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Consumer Perception, Preference, and Barriers towards Electric Passenger Car in India: An ANOVA-Based Analysis

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Abstract
The present paper analyses consumer perception, adoption, preference and perceived barriers to electric passenger cars in India through an ANOVA-based analytical model. According to the primary data obtained in 492 cases, the research utilizes descriptive statistics, a reliability analysis, ANOVA, and General Linear Model (GLM) to determine the differences in behaviors among demographic groups. The results indicate that EV buyer status has a significant effect on perception, adoption and preference whereas demographic variables have a weak effect. The perceived barriers are consistent across the groups, which means that there are systemic challenges. The research is valuable in its focus on behavioral segmentation as opposed to demographic segmentation and offers practical solutions to policymakers and industry stakeholders to facilitate EV adoption.

Keywords: Electric Vehicles (EVs), Perception, Adoption, Preference, Barriers, GLM, India.

1 Introduction

The increasing worry about environmental degradation, climate change and over-reliance on fossil fuels has increased the shift to sustainable transportation systems world over. The transport industry was one of the largest sources of greenhouse gas (GHG) emissions, with the proportion of carbon dioxide emission in the world being quite high, which required immediate policy and technological action (Chaturvedi et al., 2023). In developing economies like India, there is a high rate of urbanization, growing income, and ownership of vehicles, which have further increased the environmental burden, especially air pollution and energy insecurity (Jaiswal et al., 2022).

Electric vehicles (EVs) have become a potentially viable alternative to the traditional internal combustion engine vehicles in this regard. EVs are also known to mitigate carbon emissions, enhance energy efficiency, and lessen the reliance on fossil fuels (Jaiswal et al., 2022). There is empirical evidence that EV adoption is capable of decreasing emissions by 30 to 50 percent and increasing fuel efficiency relative to traditional vehicles (Romm, 2006; Pålsson and Johansson, 2016). As a result, governments around the globe, India being one, have implemented numerous policy frameworks and incentive programs, including the National Electric Mobility Mission Plan (NEMMP) to facilitate the EV adoption and sustainability goals (Chaturvedi et al., 2023).

Nevertheless, EV penetration in India is quite low, which means that there is a discrepancy between the intentions of the policy and consumer behavior. Previous studies indicate that most consumers do not buy EVs due to several impediments, including high upfront price, the absence of charging facilities, and the belief that they are unsafe (Vishwakarma, 2024). Also, the infrastructural issues, especially accessibility and availability of charging points, are stated as essential elements that impact consumer switching intention to EVs (Bhattacharyya and Thakre, 2021).

Theoretically, there are several behavioral and cognitive factors that affect consumer adoption of EVs. According to the Technology Acceptance Model (TAM), the perceived usefulness and perceived ease of use are important to influencing the adoption intention and perceived risk is a barrier (Davis, 1989; Jaiswal et al., 2022). Moreover, recent research has attributed significance to consumption motives, such as hedonic, gain, and normative motives, as having a role in shaping consumer behavior in adopting EV (Chaturvedi et al., 2023). Hedonic motives associated with emotional satisfaction and driving experience have been identified as among these and have been observed to have a significant impact on the purchase intention.

Consumer knowledge and awareness is another determinant of EV adoption that is critical. Research shows that a lack of information regarding EV technology and advantages is one of the main factors limiting the desire to accept EVs among consumers, especially in the emerging market (Jaiswal et al., 2022). Combining knowledge and belief related constructs like perceived usefulness and perceived ease of use offers a better insight into consumer behavior in a technology adoption setting.

Additionally, the value-based adoption model (VAM) is also a valuable view on the process of consumer decision-making. VAM suggests that consumers will consider the perceived benefits (e.g., economic savings, environmental benefits, social image) and perceived sacrifices (e.g., cost, risk, infrastructure limitations) and make adoption intentions (Kim et al., 2007; Vishwakarma, 2024). This point of view applies especially in the Indian context, where consumers are very value-conscious and cost-benefit trade-offs.

Despite the increased body of literature on EV adoption, there are various gaps in research. To begin with, technological and behavioral factors have been investigated separately, in most of the studies without an integrated framework.

To fill in these gaps, the current paper will consider consumer perception, preference and barriers to purchasing electric passenger cars in India through a quantitative and empirical method. The study uses a group-based framework of analysis to examine differences between demographic categories unlike previous studies that concentrate on structural relationships. The study results will be useful to policy makers, marketers as well as industry stakeholders who will be able to develop specific strategies to improve EV adoption in India.

