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An Analysis of User Preferences of Value Attributes of Electric Vehicles in Underserved Communities

Eyitayo Olaleye[1,*], Jacob Oluwoye[1], Deden Rukmana[1], Joyce Pressley[1], Aschalew Kassu[2]

[1]Department of Community and Regional Planning, Alabama A&M University, Normal, AL 35762, USA
[2]Department of Civil Engineering, Alabama A&M University, Normal, AL 35762, USA
[*]Corresponding Author: eolaleye@bulldogs.aamu.edu

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Abstract One of the creative innovations of the twenty-first century is the electric vehicle (EV). Unlike mainstream internal combustion cars, EVs do not rely on fossil fuel products (especially gasoline) to function. EVs are thus environmentally viable, bolstering the sustainability efforts of governments and institutions. However, the diffusion rate of EVs has been slow, notably in the United States. This study is therefore aimed at examining the role of value attributes of EVs in determining their embrace among residents of two underserved communities in the U.S. In the context of a survey design, a questionnaire was administered to obtain perceptions of the respondents, and data were analyzed using frequency counts, rank index, descriptive statistics as well as t-test technique. Findings reveal that safety, comfort, purchase price, and charging stations are areas of concern on the priority value attributes that the respondents expect a given EV to possess. We, therefore, conclude that car manufacturers, transportation planners, and metropolitan authorities should consider these attributes in their quest to make EVs popular among the general population.

Keywords Electric Vehicles, Value Attributes, Rank in Order, United States

1. Introduction

The current order in the transportation industry points out that the world is switching from conventional, internal combustion vehicles to electric vehicles (EVs). In 2020, the global stock of EVs hit a record 10 million, up from about 7 million in 2019 [1]. However, the upward trend in the adoption of EVs is not distributed evenly across countries. China, with more than 4.5 million EVs, has the largest share in the global market for EVs, followed by Europe which currently has about 3.3 million EVs on its roads [1]. It is somewhat puzzling that the United States, which is famously known as a global producer and consumer of innovative products, is a laggard in the diffusion of EVs. In 2020, registrations of EVs across the U.S. totaled about 250,000, down from a peak of 290,000 in 2018. Similarly, annual sales of EVs were 306,000 in 2020, down from more than 320,000 in 2018 [2]. Although the COVID-19 pandemic was blamed for downturns in the turnover of EVs, the U.S. shares only 2.4% of the global market for EVs indicating slow diffusion of EVs among Americans [2]. This study is therefore motivated to explore the value attributes of EVs as they conform to or differ from the automobile preferences of Americans.

According to [3], a major factor driving consumer preferences for EVs is the expected benefits of switching from normal petrol cars. The preferences are defined by evaluating the attributes of EVs. If the attributes conform to the preferences, then EVs will become popular in the users' consumption bundles. Consequently, there is less patronage for EVs if otherwise [3]. A list of such attributes in the existing literature majorly includes the purchase price, charging requirements, eco-friendliness, safety

measures, and operating costs. While previous researchers (such as [4-6]), were interested in the unpopular status of EVs in major U.S. cities such as California, New York and Texas, the present study is poised to focus on underserved communities. Meadow Hills and Edmonton Heights in Huntsville, Alabama are therefore selected as the study area because these communities are known to be underprivileged in social infrastructure. In particular, the perceptions of residents of these communities regarding their exposure to EVs were collected and analyzed in this study. This work is an expansion of previous studies earlier conducted in the Edmonton Heights neighborhood alone by [7,8]. This new work enhances the previous studies and incorporates another underserved community – Meadow Hills.

This paper proceeds as follows. Section 2 reviews the related literature and the theoretical framework as discussed in Section 3. Section 4 presents the methodology used in data collection and analysis. Section 5 contains the results and a discussion of the findings. Finally, Section 6 concludes, noting the policy implications and limitations of the study.

2. Literature Review

In a national survey conducted in the U.S., [9] analyzed the preferences of 3029 respondents towards EVs compared to conventional vehicles. The researchers obtained that the cost of purchase, driving range, fuel efficiency, and charging time were the primary determinants of people's willingness to pay for EVs. In particular, individuals were willing to pay incrementally as EVs travel long distances and as charging time reduces. They also expected the fuel-saving property of EVs to last at least 5 years.

Guided by a similar orientation, [10] described the technical characteristics of battery electric vehicles relative to internal combustion vehicles that rely on gasoline. It was noted that EVs are generally simpler to design and more environmentally compliant than normal vehicles. Except for the battery, the complexity of energy conversion in an EV is very limited, enhancing the manufacturers' propensities to design vehicles that could bolster their environmental performance. Helmers and Marx, therefore, submitted that apart from the high cost of initial purchase, EVs are creative innovations capable of replacing petrol vehicles. In addition, after conducting an online survey of potential consumers in the UK, [11] were interested in modeling instrumental, hedonic, and symbolic factors as determinants of preferences of UK residents to adopt EVs. The authors submitted that pleasure and the related identity gained from driving EVs to play on the perceptions of individuals to owning and using EVs.

In another context, [12] estimated the Indians' willingness to pay for EVs. Early in the research, [12] suspected that the preferences of Indians for EVs were dependent on their existing experiences with conventional vehicles. They, therefore, estimated a hybrid reference-dependent choice modeling technique rather than a standard utility maximization principle. Their results suggested that Indians were willing to pay additional 10-34 US dollars to reduce charging time, 7-40 dollars for an extra kilometer on the driving range, and 104-692 dollars to reduce the maintenance costs of EVs. From another perspective, [13] analyzed the load characteristics of three versions of EVs: electric taxis, electric buses and electric salons. Price, temperature, and user habits were the lead factors identified by [13] to influence the peak and off-peak loads of given EVs. The charging time is also important to affect the users' decision to load especially the salon EVs meant for household consumption.

