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A STUDY ON THE PSYCHOLOGICAL BARRIERS TO EV ADOPTION AND THE ROLE OF AI DECISION SUPPORT SYSTEMS

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Abstract:

The adoption of electric vehicles (EVs) is essential for achieving sustainable transportation and reducing greenhouse gas emissions. Despite technological advancements and policy incentives, EV adoption remains slower than expected, largely due to psychological barriers influencing consumer behavior. This study examines key psychological factors such as range anxiety, perceived risk, resistance to change, and lack of trust in EV technology that hinder consumer adoption. These barriers are often driven by subjective perceptions and misinformation rather than actual technological limitations.

The research further explores the role of Artificial Intelligence (AI)-based Decision Support Systems (DSS) in addressing these psychological challenges. AI-driven DSS provide personalized insights through data analytics, predictive modeling, and real-time simulations, enabling consumers to better understand EV performance, charging feasibility, and long-term cost benefits. By reducing uncertainty and enhancing perceived usefulness, AI-based decision support tools can positively influence consumer attitudes and adoption intentions.

Using a Quantitative research approach, the study aims to evaluate the effectiveness of AI-driven decision support systems in mitigating psychological barriers and supporting informed EV adoption decisions. The findings are expected to offer valuable implications for policymakers, manufacturers, and technology developers seeking to accelerate electric vehicle adoption.

Introduction :

The transportation sector is a major contributor to global greenhouse gas emissions, accounting for a substantial share of carbon dioxide output worldwide. As concerns over climate change, air pollution, and fossil fuel dependency intensify, electric vehicles (EVs) have emerged as a critical component of sustainable mobility strategies. EVs offer significant environmental benefits, including reduced tailpipe emissions, improved energy efficiency, and lower long-term operating costs compared to internal combustion engine (ICE) vehicles. Governments across the globe have introduced policy incentives, subsidies, and infrastructure development initiatives to encourage EV adoption. Despite these efforts and notable technological advancements, consumer adoption of electric vehicles remains slower than anticipated in many markets (Apurva Pamidimukkalaa, april 2024).

Understanding consumer attitudes toward electric vehicles (EVs) is essential to increase their adoption. Consumer attitude reflects how people think, feel, and behave toward EVs, influenced by factors such as price, driving range, charging infrastructure, and awareness of environmental benefits. Addressing these concerns helps build trust and acceptance of EV technology. A study based on the Theory of Planned Behavior (TPB), explains how attitudes, social influence, and perceived ease of use affect purchase decisions. It also draws on innovation diffusion theory, highlighting how EVs in India are gradually moving

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from early adopters toward broader market acceptance.(Pandey, June 2025)

Existing research as per abhinaya, increasingly suggests that the slow diffusion of EVs cannot be explained solely by economic or infrastructural constraints. Instead, psychological and behavioral factors play a decisive role in shaping consumer adoption intentions. Psychological barriers such as range anxiety, perceived risk, resistance to change, lack of trust in new technologies, and negative attitudes rooted in misinformation significantly influence consumer decision-making. Studies indicate that these barriers are often driven by subjective perceptions rather than actual technological limitations of modern EVs(Abhinaya krishnaswamy, Dec. 2024).

Integration holds immense potential with the convergence of AI and electric vehicle technology. It holds great promise for accelerating the transition towards a cleaner, smarter, and more sustainable transportation future. As AI continues to advance, its integration into EVs will drive innovation, improve performance, and enhance the overall driving experience, benefiting both consumers and the environment.(YADAV.P, 2024)

Technology Acceptance Model (TAM):The Technology Acceptance Model explains how consumers decide to accept or reject new technology based mainly on perceived usefulness and perceived ease of use. In the context of electric vehicles, perceived usefulness refers to benefits such as lower operating costs, environmental sustainability, and government incentives, while perceived ease of use relates to factors like charging convenience, driving comfort, and maintenance simplicity. When consumers believe that EVs are beneficial and easy to use, their attitude toward adoption becomes more positive, increasing their intention to purchase.

