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Behavioural Determinants of Smart Home Device Adoption: An Empirical Study in Jeddah, Saudi Arabia

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ABSTRACT

The smart home gadget industry is expanding quickly on a global scale, yet little is known about the purchasing habits of consumers in these areas. The current study uses the Theory of Planned Behaviour to investigate the behavioural intention of consumers in Jeddah, Saudi Arabia, who plan to buy smart home appliances. It examines the effects of attitude, perceived behavioural control, and subjective norm on purchase intentions in greater detail. Of the 450 respondents that received surveys, 388 were used for analysis after the questionnaires were delivered. Self-administered questionnaires were used in a quantitative cross-sectional survey design as part of the methodology. The associations between important variables were investigated using regression analysis, and the constructs were validated using factor analysis. The findings show that purchase intentions are significantly positively correlated with both subjective norms and perceived behavioural control, with perceived behavioural control being the most important predictor. However, attitude did not seem to be a major factor, indicating that in this situation, practical needs and social influence are more important than personal preferences. These results highlight how crucial it is to use social influence and build customer trust through focused marketing strategies, such as educational campaigns and affordable prices, in order to promote the uptake of smart home technology. For scholars, marketers, and legislators interested in advancing smart technology in Saudi Arabia and other developing countries, this study offers insightful information.

1. Introduction

Smart home appliances are transforming interior design and space utilisation, shaping contemporary culture and trends through continuous technological advancements. These automated, practical devices, which optimise electricity usage, have become essential in modern households. The global smart home industry, with a compound annual growth rate (CAGR) of 13.7%, is projected to grow from USD 84.5 billion in 2022 to USD 138.9 billion by 2026 [29]. While adoption

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rates vary across regions due to cultural, economic, and behavioural factors, this growth highlights the significant potential of smart home technology. Saudi Arabia, with its socioeconomic transformations and technological advancements, provides an ideal context for exploring these variations.

Saudi Vision 2030, as part of its economic diversification efforts, outlines a comprehensive strategy to modernise the nation's electronic infrastructure and integrate technology into daily life [1]. Urbanisation, rising disposable incomes, and growing awareness of energy conservation have driven demand for smart home solutions in cities like Jeddah. However, adoption rates in Saudi Arabia lag behind those in other countries, underscoring the need to understand market-specific perspectives. This gap highlights the importance of examining behavioural factors influencing consumer behaviour in a multicultural and evolving society.

Key smart home appliances, such as voice assistants, smart security systems, and smart lighting and heating, are central to this technological shift. These devices not only enhance convenience but also promote resource efficiency and energy conservation, which are critical in energy-intensive regions like Saudi Arabia. A 2022 global survey by Mordor Intelligence found that 75% of consumers prioritised energy efficiency as the most valued feature of smart appliances [28]. Despite increasing environmental awareness in Jeddah, the market for smart home devices has yet to reach its full potential. While the trend aligns with sustainable urban development goals, challenges such as cost and user engagement remain significant barriers to widespread adoption. This study focuses on the factors driving Jeddah residents to adopt smart home devices. The Theory of Planned Behaviour [2] provides a robust framework for analysing how attitudes, subjective norms, and perceived behavioural control influence behavioural intentions. Attitudes reflect individuals' approval or disapproval of technology use, subjective norms capture societal influence, and perceived behavioural control assesses confidence and resource availability. Together, these elements offer a comprehensive approach to understanding consumer behaviour.

Smart home technology has evolved from a trend to a necessity, addressing critical issues such as comfort, security, and energy efficiency. These devices are increasingly viewed as essential tools for improving living standards and resource management. Adoption is heavily influenced by psychological and cultural factors, particularly in collectivist societies like Saudi Arabia, where family and community play a pivotal role in shaping consumer behaviour [3]. This underscores the importance of analysing regional trends in developing economies. This study aims to identify the behavioural factors influencing smart home appliance (SHA) adoption among Jeddah residents, addressing a gap in existing research. It evaluates the relative impact of attitudes, subjective norms, and perceived behavioural control on behavioural intentions, offering practical recommendations for stakeholders. The findings can inform marketing strategies tailored to Saudi Arabia's social and cultural context and guide policymakers in addressing adoption barriers. Additionally, they can help technology providers tailor their offerings to local preferences.

By integrating existing knowledge with localised insights, this study contributes to understanding smart home technology adoption in developing regions. It provides a multidimensional analysis of consumer behaviour, cultural norms, and technological advancements, offering valuable implications for researchers, marketers, and policymakers [4;5]. The interplay between cultural dynamics and technological progress is central to driving smart home adoption in Jeddah and similar contexts.