2 Literature Review

The movement towards electric mobility has received significant academic interest, especially in relation to the sustainability, technological innovation, and consumer behavior. Though the initial research conducted mainly placed early environmental and technological advantages, modern studies concentrate more on the behavioral processes of electric vehicle (EV) adoption.

One of the most prevalent bodies of literature understands the adoption of EV in terms of technology acceptance frameworks. Upon the Technology Acceptance Model (TAM), the key factors have always been perceived usefulness and perceived ease of use as the main factors that trigger adoption intention

(Davis, 1989). Building on this concept, Jaiswal et al. (2022) establish that these cognitive beliefs play a major role in the EV adoption in the new markets, and the perceived risk has a negative moderating effect on this relationship. Nonetheless, the later studies believe that TAM itself is not a complete explanation, especially in high-involvement and sustainability-oriented consumption situations.

Scholars have incorporated the motivational and behavioural perspectives in the research on EV adoption in order to overcome these limitations. Chaturvedi et al. (2023) present a goal-framing strategy, and they differentiate between hedonic, gain, and normative motives. Their research states that EV adoption cannot be considered as utilitarian solely; instead, hedonic factors, like emotional satisfaction and experience value, have a predominant influence on consumer intentions. This fits in a larger body of consumer behavior literature, highlighting that both affective and symbolic aspects of consumer behavior are gaining more and more power in high-involvement purchasing decisions (Schuitema et al., 2013).

In parallel with motivational approaches, the other line of research takes a value-based orientation and focuses on the trade-off between the perceived benefits and perceived sacrifices. The value-based adoption model (VAM) is based on the assumption that consumers consider economic, functional, and environmental benefits in comparison to perceived costs and risks (Kim et al., 2007). This suggestion is substantiated by empirical data in the EV setting, suggesting that the perceived value serves as an intermediate between product qualities and adoption intention (Vishwakarma, 2024). Remarkably, perceived risks, including financial cost, infrastructure constraints, and performance uncertainty, always appear to be the most important barriers to adoption (Egbue and Long, 2012).

Nevertheless, with these developments, the literature has started appreciating the value of knowledge and awareness in influencing behavior toward EV adoption. Jaiswal et al. (2022) claim that consumer knowledge is an underlying cognitive construct and determines perceived usefulness and risk perception. In less-developed countries, where EV adoption is still in its early phase, the lack of awareness and misinformation can greatly limit its adoption. This point of view is in line with the diffusion theory that states that knowledge is a condition of forming attitudes and behavioral intention.

This highlights the influence of demographic heterogeneity on EV adoption. Age, income, education, and occupation are some of the widely used variables as proxies to consumer segmentation. Previous studies show inconsistent results: some studies indicate that there are significant demographic differences in EV adoption behavior (Egbue and Long, 2012), whereas other studies report small or insignificant effects (Chaturvedi et al., 2023). This discrepancy implies the possibility of the demographic factors interacting with psychological constructs and not having the direct effects.

Despite the increasing literature, there are still some significant gaps. To start with, the current literature depends heavily on structural modeling (e.g., SEM) that is concerned with the causal effects, but does not consider variations in consumer behavior based on the group. Second, there is weak combination of perception, preference and perceived barriers into a single analysis model. Third, although the significance of demographic heterogeneity is acknowledged, not many studies utilize powerful statistical methods like ANOVA or GLM-related methods to investigate the differences in a systematically organized way among the consumer groups.

To this end, the current research contributes to the body of literature by taking an analytical approach of groups to investigate consumer perception, preference and barriers to electric passenger cars. This study will supplement the current structural models and give a more nuanced view of consumer heterogeneity in the Indian EV market, as it addresses demographic differences with an ANOVA model.

3 Research Methodology

3.1 Research Design

The current research takes a quantitative and empirical research design to investigate the consumer perception, preference, and barrier towards electric passenger cars in India under the ANOVA-based analytical framework. Unlike the previous research, where the modelling of purchase intention was based on the structural relationships, the current research focuses on investigating group-based behavioural differences in terms of demographic categories. The study is both exploratory and descriptive in nature. The exploratory dimension helps in establishing the important behavioural constructs related to the adoption of electric vehicles whereas the descriptive approach allows the measurement and interpretation of consumer behaviour in a systematic manner across the dimensions of perception, awareness, preference and barrier. The empirical focus of the research provides the possibility of statistical confirmation of the identified behavioural patterns with the help of primary data.