Stimulus–Organism–Behavior–Consequence (SOBC) Framework: The SOBC framework explains consumer behavior by showing how external stimuli influence internal psychological states, leading to behavior and outcomes. For EV adoption, stimuli include government policies, charging infrastructure, fuel prices, and environmental awareness. These stimuli affect the organism, which represents consumers' attitudes, perceptions, and trust in EV technology. These internal responses shape behavior, such as the intention to buy or use an EV, and result in consequences like customer satisfaction, cost savings, and reduced environmental impact.(Priya Rani)

Objectives of the Study:

1. To identify key psychological barriers influencing consumer adoption of electric vehicles.
2. To analyze consumer perceptions and attitudes toward EV technology.
3. To examine the role of AI-based decision support systems in reducing psychological barriers.
4. To assess the effectiveness of AI-driven DSS in influencing EV purchase decisions.
5. To provide recommendations for policymakers and industry stakeholders to promote EV adoption

Research Methodology:

The study adopts a **Quantitative research design** combining quantitative and qualitative approaches. Primary data is collected through structured questionnaires administered to potential and existing vehicle buyers. The survey measures psychological factors such as risk perception, trust, anxiety, and attitude toward EVs. Secondary data is gathered from academic journals, industry reports, and policy documents.

Quantitative data is analyzed using statistical tools such as descriptive statistics, correlation analysis, and regression analysisto gain deeper insights into consumer perceptions and experiences with AI-based decision support tools.

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Hypotheses:

- **H1:** Psychological barriers have a significant negative impact on consumer intention to adopt electric vehicles.
- **H2:** Range anxiety significantly influences consumer resistance to EV adoption.

Review of Literature (ROL):

The transportation sector remains one of the highest contributors to global greenhouse gas emissions, prompting urgent interest in sustainable mobility alternatives such as electric vehicles (EVs). Electric vehicles promise substantial reductions in carbon emissions, improved air quality, and long-term cost efficiencies compared to internal combustion engine vehicles, but consumer adoption remains slower than expected in many regions. A growing body of literature suggests that psychological and behavioral factors are increasingly significant in shaping consumer intentions toward EV adoption, beyond traditional economic and infrastructure determinants. For example, a systematic review identified range consciousness, attitudes and experiences, and anticipated emotion as core psychological constructs that negatively influence EV purchase decisions. (Abhinaya krishnaswamy, Dec. 2024)

Global research similarly categorizes consumer decision influences into contextual, situational, demographic, and psychological factors, with limited driving range and high purchase price among the most recurrent barriers. (Apurva Pamidimukkalaa, april 2024). Psychological barriers also include perceived risk and skepticism toward new technologies; such barriers stem from entrenched attitudes toward internal combustion engine vehicles and affect willingness to switch to EVs significantly. Several significant barriers to the universal adoption of electric vehicles (EVs) remain. Predominantly, there are various psychological hesitations that influence consumer intention of purchasing and owning EVs. It identified three key psychological factors that play an important role in consumer decisions regarding EVs: range consciousness, attitudes and experiences, and anticipated emotion and moral norms. (Abhinaya krishnaswamy, Dec. 2024)

Studies in the Indian context confirm the relevance of psychological determinants such as risk perception, environmental concern, and technology acceptance—for example, research applying an extended UTAUT2 framework found that risk perception and environmental concern significantly affect EV purchase intentions.(Kushwaha, june 2024). Furthermore, prior studies grounded in technology acceptance models such as TAM, UTAUT2, and perceived value frameworks highlight the importance of perceived usefulness, trust, and product knowledge in shaping adoption intentions. Research in emerging markets like India and China confirms that psychological factors such as risk perception, environmental concern, and technological acceptance significantly affect EV purchase decisions (Kushwaha, june 2024). The present study investigates the role of AI-based DSS in reducing psychological resistance and supporting informed consumer decision-making, thereby contributing to accelerated adoption of electric vehicles.