2. Literature Review

2.1 Attitude

One psychosocial component is attitude, defined as an individual's psychological state involving a favourable or unfavourable evaluation of a specific behaviour or object. According to [6] and , it measures a person's disposition towards a particular action by considering their knowledge, emotions, and intentions. Consumer behaviour analysts consistently identify attitude as a primary factor influencing individual behaviour [7]. For instance, a positive attitude towards a system or product is strongly correlated with the willingness to adopt it. Existing research highlights attitude as a key determinant in the adoption and purchase of new technologies.

[8] explored the adoption of smart home technology among older adults through a mixed-methods approach, combining surveys and interviews. Similarly, [9] conducted a systematic review to analyse data from multiple studies, focusing on how technological features shape consumer attitudes. Current evidence suggests that attitude is generally a strong predictor of behaviour, as demonstrated by prior research. However, external factors such as accessibility, affordability, and awareness can substantially moderate its predictive power. In emerging markets like Saudi Arabia, where awareness of smart home technologies remains relatively limited, perceived behavioural control and subjective norms are expected to exert a stronger influence than attitude. Based on the literature, the following hypothesis is proposed:

H1: The more positive the attitude, the greater the consumer's intention to purchase smart home devices in Saudi Arabia.

2.2 Subjective Norms

Subjective norms represent the perceived social pressure to adopt a behaviour [2], influenced by family, friends, and societal expectations [10]. [11] found that in collectivist cultures, where family influence is paramount, perceived behavioural control significantly impacts purchase intentions. [3] emphasised the dominant role of family in Saudi purchasing decisions, traditionally led by men. However, with increasing female education, wives are becoming more involved in decisions on smart home devices, reflecting shifting societal norms and reinforcing the role of subjective influences. Findings on subjective norms remain mixed. While [12-14] affirmed their predictive value, [15] and [16] found no significant effects. In Saudi Arabia's collectivist society, these norms are more influential, as demonstrated by [5], who identified family and peers as key reference groups, and [17], who highlighted the role of relatives and religion.

[17] used qualitative interviews, whereas [5] employed regression analysis to assess reference group influence on consumer decision-making. These diverse methodologies provide strong evidence for understanding subjective norms. Recent studies suggest that social media increasingly challenges traditional subjective norms. Platforms like Instagram and Snapchat have emerged as key opinion leaders, with consumer and influencer opinions shaping purchasing decisions, including smart home technology adoption. This trend is particularly significant in Saudi Arabia, where over 90% of the population actively engages with social media. Based on the literature, the following hypothesis is proposed:

H2: The more positive the subjective norm, the greater the consumer's intention to purchase smart home devices.

2.3 Perceived Behavioural Control

Perceived behavioural control (PBC) comprises perceived power and control beliefs, reflecting the perceived ease or difficulty of a task [18]. Considering both internal and external factors, it indicates an individual's self-efficacy in performing a behaviour [6;19]. [20] applied survey-based regression models to assess financial competence and technological familiarity, while [21] employed structural equation modelling to explore the link between self-efficacy and behavioural intentions. [20] noted that in technology adoption, PBC encompasses access to smart home technologies, product familiarity, and financial competence. [22] found that as individuals gain confidence and experience with smart home devices, their acceptance increases. In Saudi Arabia, access to advanced technology and relevant knowledge influences PBC. Despite government initiatives under Saudi Vision 2030 to enhance ICT infrastructure, the digital divide persists. Addressing resource constraints is essential to maximising prospective customers' PBC. Research suggests that PBC can be strengthened through engaging demonstrations, informative tutorials, and competitive pricing. [4] demonstrated that educational marketing campaigns could significantly enhance PBC. Based on the reviewed literature, the following hypothesis is proposed:

H3: The higher the perception of behavioural control, the higher the consumer's intention to purchase smart home devices.

2.4 Conceptual Framework and Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) offers a framework for predicting human behaviour by examining key psychological factors, including perceived behavioural control (PBC), subjective norms, and attitudes. These factors, alongside PBC, influence behavioural intention, the most reliable predictor of actual behaviour. TPB is particularly useful for studying smart home technology adoption, providing insights into consumer behaviour in developing economies like Saudi Arabia.

Conceptual Framework

The relationships between attitudes, subjective norms, and perceived behavioural control in predicting the behavioural intention to purchase smart home devices will be operationalised within a conceptual framework grounded in the Theory of Planned Behaviour (Figure 1).