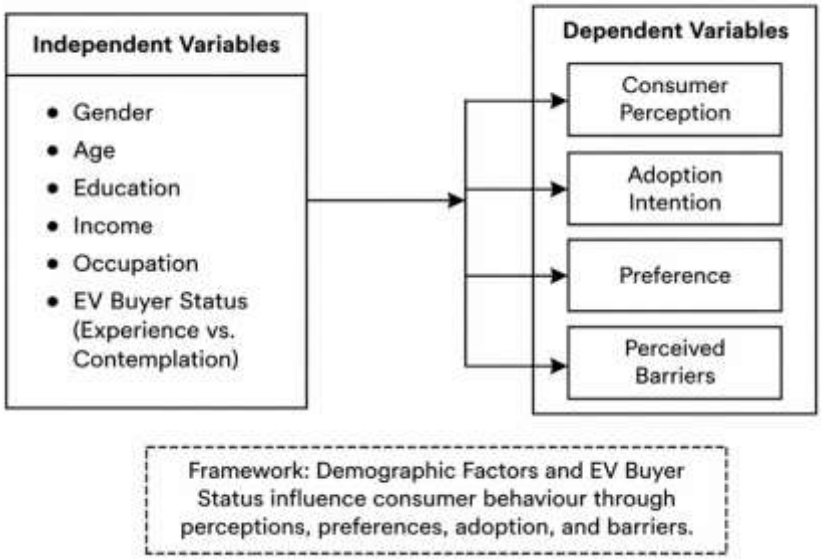
3.2 Conceptual Framework

The current paper constructs a conceptual framework that will help analyse consumer behaviour in relation to electric passenger cars in India by synthesising the demographic and behavioural approaches. The framework will be based on the well-known theoretical backgrounds like the Technology Acceptance Model (TAM) and the Value-Based Adoption Model (VAM) that place the emphasis on the role of cognitive evaluation and the perceived value in forming adoption decisions.

Demographic variables; that is, gender, age, education, income, and occupation as well as EV buyer (experience vs. contemplation) are considered as independent variables in this framework affecting consumer behaviour. It is believed that these factors make differences in four major dependent constructs which include consumer perception, adoption intention, preference and Perceived barriers.

Consumer perception is a measure of how people assess EV characteristics like environmental benefits, cost efficiency and technological development. Adoption is the intention or actual choice to buy EVs, and preference is a measure of how desirable EVs are in comparison to conventional cars. Financial, infrastructural, and performance related barriers have been perceived.

It is assumed that the framework is based on the premise that demographic traits and previous experience will influence the behavioural response by driving consumer interpretation of the benefits and risks related to EVs. Through experiential learning influences, it is notable that EV buyer status is likely to have a greater impact. Therefore, the model offers an organized foundation to examine group-based variations in consumer behaviour through ANOVA and GLM.



3.3 Data Collection and Sample

The research is grounded on primary data which is gathered by use of structured questionnaire that is given to the respondents in India. The questionnaire was formulated in a manner that it was able to capture an all-inclusive behavioural framework which included demographic factors and attitudinal reactions towards electric passenger cars. The total count of valid responses was 492 and was used to conduct the analysis, which was sufficient to perform a strong statistical analysis. The sampling method is a non-probability convenience sampling strategy because of the practical aspects of the need of accessibility and time. The target population will consist of current and potential car consumers that are conscious of electric passenger cars. As the sample includes pan-Indian coverage, the dataset represents a wide range of socio-economic and demographic backgrounds and, thus, increases the extraneous validity of the results.

3.4 Research Instrument

The study tool is a structured questionnaire that is subdivided into several parts that capture demographic variables and behavioural constructs that include perception, awareness and adoption factors, preference and perceived barriers. The measurement items were well constructed to suit the Indian context of the electric passenger-car so that there is content validity and clarity. Attitudinal statements were all measured on a five-point Likert scale of one strongly disagree to strongly agree, which made the subjective consumer evaluation measurable and made the statistical analysis of the parameters parametric.

