaning remains incomplete, or manual intervention from the user is required. The reasons for this situation are explained as follows:

"The feet of our living room chairs are designed with a slope, and the brush of the robot vacuum cleaner cannot reach that sloped area, leaving a triangular area inaccessible." Participant 12.

"The legs of the kitchen chairs are shaped like a sideways 'U,' with metal elevations. The vacuum cleaner can jump over one of these elevations and enter, but then it gets stuck between the legs of the chair. We have to rescue it every time during cleaning. Alternatively, we have to lift the chairs onto the table before cleaning. But that's a hassle, always lifting and putting them back. I often don't have the kitchen cleaned using this method." Participant 6.

"We have a coffee table in the living room with legs in the shape of a 'C,' and the vacuum cleaner gets stuck on those legs every time it cleans. I'm pregnant, so I can't always lift the coffee table for cleaning. That's why I prefer not to have the living room cleaned." Participant 5.

"I have a rotating armchair with a conically-shaped leg that slopes upward. The vacuum cleaner tries to climb on its leg every time, but its memory gets disrupted when it can't get off. So, either I manually prevent it from going there or place an obstacle on the map to block it." Participant 13.

Users who have furniture with wheels have reported difficulties in achieving thorough cleaning due to this feature prolonging the cleaning time and the vacuum cleaner being unable to reach between the wheels.

"Our office chair has wheels. The vacuum cleaner can't go over them because they are high, so it tries maneuvering around each one individually during cleaning. That's why we lift the chair during cleaning." Participant 1.

Participants reported that cleaning sessions took longer and were frequently interrupted due to these issues. These strategies included lifting furniture before cleaning, avoiding cleaning rooms with such furniture, or manually intervening when problems occurred during cleaning.

Users reported different experiences when using robot vacuum cleaners on carpets. Some users stated that carpet color affected the performance of the robot vacuum cleaner during cleaning.

"I use rugs in the hallway and kitchen. They get tangled in the vacuum cleaner's brush during cleaning, and the cleaning process cannot continue." Participant 3.

"We had a gel-based carpet in the children's room, and during cleaning, the vacuum cleaner would get tangled in the carpet, leaving the cleaning unfinished." Participant 13.

Some users stated that dark-colored carpets caused navigation and mapping problems during cleaning. Users with dark-colored carpets faced difficulties during cleaning and even found it impossible to clean using this method.

"We can never clean the kitchen with the robot vacuum cleaner. The kitchen door needs to be constantly closed during cleaning. Our carpets are dark navy blue in color. The robot vacuum cleaner gets confused on dark-colored surfaces, causing mapping problems, and keeps rotating in place, unable to move forward. That's why we clean the kitchen ourselves." Participant 6.

Another issue reported by users was the presence of carpet fringes. Users with such carpets mentioned that the vacuum cleaner's brush would get tangled in the fringes, preventing them from continuing the cleaning process.

"Our living room and bedroom carpets have fringes. When we first bought them, the vacuum cleaner would get caught in the fringes so we couldn't use it." Participant 15.

Another problem encountered by users who want to clean with a robot vacuum cleaner is the inability of the vacuum cleaner to enter the desired room on its own. It has been shared that it cannot enter environments with suitable conditions for cleaning due to its inability to pass through thresholds. Users stated that manually placing the robot vacuum cleaner in certain areas disrupted the mapping process. Users reported avoiding this method due to the time required for remapping. It has been observed that these areas are cleaned with the help of another vacuum cleaner. The reasons for this situation are explained as follows:

"We can't clean the bathroom. There's a threshold, so it can't enter inside. I wish it could clean that area." Participant 6.

"Our balconies are enclosed, and there's a carpet on the floor. I want it clean. It can't pass through the threshold alone. If we lift it and place it there, it messes up the mapping, so we clean the balconies ourselves." Participant 15.

"There's a threshold in the bathroom, but it can still enter and clean there, although it can't come out on its own. We have to go and get it once the cleaning is done." Participant 3.

Users reported that due to certain interior components, they were unable to clean some areas with the robot vacuum cleaner and instead used other cleaning tools.

Encountered Problems and Generated Solutions

Users described various solutions they implemented to address problems encountered while using the robot vacuum cleaner. Users have shared the following solutions regarding the most common problem, which is related to furniture heights:

"We had a bed with a base in our bedroom, and the robot vacuum couldn't go under it. It was difficult for me to clean that area, so we called a carpenter and had the legs changed. Now it can clean under the bed without any issues." Participant 12.

"Our bed used to get stuck under it. We stacked and joined wooden coasters and then placed them under the legs of the bed. Since the height issue was resolved, we no longer faced any difficulties in cleaning. It cleans beautifully and can go in and out everywhere." Participant 6.

"It could go under the couch, but there was an area where the lining was loose, and it would turn back when it encountered it. So I hammered a nail to tighten that area. Now it can clean it without any problems." Participant 14.