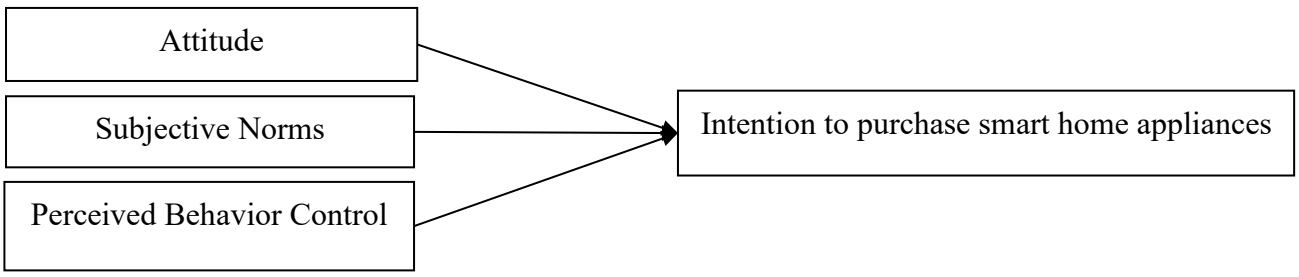

Fig.1. Research Framework

3. Methodology

This quantitative study utilised a cross-sectional survey methodology to identify the behavioural factors influencing the likelihood of purchasing smart home appliances among residents of Jeddah, Saudi Arabia. The strategy was designed to ensure representative and valid data collection, guided by theoretical frameworks and the study's objectives. This approach aligns with prior research, such as

[23] and [24], which effectively employed cross-sectional surveys to examine behavioural variables in developing markets.

3.1 Research Instrument and Data Collection

The study employed self-administered questionnaires adapted from established measures [23;24]. The questionnaire comprised two sections: the first gathered demographic data on age, gender, income, education, and occupation, while the second assessed behavioural constructs, including attitudes, subjective norms, perceived behavioural control (PBC), and purchase intentions for smart home devices. A five-point Likert scale was used to enhance reliability, measurement efficacy, and respondent engagement, ranging from 1 ("strongly agree") to 5 ("strongly disagree"). To refine clarity and wording, the questionnaire was pilot-tested on 30 participants. Minor modifications ensured cultural and linguistic appropriateness. A total of 450 questionnaires were distributed via physical handouts at events and community centres, emails, and social media, yielding 388 responses—a high response rate of 86%. This enhances the sample's generalisability and strengthens subsequent analyses. The approach aligns with [20] and [21], who employed Likert scales and pre-tested questionnaires for data reliability.

3.2 Population and Sampling

The target sample comprised predominantly lower-middle-class residents of Jeddah aged 18 and above, selected based on socioeconomic status, education level, and technology usage. To ensure representation and minimise sampling bias, ageing random choice sampling was employed. Male outpatients from the same medical facilities were purposively included. A sample size of 450 was determined using a 95% confidence level and a 5% margin of error, a standard in social science research. To enhance applicability and reduce generalisation bias, a diverse and representative sample of 388 responses was obtained. Notably, similar studies, such as [11] and [25], have utilised random sampling techniques to investigate behavioural actions and intentions.

3.3 Data Analysis

Statistical analysis was performed using SPSS version 21.0 to ensure validity and reliability. Frequency analysis provided demographic data, and Cronbach's alpha confirmed reliability, with all constructs exceeding 0.70. Exploratory Factor Analysis (EFA) with Varimax rotation assessed construct validity, yielding a KMO value above 0.60, and Bartlett's Test ($p < 0.001$) confirmed data suitability for factorisation. Regression analysis examined the relationships between attitude, subjective norms, perceived behavioural control, and behavioural intention to purchase smart home devices, supporting the theoretical framework. This methodology aligns with previous studies by [4] and [22].

3.4 Ethical Considerations

Following ethical standards, this study guaranteed anonymity and safeguarded participants' rights. Participants were briefed on the usage of their answers after being advised of the goal of the study—which was not credit. Consent was obtained solely for academic use for data collecting, storage, and usage.

4. Results and Analysis

The following section outlines the research findings obtained from 388 respondents in Jeddah,

Saudi Arabia. The data were analysed using respondents' demographic profiles, factor and reliability analysis, descriptive statistics, and hypothesis testing through regression analysis.