3.5 Measurement of Variables

The research will use various behavioural constructs that will reflect consumer perception, awareness and adoption, preference, and perceived barriers to the purchase of electric passenger cars. All constructs are operationalized with several Likert-scale items and composite scores are calculated to denote the underlying dimension with mean values. These composite indices are used as dependent variables in the empirical analysis and demographic variables like gender, age, education, income, and occupation are categorical independent variables. This operationalization enables the systematic analysis of behavioural differences among the various consumer segments.

3.6 Reliability Analysis

Cronbach Alpha was used to guarantee internal consistency and reliability of the measurement scale. The reliability analysis determines the degree to which several items in each construct measure the same

concept. The acceptable limit was set to 0.70 and this result showed satisfactory internal consistency. This is necessary to test the measurement tool before the study applies any inferential statistics and so that the composite measures applied in the study are statistically sound.

3.7 Data Analysis Techniques

The data was summarized using descriptive statistics including frequency distributions, percentages, mean, and standard deviation to summarize the respondent characteristics and general patterns of responses. The analytical method that will be used in the study is the Univariate General Linear Model (GLM) which is operationalized by Analysis of Variance (ANOVA). GLM framework builds on traditional ANOVA as it permits the incorporation of numerous categorical variables and observes their effects on continuous dependent variables. In ANOVA, the test is used in the current study to determine whether there are statistically significant differences in consumer perception, awareness, preference, and perceived barriers among the various demographic segments.

3.8 Model and Hypothesis Testing

ANOVA model assesses how much the variance in behavioural constructs can be accounted by demographics by breaking down total variance into between-group and within-group variance. The main aim is to test the statistical significance of mean differences between groups. The first hypothesis is the null hypothesis where it is assumed that there are no significant differences between demographic categories and the second hypothesis is the alternative hypothesis where significant differences between demographic categories are assumed. The p-value of F-statistic is used to determine the decision rule, where the level of significance is 5 percent. A p-value below 0.05 will cause the null hypothesis to be rejected and is a sign of a significant difference in groups whereas a p-value above that will mean there is no significant difference between groups.

3.9 Assumptions of the Model

Univariate General Linear Model is applied on the basis of typical statistical assumptions such as normality of the dependent variable, equal variances of the groups, independence of observations and linearity of relationships where necessary. These assumptions make the inferential outcomes obtained through the analysis valid and strong and give a good statistical basis of interpreting group differences in consumer behaviour.

3.10 Hypotheses

H01: There is no significant difference in consumer perception towards electric passenger cars across demographic groups.

H1: The perception of consumers towards electric passenger cars differs significantly among the demographic groups.

H02: Demographic groups do not exhibit any significant difference in the consumer adoption of electric passenger cars.

H2: There is a significant difference in consumer adoption of electric passenger cars across demographic groups.

H03: Consumer preference to electric passenger cars among demographic groups does not differ significantly.

H3: There is a significant difference in consumer preference towards electric passenger cars across demographic groups.

H04: There is no significant difference in perceived barriers towards electric passenger cars across demographic groups.

H4: There is a significant difference in perceived barriers towards electric passenger cars across demographic groups.

4 Data Analysis and Results

4.1 Sample Profile

Table 1 shows the demographic aspect of the respondents. The respondents are 492 which is sufficient to do the statistical analysis. The gender balance shows that there are more male respondents (59.96) than females (40.04). The age group is comparatively evenly distributed with those falling within the age group of between 20 and above 60 years, thus making the respondents represent various generational perceptions.

Regarding educational level, most of the respondents are postgraduates (53.05%), then graduates (38.41%), which means that the sample is rather well-educated. Professionally, the sample is composed of mostly self-employed people (58.13%), and salaried people make up 41.87. The distribution of income is distributed evenly in three groups making the comparisons between groups very strong. Interestingly, there is a balance between actual and potential consumers, as 51.02 percent of the respondents already own electric vehicles, and 48.98 percent are strongly considering owning an electric vehicle already.