Users stated that areas with insufficient furniture height could not be cleaned using the robot vacuum cleaner. To solve this problem, they have shared interventions such as

changing the furniture legs or adding other materials to raise them. Another problem that arises is related to door thresholds. One user with door thresholds too high for the robot vacuum to pass has described their solution as follows:

"It couldn't enter the bathroom due to the threshold, so we had to pick it up and put it inside every time. There is no obstacle to cleaning inside; everything is wall-mounted and cleans nicely once it gets in. So we broke the threshold. Now it can easily enter and clean on its own. Later, I learned that ramps are available online for robots to pass thresholds, but we had already broken it, so there was no need." Participant 2.

As seen, users are not hesitant to make interventions to household components to achieve effective cleaning. Another shared problem is radiator heights. Users with radiator heights that are too low for the robot vacuum to pass have mentioned that they only start cleaning when they are home as a solution.

"In our house, the radiators are very low from the floor and always get stuck there. We remove them, so we can't run it when we're not home. After preparing the suitable environment, we give it 3 hours to clean the entire house while taking care of our tasks. We receive a notification on our phone when it gets stuck, and then we remove it, and the cleaning continues." Participant 5.

They have also pointed out that carpets can pose obstacles to effective cleaning. It is observed that the problems with carpets vary. While some users mention that the robot vacuum gets tangled in the fringes of the carpets and they hide the fringes under the carpet, others state that gel-based carpets are too thin and tend to gather during cleaning, which is why they stopped using such carpets.

"We couldn't use it because it got caught in the fringes of the carpets. Later, we folded and glued the fringes under the carpet, and now the carpets are cleaned without any problems." Participant 15.

"We had a wool carpet in the living room, but it couldn't move easily on it, so I replaced it. We also had a gel-based carpet in the children's room, but it would gather a lot while it was running, so I changed it." Participant 13.

Expectations About Unresolved Problems

Users stated that while they attempted to address some of the problems they encountered, certain issues remained unresolved. Users have shared their expectations for these problems. Users' expectations regarding unresolved issues were mainly related to furniture designs and carpets. Users described the criteria they would consider if they were to repurchase furniture. Users stated that future furniture preferences would focus on leg designs and furniture heights.

"Next time, I prefer to buy kitchen chairs with a classic leg design so that cleaning can be done more easily." Participant 6.

"From now on, I pay attention to the heights of all furniture, not just for the convenience of cleaning but also to provide advantages for it, including the vacuum cleaner." Participant 10.

Users stated that they would avoid lightweight carpets that tend to gather and carpets with fringes in future purchases. Users stated that they would avoid dark-colored carpets due to difficulties experienced during cleaning. Carpets that hinder effective cleaning and related expectations are explained as follows:

"If I had known it would be like this, I wouldn't have bought a rag. I consider the robot vacuum cleaner the best household item I have bought. That's why I prefer to change items that obstruct its operation, even though I like rags for decorative purposes. We're all racing against time to finish cleaning quickly and return to work. It seems logical to change things that prolong this time." Participant 3.

"I'm currently looking for a carpet for the bathroom, and I've eliminated all the models with fringes so that the vacuum cleaner can work comfortably." Participant 8.

"I never buy dark-colored carpets." Participant 6.

Some users stated that although they were aware of which products were more compatible with the robot vacuum cleaner, they preferred not to change their existing decoration choices.

"The living room is where we get the most efficiency and use it the most frequently. We can clean it comfortably without changing anything. When the furniture is compatible with the vacuum cleaner, cleaning becomes very easy, but I don't want to change my decoration preferences for the sake of the vacuum cleaner." Participant 5.

DISCUSSION

This study examines the interaction between domestic space and robotic household technology through the lens of adoption theory. Previous research reported increased adoption of robotic household technologies during the Covid-19 pandemic, particularly due to changes in work routines and heightened hygiene concerns (Zeng et al., 2020). The findings highlight that adoption is influenced not only by the availability of technology but also by contextual factors such as prolonged home presence, childcare responsibilities, and the physical characteristics of domestic spaces.

This aligns with the adoption stage of Rogers' adoption theory, where users make the initial decision to integrate new technology into daily life. The need for preparation before operating the device indicates that adoption is not passive; users actively negotiate their domestic environments. Findings show that users rearranged furniture, removed obstacles, and modified carpets to facilitate the robot vacuum's operation, demonstrating active adaptation of interior contexts.

Empirical research on service robots in the home supports the idea that domestic robots and environments influence each other: homes and robots must adapt reciprocally for effective operation and usability, and design decisions in both realms shape long-term interaction patterns (Forlizzi & DiSalvo, 2006). Physical domestic attributes play an important role in how service robots perform and are perceived in everyday use.

According to adoption theory, users are likely to encounter challenges in effectively using new technology. Progression into the implementation stage is evidenced by strategies developed to integrate the robot vacuum cleaner into daily routines and spatial arrangements. Users' solutions, such as adjusting furniture heights or lifting chairs, reflect tacit knowledge of ergonomics and imply that spatial configuration and interior design decisions are part of the implementation process.