4.1 Respondent Demographics

Descriptive information concerning the demographic characteristics of the respondents is summarised in Table 1. The survey employed a purposive sampling approach, capturing data on age, marital status, household size, educational attainment, job positions, and income levels of participants from Jeddah. The respondents comprised 32.2% in the 26–33 age group, with 57.2% being married. Approximately half of the participants held a bachelor's degree (56.2%) and were employed in private organisations (49.0%). Income distribution indicated that 47.0% of respondents earned less than SR 10,000 per month.

Table 1
Demographic Profile of Respondents

Demographic Variable	Category	Frequency	Percentage (%)
Age	18-25	117	30.2
	26-33	125	32.2
	34-40	49	12.6
	Above 40	97	25.0
Marital Status	Single	166	42.8
	Married	222	57.2
Family Members	2	56	14.4
	3-4	147	37.9
	5-6	118	30.4
	More than 6	67	17.3
Education Level	Secondary Level	68	17.5
	Diploma/Degree	8	56.2
	Bachelor's Degree	218	56.2
	Postgraduate	94	24.2
Job Type	Retired	61	15.7
	Private Sector	190	49.0
	Government	93	24.0
	Other	44	11.3
Income (SAR)	Below 10,000	184	47.0
	10,001 to 20,000	128	33.0
	20,001 to 50,000	59	15.2
	Above 50,000	17	4.4

4.2 Factor and Reliability Analysis

Factor analysis was conducted to validate the constructs based on the Theory of Planned Behaviour: attitude, subjective norms, perceived behavioural control (self-efficacy), and purchase intention. Bartlett's Test of Sphericity was significant ($p = 0.001$), and the KMO value of 0.861 confirmed the data's suitability. The rotated component matrix (Table 2) showed all factor loadings exceeded 0.35, with eigenvalues above 1. The constructs explained a substantial amount of variance, as detailed in Table 2. The reliability test confirmed that all personalized constructs demonstrated acceptable internal consistency, with Cronbach's alpha coefficients exceeding the recommended threshold of 0.70.

Table 2
Results of Factor Analysis and Reliability

Variable	Eigenvalue	Variance (%)	Reliability (α)
Attitude	9.685	56.971	0.917
Subjective Norms	1.199	7.053	0.904
Perceived Behavioural Control	1.054	6.203	0.899
Intention to Purchase	3.784	63.07	0.882

4.3 Descriptive Statistics

Descriptive statistics were employed to offer basic insights into the central tendencies and dispersion of the study variables. As shown in Table 3, only the means for perceived risks to self and others demonstrated a significant difference. The findings indicate meaningful patterns of association (MPA) in attitudes and behavioural intentions, with respondents perceived behavioural control slightly exceeding the other constructs.

Table 3
Descriptive Statistics of Constructs

Variable	Mean	Standard Deviation (SD)
Attitude	3.8799	1.05835
Subjective Norms	3.6787	1.0169
Perceived Behavioural Control	3.6903	1.0253
Intention to Purchase	3.6293	1.05842

4.4 Hypothesis Testing and Regression Analysis

Multiple regression analysis was conducted to test the study's hypotheses, namely, that perceived attitude, perceived subjective norms, and perceived PBC impact the intention to purchase smart home devices. The model demonstrated a good fit, where the dependent variable—purchase intention—accounted for 69% of the variation in the data ($R^2 = 0.685$) with an adjusted R^2 of 0.682.

Table 4
Regression Analysis Results

Variable	Standardized Coefficients Beta	Significance (P-Value)
Attitude	0.091	Not significant
Subjective Norms	0.304***	< 0.001
Perceived Behavioural Control	0.504***	< 0.001

The validity of the model is supported by the F-statistic ($F = 277.957$, $p < 0.001$). It can be inferred that the developed models are robust, as the Durbin-Watson test value of 1.96 indicates no autocorrelation among the residuals.

H1: Attitude was not found to significantly influence purchase intention ($\beta = 0.091$, $p > 0.05$), leading to the rejection of this hypothesis.

H2: Subjective norms exhibited a significant positive effect on purchase intention ($\beta = 0.304$, $p < 0.001$), supporting the hypothesis.

H3: Perceived behavioural control emerged as the strongest predictor of purchase intention ($\beta = 0.504$, $p < 0.001$), also supporting the hypothesis.