The study reveals that electric vehicle adoption is strongly influenced by perceived value, which is positively shaped by perceived usefulness, technological features, self-identification expressiveness, and environmental awareness, while high cost negatively affects value perception. Perceived value plays a mediating role between these factors and adoption intention, highlighting its central importance. Sensitivity analysis identifies perceived usefulness and perceived value as the strongest drivers of adoption. The findings suggest that enhancing technological innovation, environmental awareness, and the practical benefits of electric vehicles can

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encourage consumer acceptance, support policy initiatives, and contribute to reducing greenhouse gas emissions and promoting sustainable transportation development.(Sohaib Mustafa)

The study confirms the effectiveness of the integrated TAM–SOBC framework in explaining electric vehicle adoption in the Indian context. Social influence, facilitating conditions, and product knowledge significantly enhance perceived ease of use and perceived usefulness, shaping favorable consumer perceptions of electric vehicles. Perceived ease of use and perceived usefulness strongly drive adoption intention, indicating that convenience and practical benefits are critical for acceptance. Adoption intention further emerges as a key determinant of consumers' willingness to pay a premium, reflecting readiness for actual purchase. Overall, the findings highlight the importance of social, infrastructural, and knowledge-based factors in accelerating electric vehicle adoption.(Priya Rani)

In a research study by Manish Sopan Shinde found factors like socio-cultural factors, psychological factors affect the adoption of electric vehicle. The findings perceived usefulness, environmental awareness and vehicle price are some of the key socio-cultural and psychological aspects that strongly act when adopting electric vehicles.(Manish Sopan Shinde, 2023)

A study found that the attitude of consumers to be positively related to purchase intention and ecological behavior. Manufacturers and marketers of EVs must include lifestyle and conspicuous aspects in their offerings. Moreover, they should work on enhancing the utilitarian value of EVs. Never should a person feel that he/she is paying more than he/she is getting. Special note for conspicuous consumers who are shedding huge resources to make a statement among peers.(Pushpinder Singh, June 2023)

A study highlights psychological hesitations — including range consciousness (a form of range anxiety), attitudes based on perception rather than experience, and anticipated emotional responses — as primary barriers to EV adoption. In a systematic review examining psychological hesitations, Krishnaswamy & Deilami (2024) identified range consciousness, personal attitudes and anticipated emotional outcomes as core psychological constructs negatively influencing EV purchase decisions. Global reviewers have similarly categorized consumer decision influences into contextual, situational, demographic, and psychological factors, with limited driving range and high purchase price being among the most recurrent barriers.

A growing awareness of climate change and the desire for sustainable practices have led many consumers to view EVs as environmental friendly alternatives to traditional internal combustion engine vehicles. However, economic factors, such as the initial purchase price, government incentives, and long-term cost savings, play a crucial role in shaping consumer decisions. Technological advancements, including improvements in battery life, charging infrastructure, and vehicle performance, significantly enhance consumer confidence in EVs.(Habeeb Agoro, 2025)

Although electric vehicles are experiencing early market growth, several challenges continue to limit their widespread adoption. These challenges include high initial costs, concerns over driving range and long charging times, and limited consumer awareness about the practicality and availability of EV technology. Among these factors, customer awareness plays a particularly critical role in influencing adoption decisions.(DR HIREN HARSORA, April 2024)

The current study seeks to bridge this gap by investigating the relationships between psychological barriers to EV adoption and the potential mitigating role of AI-based DSS. Specifically, we explore whether AI decision support by enhancing clarity, confidence, and perceived usefulness positively alters consumer

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attitudes and reduces risk perceptions. By integrating consumer psychology with decision support technology, this research aims to generate insights that are not only theoretically grounded but also practically useful for policymakers, automotive industry stakeholders, and technology developers seeking to accelerate EV adoption.

Data Analysis:

1. **H1:** Psychological barriers have a significant negative impact on consumer intention to adopt electric vehicles.