Although users' motivations for purchasing a robot vacuum cleaner may differ, adoption theory suggests that strong underlying reasons reinforce the psychological attachment between the user and the technology, framing the product as a domestic assistant rather than a mere appliance. Prior studies emphasize that users form meaningful

interactions with domestic service robots, shaped not only by functional performance but also by social and contextual fit within the home environment (Önal, 2022).

These findings align with previous ethnographic studies on domestic robot use. Users adapt furniture placement and routines to optimize robot vacuum performance and often anthropomorphize robots, creating expectations for reliability. In contrast, the present study shows that childcare responsibilities and pandemic-related work-from-home arrangements significantly influence adoption decisions, suggesting that contextual factors can amplify or modify the interaction between domestic space and technology.

Integration into the home also signals progression into the diffusion phase of adoption theory, where technology begins to shape domestic routines, spatial arrangements, and even future purchasing decisions. Furniture and interior modifications initiated by users are functional and experiential, affecting cleaning efficiency and perceived domestic harmony. These behaviours illustrate that household technology can actively reshape the perception and use of living spaces, highlighting the transformative potential of adoption.

Satisfaction with a robot vacuum cleaner's performance is closely linked to the compatibility of household products and environments with its operation. Understanding the adopter is crucial in technology adoption, as it encompasses the predisposition to guide, support, or resist new technologies (Ellsworth, 2015). Adoption theory explains variability in user attitudes: some individuals, categorized as laggards (Rogers, 2003), approach technological innovations cautiously, prioritizing established values over functional efficiency.

In contrast, families with children and working parents, corresponding to innovators, perceive the robot vacuum cleaner as indispensable. They willingly modify domestic environments to optimize technology use, adjusting furniture, carpets, and decorative items. These actions demonstrate that integrating household technology can reshape how living spaces are perceived and utilized, extending the transformative potential of adoption beyond functional efficiency.

LIMITATIONS

There are some limitations to the study. Firstly, the research is limited to only 16 participants living in Turkey. Qualitative research often relies on a small and specific sample group. Hence, the study's findings lack generalizability to a more extensive participant base. This limits the generalizability of the findings. Another limitation of the study is the online conduct of interviews due to pandemic conditions. This situation leads to a lack of face-to-face communication and prevents the researcher from observing areas where robot vacuum cleaners are used.

CONCLUSION

This study highlights the intricate relationship between technology and home environments, exemplified through the adoption of robot vacuum cleaners. The research underscores that significant lifestyle changes, such as those triggered by the Covid-19 pandemic, and the need for assistance with household chores play a crucial role in influencing technology adoption. This aligns with the initial stage of adoption theory, where users decide to adopt new technology based on such influential factors. The desire to reduce cleaning time and enhance personal time further supports the decision to integrate robot vacuum technology into daily life.

The research provides some criteria for designing and developing products in environments where robot vacuum cleaners are used. If companies are aware of the difficulties users face, such as furniture design and heights, carpet types, they can design future models by keeping these in mind. Increasing the compatibility between the home environment and the robot vacuum cleaner will increase user satisfaction and the user's adoption of technology in the home environment. The solution suggestions that users develop against the difficulties they encounter while using a robot vacuum cleaner can help other users gain practical insights. In this way, it is thought that users can make informed decisions about home components and the arrangements required to optimize the device's performance. Therefore, the study reveals the importance of users' knowledge and awareness about the compatibility of robot vacuum cleaners with existing home components. It has been observed that users need to have information about how to organize the environment or what kind of problems they will encounter before using the robot vacuum cleaner and that solution suggestions related to the problems are obtained through experiences during the process. In this context, it is thought that robot vacuum cleaner manufacturers can offer suggestions to users through guides on preparing their homes for cleaning with this method. Thus, it is anticipated that the need to organize the home environment will be minimized by learning through post-purchase experiences.

Undoubtedly, robot vacuum technology continues to advance. This will make its use in home cleaning easier. The importance of considering the design of products used in homes and the design of robot vacuum cleaners together has emerged to ensure user satisfaction. As a result, overcoming the challenges identified throughout the process will be possible. It is believed that the simultaneous progress of these developments will enable more effective use of robot vacuums for home cleaning, thus positively impacting the adoption process of the technology in parallel.

Overall, this research contributes to a deeper understanding of how technology integration can transform user perceptions and utilization of their living spaces. Future studies may build on these findings to further explore the evolving dynamics of technology adoption in home environments, offering potential avenues for enhancing both user experience and technological advancements.

Ethical Issues

This study has obtained ethical approval from the Karabük University Ethics Committee with decision number E-78977401-050.02.04-29393 dated May 5, 2021.

Contribution Rate of the Researchers

The study was prepared by a single author.

Statement of Conflict of Interest

There are no personal or financial conflicts of interest related to this study.

Artificial Intelligence (AI) Commitment

The author of this article has consented the artificial intelligence (AI) policy of LOKUM Journal of Art and Design and has undertaken to be legally, ethically, morally, and intellectually responsible for all content produced regardless of the preparation process, for ethical source citation, and for the opinions and information presented in the content.

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