5. Discussion

The conceptual framework of Perceived Usefulness and Ease of Use developed in this study offers

insights into the behavioural factors affecting smart home appliance purchases in Jeddah, Saudi Arabia. Results show that attitude has the least influence on purchase intention, with subjective norms and perceived behavioural control being stronger predictors. This contrasts with prior studies [15;26] that highlighted attitude as a key factor in technology adoption. The discrepancy may stem from Saudi Arabia's sociocultural and market dynamics, where societal pressures often override individual preferences. The dominance of subjective norms aligns with studies highlighting the significance of social networks in collectivist societies. Saudis are inclined to conform to social, familial, and peer expectations [27], a notion reinforced by [3], who underscored the traditional influence of family on purchasing decisions. Since subjective norms significantly predict purchase intention, these findings suggest that cultural norms can be leveraged to promote smart home technology adoption. Marketing efforts should adopt a community- and family-oriented approach, incorporating endorsements from prominent Saudi personalities or organisations.

Among the examined factors, perceived behavioural control exerted the greatest influence on purchase intention, highlighting the role of practical feasibility. Consistent with [20], findings indicate that financial capability, market accessibility, and technological familiarity are key drivers of adoption. This underscores the importance of ensuring consumers feel confident in accessing and affording smart home appliances. Marketing strategies should focus on minimising perceived barriers through price reductions, consumer education, and improved product accessibility. Facilitating financing options, offering product demonstrations, and enhancing customer service could significantly boost adoption rates.

Limited exposure to smart home technology in Saudi Arabia explains the weak link between attitude and purchase intention. Unlike other markets, Saudi consumers may lack personal affinity towards such technology and instead rely on external reference groups, such as family and friends, when making brand choices. This aligns with [2] theory, suggesting that attitudes predict behaviour depending on contextual and individual factors. Low exposure to smart home technology may weaken attitude as a key determinant in this context. These findings hold practical implications for businesses and policymakers promoting smart home adoption. Social proof incentives, such as endorsements from community leaders and family-focused influencers, should be prioritised in marketing campaigns. Additionally, addressing key sources of perceived behavioural control through comprehensive initiatives—such as flexible payment plans and consumer-friendly product demonstrations—would enhance adoption. Retailers could implement instalment plans, while companies might simplify product descriptions to increase accessibility.

Beyond adapting marketing strategies to cultural contexts, this study highlights the necessity of aligning business and communication strategies with Saudi Arabia’s collectivist values and socioeconomic realities. Global marketing trends reinforce the importance of contextualising product success stories to effectively penetrate new markets. The strong influence of subjective norms and perceived behavioural control, coupled with the minor role of attitude, suggests that the market remains in its early stages. Findings highlight the need to enhance social norms and eliminate adoption barriers, offering valuable insights for academics, marketers, and policymakers. As smart home devices become mainstream, future research should examine how these dynamics evolve.

6. Conclusion and Recommendation

In conclusion the findings indicate that PEOU exerts the strongest effect on purchase intention, while attitude is not a significant predictor. This suggests that societal pressures and practical

considerations outweigh personal preferences in smart home technology adoption, underscoring the role of functional and cultural dynamics in technology diffusion within Saudi Arabia. Given the strong effect of perceived behavioural control, increasing consumer access and usability is crucial for boosting adoption rates. The study's conclusions offer a foundation for future initiatives. Marketing strategies should focus on strengthening subjective norms through family-centric advertisements, community engagement, and endorsements from influential figures. Enhancing perceived behavioural control via product trials, educational campaigns, and affordability schemes such as instalment plans or subsidies can further drive adoption. Legislators can support adoption by reducing structural barriers through financial incentives and accessibility improvements.

However, the study has limitations. Its focus on Jeddah restricts generalisability to other Saudi regions with diverse socioeconomic and cultural backgrounds. It examines only three constructs—attitude, subjective norms, and perceived behavioural control—excluding factors like perceived quality, environmental concerns, and technological trust. Additionally, as a cross-sectional study, it captures consumer intentions at a single point in time without accounting for market evolution. Future research should expand to other Saudi cities for a more comprehensive understanding of consumer behaviour. Additional predictors, including technological trust, environmental impact, and new media influence, could enhance insights into smart home adoption. Longitudinal studies tracking behavioural shifts over time would be valuable, while qualitative methods such as interviews and focus groups could deepen understanding. Cross-cultural comparisons between collectivist and individualist societies may also provide theoretical insights into technology adoption. This study contributes to consumer behaviour literature by highlighting the significance of subjective norms and perceived behavioural control in predicting smart home adoption. While attitude was not a key factor, its influence may grow as the market matures. These findings offer valuable guidance for marketers, policymakers, and researchers aiming to facilitate smart home technology adoption in Saudi Arabia and similar emerging economies.

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