Table 1. Demographic Profile of Respondents (N = 492)

Variable	Category	Frequency	Percentage (%)
Gender	Female	197	40.04
	Male	295	59.96
Age (Years)	20–30	92	18.70
	30–40	104	21.14
	40–50	99	20.12
	50–60	103	20.93
	60+	94	19.11
Education	12th	42	8.54
	Graduate	189	38.41
	Post Graduate	261	53.05
Occupation	Salaried	206	41.87
	Self-Employed	286	58.13
Monthly Income	Less than ₹50,000	163	33.13
	₹1,00,000 – ₹2,00,000	166	33.74
	₹2,00,000 – ₹3,00,000	163	33.13
EV Buyer Status	Already Purchased	251	51.02
	Seriously Contemplating	241	48.98
Source: Author's own computation			

4.2 Descriptive Statistics and Normality Assessment

Table 2 provides the descriptive statistics of the most important constructs. Relatively high values are also observed in consumer perception (Mean = 4.173) and preference (Mean = 4.061) which reflects a relatively positive attitude towards electric passenger cars. Adoption intention (Mean = 3.893) is also a

moderately positive orientation, but perceived barriers (Mean = 3.156) are relatively low, which implies that there are challenges but these might not be so restraining.

All the values of skewness are negative, which implies that the distribution is a little skewed to the left, and the values of kurtosis are within the acceptable ranges. These findings affirm that the values are close to normal distribution, which meets the conditions of the parametric statistical analysis.

Table 2. Descriptive Statistics of Constructs

Variable	Mean	SD	Min	Max	Skewness	Kurtosis
Perception	4.173	0.665	2	5	-0.73	2.89
Adoption	3.893	0.745	1.6	5	-0.532	2.653
Preference	4.061	0.676	1.9	5	-0.601	2.71
Barriers	3.156	0.708	1.2	4.9	-0.121	2.7
Source: Author's own						

4.3 Reliability Analysis

Cronbach Alpha was used to measure the internal consistency of the measuring scale. Table 2 indicates that all constructs are highly reliable with values of above the recommended 0.70 level. Particularly, the scores of perception (alpha = 0.916), adoption (alpha = 0.916), preference (alpha = 0.903) and barriers (alpha = 0.881) represent high internal consistency.

These findings indicate that the measurement items are reliable to measure the underlying constructs and thus confirm their appropriateness in the further inferential analysis.

Table 3. Reliability

Construct	Alpha
Perception	0.916
Adoption	0.916
Preference	0.903
Barriers	0.881
Source: Author's own	

4.4 ANOVA Results: Group-wise Differences

ANOVA was used in order to test the hypothesis that there are significant differences between various demographic groups. Table 3 summarizes the results.

Perception: The result of the analysis shows that there is no significant difference between the perception of consumers with regard to electric passenger cars based on demographic factors, including gender, age, education, occupation, and income ($p > 0.05$). But EV buyer status has a very strong effect ($F = 204.964$, $p = 0.01$) and an enormous effect size (0.295). This means that those who have already used EVs are very different than those that are only considering adopting EVs.

Adoption: Like perception, there are no significant differences in adoption intention between most of the demographic variables. Nevertheless, the status of EV buyers once again is subject to a strong and statistically relevant influence ($F = 284.630$, $p < 0.01$; $\eta 2 = 0.367$), which means that previous experience with EVs is a vital factor in determining the adoption behavior.

Preference: Unlike perception and adoption, age has a statistically significant impact on consumer preference ($F = 3.348$, $p < 0.05$), which shows that there is a difference in EV preference between generations. Additionally, EV buyer status continues to exert a strong influence ($F = 171.323$, $p < 0.01$; $\eta^2 = 0.259$). The other demographic factors are not important.

Barriers: The analysis shows that none of the demographic variables including EV buyer status can significantly affect perceived barriers ($p > 0.05$). This implies that there are fairly similar perceived barriers to EV adoption among various demographic groups.

In general, the results of the ANOVA indicate that the buyer status of EVs is the most predictable and significant factor, and traditional demographic factors show low explanatory capacities.

Table 4. ANOVA Results for Differences in Consumer Behaviour across Demographic Factors