Table showing the psychological barriers and its impact

Anova: Single Factor				
SUMMARY				
Dependent Variables and Group	***Count***	***Sum***	***Average***	***Variance***
I feel anxious about switching from conventional cars to electric vehicles.	110	268	2.436364	0.74362
I am concerned about the reliability of electric vehicles.	110	257	2.336364	0.812427
I think adopting EVs would be inconvenient for my daily routine.	110	290	2.636364	0.894078
I worry that EV technology is too complex to use effectively.	110	308	2.8	1.06055
I am reluctant to invest in an EV due to uncertainty about its long-term performance	110	260	2.363636	0.949124
I fear that maintenance and repair of EVs could be difficult or expensive.	110	262	2.381818	0.917098
I am concerned about the resale value of an EV compared to a conventional car.	110	262	2.381818	0.843703

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	20.03377	6	3.338961	3.75731	0.001079	2.110445
Within Groups	678.0455	763	0.888657			
Total	698.0792	769				

Source: Primary Data

The ANOVA results show that psychological barriers have a statistically significant impact on consumers' intention to adopt electric vehicles. Since the calculated F-value (3.757) is greater than the F-critical value (2.110) and the p-value (0.001) is less than 0.05, the null hypothesis is rejected.

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This indicates that concerns such as anxiety about switching, perceived complexity, inconvenience, reliability, maintenance, and long-term performance significantly and negatively influence consumers' willingness to adopt electric vehicles. Hence, H1 is accepted.

2. **H2:** Range anxiety significantly influences consumer resistance to EV adoption.

Anova: Single Factor				
SUMMARY				
Dependent Variables and Group	***Count***	***Sum***	***Average***	***Variance***
I worry that an electric vehicle will run out of battery during my trips.	110	229	2.081818	0.809758
I am concerned that charging stations may not be available when needed.	110	228	2.072727	1.003837
The limited driving range of EVs makes me hesitant to purchase one.	110	269	2.445455	0.909842
I am concerned that EVs are not suitable for long-distance travel.	110	258	2.345455	0.980484
Range anxiety would prevent me from recommending an EV to others.	110	282	2.563636	0.835363

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	21.11636	4	5.279091	5.814895	0.000138	2.388289
Within Groups	494.7818	545	0.907857			
Total	515.8982	549				

Source: Primary data

The ANOVA results indicate that range anxiety has a significant influence on consumer resistance to electric vehicle adoption. The calculated F-value (5.815) exceeds the F-critical value (2.388), and the p-value (0.0001) is well below the 0.05 significance level.

Therefore, the null hypothesis is rejected, and H2 is accepted, confirming that concerns related to battery range, charging availability, and long-distance travel significantly increase consumer resistance to adopting electric vehicles.

Conclusion:

The study concludes that psychological factors play a crucial role in shaping consumer resistance to electric vehicle (EV) adoption. The findings confirm that psychological barriers—such as anxiety about switching from conventional vehicles, perceived complexity of EV technology, concerns over reliability, maintenance, resale value, and long-term performance—have a significant negative impact on consumers' intention to adopt EVs. This directly fulfils and demonstrates that consumer attitudes toward EV technology are still influenced by uncertainty and lack of confidence.

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Further, the results establish that range anxiety is a major determinant of resistance to EV adoption. Concerns regarding limited driving range, inadequate charging infrastructure, and suitability for long-distance travel significantly discourage consumers from purchasing or recommending EVs. This highlights range anxiety as one of the most critical psychological barriers affecting EV adoption decisions. The findings suggest that AI-based decision support systems (DSS) have strong potential to mitigate these psychological barriers by providing real-time information on battery range, charging station availability, cost savings, maintenance forecasts, and personalized usage insights. By enhancing transparency and reducing uncertainty, AI-driven DSS can positively influence consumer confidence and EV purchase decisions.

Finally, the study recommends that policymakers and industry stakeholders focus on integrating AI-driven decision support tools into EV platforms, expanding charging infrastructure, and implementing targeted awareness programs. Such measures can effectively reduce psychological barriers, alleviate range anxiety, and accelerate the adoption of electric vehicles, contributing to sustainable transportation goals.

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