Dependent Variable	Factor	F-value	p-value	Effect Size (η^2)	Decision
Perception	Gender	1.217	0.271	0.002	Not Significant
	Age	0.273	0.895	0.002	Not Significant
	Education	0.435	0.648	0.002	Not Significant
	Occupation	0.606	0.437	0.001	Not Significant
	Income	0.262	0.770	0.001	Not Significant
	EV Buyer Status	204.964	0.000***	0.295	Significant
Adoption	Gender	0.126	0.722	0.000	Not Significant
	Age	2.210	0.067	0.018	Not Significant
	Education	0.421	0.657	0.002	Not Significant
	Occupation	2.231	0.136	0.005	Not Significant
	Income	0.310	0.734	0.001	Not Significant
	EV Buyer Status	284.630	0.000***	0.367	Significant
Preference	Gender	0.974	0.324	0.002	Not Significant
	Age	3.348	0.010**	0.027	Significant
	Education	0.833	0.435	0.003	Not Significant
	Occupation	2.382	0.123	0.005	Not Significant
	Income	0.922	0.399	0.004	Not Significant
	EV Buyer Status	171.323	0.000***	0.259	Significant
Barriers	Gender	0.137	0.712	0.000	Not Significant
	Age	0.616	0.652	0.005	Not Significant
	Education	0.334	0.717	0.001	Not Significant
	Occupation	1.275	0.259	0.003	Not Significant
	Income	0.188	0.829	0.001	Not Significant
	EV Buyer Status	0.220	0.640	0.000	Not Significant

Source: Author's own computation

Note: ***p < 0.01, **p < 0.05

4.5 General Linear Model (GLM) Results

In order to further analyze the effects of the demographic variables, a General Linear Model (GLM) was used.

Perception Model: The findings have shown that EV buyer status (= -0.731, p < 0.01) is a very important factor in perception, whereas all other demographic factors are negligible. The model accounts 30.5% of the variance (R 2 = 0.305) indicating moderate explanatory power.

Table 5. General Linear Model (GLM) Results for Consumer Perception towards Electric Passenger Cars

Variable	Estimate (β)	Std. Error	t-value	p-value
Intercept	4.486	0.125	35.769	0.000***
Gender (Male)	0.077	0.052	1.464	0.144
Age (30–40)	0.027	0.081	0.331	0.741
Age (40–50)	0.088	0.082	1.068	0.286
Age (50–60)	0.002	0.081	0.019	0.985
Age (60+)	-0.012	0.084	-0.145	0.885
Education (Graduate)	0.032	0.097	0.333	0.739
Education (Post Graduate)	0.036	0.094	0.382	0.702
Income (₹2L–₹3L)	-0.043	0.062	-0.686	0.493
Income (< ₹50,000)	0.006	0.063	0.097	0.923
Occupation (Self-Employed)	-0.070	0.052	-1.352	0.177
EV Buyer Status (Contemplating)	-0.731	0.051	-14.290	0.000***
Model Summary				
Statistic	**Value**			
R^2	0.305			
Adjusted R^2	0.289			

Source: Author's own computation
Note: ***p < 0.01

Adoption Model: In line with the ANOVA results, EV buyer (= -0.895, p = 0.01) is the only significant predictor. Explanatory power (R 2 = 0.379), which is shown by the model, indicates that the prior experience has a strong influence on the adoption behavior.

Table 6. General Linear Model (GLM) Results for Consumer Adoption of Electric Passenger Cars

Variable	Estimate (β)	Std. Error	t-value	p-value
Intercept	4.318	0.133	32.548	0.000***
Gender (Male)	-0.002	0.055	-0.030	0.976
Age (30–40)	-0.008	0.086	-0.089	0.929
Age (40–50)	0.033	0.087	0.384	0.701
Age (50–60)	-0.035	0.086	-0.406	0.685
Age (60+)	0.129	0.089	1.450	0.148
Education (Graduate)	0.012	0.102	0.120	0.904

Education (Post Graduate)	-0.086	0.099	-0.864	0.388
Income (₹2L–₹3L)	0.001	0.066	0.017	0.986
Income (< ₹50,000)	-0.031	0.066	-0.462	0.645
Occupation (Self-Employed)	0.074	0.055	1.346	0.179
EV Buyer Status (Contemplating)	-0.895	0.054	-16.544	0.000***
Model Summary				
Statistic	**Value**			
R^2	0.379			
Adjusted R^2	0.365			
Source: Author's own computation **Note:** ***p < 0.01				

Preference Model: EV buyer status (= -0.684, p = 0.01) has a statistically significant negative influence, but income (= 2L-3L) has a statistically significant negative effect (= -0.130, p = 0.05) as well, indicating that higher income groups may have slightly less preference toward EVs. The model describes 29% of the variance.

Table 7. General Linear Model (GLM) Results for Consumer Preference towards Electric Passenger Cars

Variable	**Estimate (β)**	**Std. Error**	**t-value**	**p-value**
Intercept	4.339	0.129	33.693	0.000***
Gender (Male)	0.054	0.054	1.014	0.311
Age (30–40)	-0.122	0.084	-1.461	0.145
Age (40–50)	-0.018	0.084	-0.218	0.828
Age (50–60)	0.154	0.083	1.850	0.065
Age (60+)	-0.009	0.087	-0.108	0.914
Education (Graduate)	0.013	0.099	0.133	0.895
Education (Post Graduate)	0.072	0.096	0.744	0.457
Income (₹2L–₹3L)	-0.130	0.064	-2.025	0.043**
Income (< ₹50,000)	-0.067	0.064	-1.034	0.302
Occupation (Self-Employed)	0.079	0.053	1.475	0.141
EV Buyer Status (Contemplating)	-0.684	0.053	-13.011	0.000***
Model Summary				
Statistic	**Value**			
R^2	0.290			
Adjusted R^2	0.274			
Source: Author's own computation **Note:** ***p < 0.01				

Barriers Model: GLM results show that the demographic variables do not have a significant impact on perceived barriers. The model has a very low explanatory power (R 2 = 0.011) which supports the idea

that the barriers are widely-held similar perceptions among consumer segments.

Table 8. General Linear Model (GLM) Results for Perceived Barriers towards Electric Passenger Cars

Variable	Estimate (β)	Std. Error	t-value	p-value
Intercept	3.357	0.159	21.097	0.000***
Gender (Male)	-0.041	0.066	-0.613	0.540
Age (30–40)	-0.118	0.103	-1.145	0.253
Age (40–50)	-0.138	0.104	-1.326	0.186
Age (50–60)	-0.033	0.103	-0.322	0.748
Age (60+)	-0.081	0.107	-0.756	0.450
Education (Graduate)	-0.117	0.123	-0.956	0.340
Education (Post Graduate)	-0.086	0.119	-0.724	0.469
Income (₹2L–₹3L)	0.014	0.079	0.175	0.861
Income (< ₹50,000)	0.053	0.080	0.671	0.503
Occupation (Self-Employed)	-0.080	0.066	-1.213	0.226
EV Buyer Status (Contemplating)	0.028	0.065	0.428	0.669
Model Summary				
Statistic	**Value**			
R^2	0.011			
Adjusted R^2	-0.011			

Source: Author's own computation
Note: ***p < 0.01

5 Discussion

The present study provides important insights into consumer behavior toward electric passenger cars by examining perception, adoption, preference, and perceived barriers across demographic groups. The findings contribute to the growing literature on EV adoption by challenging several conventional assumptions regarding the role of demographic factors and highlighting the dominance of behavioral segmentation.

A key finding of this study is that EV buyer status consistently emerges as the most significant determinant across perception, adoption, and preference. This result indicates that prior experience and exposure to electric vehicles play a crucial role in shaping consumer attitudes. Individuals who have already adopted EVs demonstrate significantly more favorable perceptions and stronger adoption tendencies compared to those who are merely contemplating adoption. This finding aligns with the diffusion of innovation perspective, which posits that direct experience with an innovation reduces uncertainty and enhances perceived benefits. It also supports the argument by Jaiswal et al. (2022) that knowledge and familiarity significantly influence consumer beliefs and behavioral intentions in emerging technology contexts.

Interestingly, the results reveal that traditional demographic variables—such as gender, education, occupation, and income—do not significantly influence perception or adoption behavior. This finding challenges a large body of prior research that has emphasized demographic segmentation as a primary determinant of consumer behavior (Egbue & Long, 2012). Instead, the present study suggests that EV

adoption is less dependent on socio-demographic characteristics and more influenced by psychological and experiential factors. This observation is consistent with recent literature arguing that high-involvement and sustainability-driven consumption decisions are shaped more by cognitive evaluations and value perceptions than by demographic attributes.

However, the analysis identifies a significant effect of age on consumer preference, indicating that generational differences still play a role in shaping attitudes toward EVs. Younger and middle-aged consumers appear to exhibit relatively stronger preferences for electric vehicles, possibly due to greater openness to technological innovation and environmental consciousness. This finding is in line with previous studies that suggest age influences technology adoption through differences in risk perception, innovativeness, and environmental awareness (Schuitema et al., 2013). Nevertheless, the limited overall impact of demographic variables suggests that such effects are context-specific rather than universally applicable.

Another important finding relates to perceived barriers, which are found to be statistically insignificant across all demographic groups. This indicates that barriers such as cost, infrastructure limitations, and technological uncertainty are perceived uniformly across consumers. This result reinforces the argument that EV adoption challenges are largely systemic rather than segment-specific. It corroborates the findings of Bhattacharyya and Thakre (2021), who emphasize that infrastructural constraints—particularly charging availability—represent structural issues affecting the entire market rather than specific consumer segments.

The GLM results further strengthen these insights by demonstrating that EV buyer status remains the only consistently significant predictor across models, while most demographic variables fail to achieve statistical significance. The relatively higher explanatory power of the adoption model compared to perception and preference suggests that actual behavioral outcomes are more strongly influenced by experiential factors than by static characteristics. This finding aligns with the value-based adoption perspective, which posits that consumer decisions are driven by perceived value derived from experience rather than demographic identity (Kim et al., 2007; Vishwakarma, 2024).

Collectively, these findings indicate a shift from traditional segmentation approaches toward a more behavioral and experience-driven understanding of consumer adoption. The dominance of EV buyer status highlights the importance of trialability and experiential learning in reducing uncertainty and enhancing adoption. This supports the growing consensus in innovation and sustainability literature that direct interaction with a product significantly influences consumer acceptance.

From a theoretical standpoint, the study extends existing frameworks such as TAM and VAM by demonstrating that experience acts as a critical moderator in shaping perception and adoption behavior. While TAM emphasizes cognitive beliefs and VAM focuses on cost-benefit evaluation, the present findings suggest that these processes are significantly strengthened through prior usage and familiarity.

In summary, the study contributes to the EV adoption literature by highlighting three key insights: (1) behavioral segmentation based on experience is more influential than demographic segmentation, (2) demographic variables have limited explanatory power in high-involvement green consumption contexts, and (3) perceived barriers are universally recognized and require systemic rather than segment-specific interventions. These findings provide a more nuanced understanding of consumer heterogeneity and offer a strong foundation for both theoretical advancement and practical strategy formulation.

6 Conclusion

This study examined consumer perception, adoption, preference, and perceived barriers toward electric passenger cars in India using a group-based analytical approach. Moving beyond dominant structural modeling traditions, the study employed ANOVA and GLM to capture behavioral variations across demographic segments.

The findings reveal that EV buyer status (i.e., prior adoption vs. contemplation) is the most consistent and influential determinant across perception, adoption, and preference. In contrast, traditional demographic variables exhibit limited explanatory power, with the exception of age influencing preference. Furthermore, perceived barriers are largely uniform across demographic groups, indicating that adoption constraints are systemic rather than segment-specific.

These results suggest that EV adoption is better explained through experience-driven and cognitive-behavioral mechanisms rather than static demographic characteristics. The evidence underscores the centrality of exposure, familiarity, and learning effects in shaping consumer attitudes and intentions toward emerging green technologies.

Overall, the study contributes to the literature by (i) demonstrating the superiority of behavioral segmentation over demographic segmentation, (ii) integrating perception, preference, and barriers within a unified empirical framework, and (iii) providing robust evidence using ANOVA/GLM-based group comparisons in the Indian EV context.

7 Managerial and Policy Implications

The results indicate that experience is a key factor in EV adoption, not demographic factors, which means that behavioral segmentation is essential. Experience marketing, like test drives and awareness campaigns, should be emphasised by the managers to increase consumer familiarity. At the same time, policy makers should work to enhance charging infrastructure and minimize systemic uncertainties instead of using financial incentives only. Homogenized view of barriers signifies that ecosystem-wide measures are necessary such as standardization, accessibility, and information transparency. The partnership between industry and government will help enhance the adoption of EVs faster since these two factors are psychological and structural factors in the market.

8 Limitations of the Study

This study is subject to certain limitations. To begin with, the convenience sampling is not probability, restricting the extent to which the results can be generalized. Second, the cross-sectional design does not allow capturing consumer behavior changes over time. Third, the research concentrates on electric passenger vehicles and, thus, does not include other types of EVs, including two-wheelers. Fourth, there can be a response bias due to the use of self-reported data. Lastly, the analysis is also confined to demographic measures and fails to include deeper psychological or attitudinal measures that can further elucidate consumer behavior.

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