[14] were worried that, despite the promising features of EVs towards sustainable urban development, their adoption has been progressing slowly. They, therefore, carried out a systematic review of 49 articles that have researched the determinants of the adoption of EVs. Their findings pointed out that the manufacturers of EVs should pay closer attention to the technical design and battery life of EVs. In addition, there should be a proliferation of charging stations for EVs, as limited access to these stations has been contributing to unimpressive patronage for EVs among the general population.

The world leaders are currently charged to find solutions to global warming and the consequential climate change. [15] therefore called on global powers and international institutions to popularize the use of EVs as a way of checkmating carbon emissions. In their comprehensive review, Liao et al. concluded that the value attributes of EVs determine their utility and thus preferences of consumers regarding them. In addition, the government has a role to play in making EVs attractive to the populace. This can be achieved through tax-reducing or subsidy-inducing arrangements. In a similar vein, [16] blamed carbon emission in the transport sector majorly on the exhausts of conventional vehicles. They therefore equally called for the promotion of the use of EVs as a sustainable alternative to petrol cars. However, general awareness of EVs is currently low and the high cost of purchase has made them more popular in advanced countries than in developing nations. On the expected characteristics of a given EV, driving range, charging time, safety features, eco-friendliness and purchase price are primary attributes identified by [16] to determine consumers' preferences for EVs.

In essence, EVs have come to stay, but they are not yet popular among the majority of the world's population. When compared with the diffusion rate in the early 20th century of modern vehicles that use internal combustion engines, the awareness rate of EVs is unimpressive not to talk of their continuous usage to replace petrol cars. Even the little awareness is not evenly distributed across countries. The advanced countries have leapfrogged the developing ones in the popularity of EVs on their roads and

streets. Major factors that have contributed to the low diffusion of EVs include high purchase price [9,10], limitations of travel distance [12,13], insufficient charging stations [9,12], inadequate government incentives [3,14], and conservative orientation [11,15].

3. Theoretical Framework

Developed in the 1980s, the theory of planned behavior (TPB) proposes that most human behaviors are premeditated, not just occurring randomly [16]. According to [17], the TPB upholds the tenet that the individual exhibits a given behavior out of two main concerns: intention and control. Once the individual intends a behavior and has control over it, they will go ahead to do it, regardless of the consequences. That is, the intention is at the center of decision-making [18].

Related to the adoption of EVs, the TPB can dissect the behavioral patterns of consumers. A car user has a high likelihood to purchase an EV if they have the intention and control to do so. The intention is a function of personal beliefs and attitudes as well as subjective norms within the social class that which the individual belongs. Control is the ability to execute an action independently with no interference from someone else.

Taking this theoretical route, [19] analyzed the consumers' preferences for EVs from the lens of the TPB. They noted that a consumer's choice of EVs is influenced by their interest and control in the purchase of EVs. According to [19], both elements should be strong enough to pull EVs towards consumers. More specifically, the consumer's intention is related to the personal gratification that may ensue from driving an EV. And their control is associated with their purchasing power. While the findings of [18] echoed those of [19], the former extended the determinants of consumers' intention to include the consciousness of the environmental impact of conventional vehicles that use internal combustion engines.

Still on theoretical footprint, [20] applied the innovation diffusion theory in the global market for EVs. Of the five stages of innovation diffusion (awareness, interest, preference, usage, and continuation), [20] likened EVs to still being in the awareness stage in many developing countries while they are already in the preference stage in most advanced countries. This suggests that developing countries are laggards while developed societies are early adopters. While it may be tempting to suggest that the diffusion of EVs in advanced countries is on a higher step on the ladder because most EVs are manufactured there, the argument is not entirely correct as car manufacturers in China, a developing country, has comparable levels of EV production to their American and European counterparts.

According to [14], the expectations of consumers with regard to the value attributes of EVs determine their preferences for such vehicles. This projects the importance of TPB in this study. The expectations indicate the planned behaviour in that a preference for a certain EV is revealed only if the EV conforms to the expectations. In another vein, consumers represent their expectations via the value attributes of EVs, implying that their behaviour towards EVs is not spontaneous. Rather, regardless of individual socio-economic status, consumers have preferences for EVs long before they actually buy and use them. This causes EVs to face the desired demand. [21,22] have argued the relevance of TPB to make sense of desired consumption.

4. Methodology

This study adopted the survey approach to elicit respondents' views on their preferences for EVs. A questionnaire was designed to capture these perceptions. Using a stratified sampling technique, a total of 50 copies of the questionnaire were administered each in two underserved communities of Edmonton Heights and Meadow Hills. This was after a pilot study had been carried out among residents of Edmonton Heights only – the validity and reliability of the questionnaires were high. Only 71 questionnaires were correctly filled and deemed fit to have valid results – 42 for Edmonton Heights and 29 for Meadow Hills, thereby showing a questionnaire completion rate of 84% and 58% respectively for the two communities.

Having analyzed the demographic characteristics of the respondents using frequency counts, a priority index was conducted to rank the perceived attributes of EVs as preferred by the respondents. The index was constructed using the following formula:

$$PI = \sum aX * 100 \Big/ 5 \, , X = n / N$$

where PI is the priority index, a is the constant expressing the weight given to each response. Since value attributes have binary responses on the questionnaire, the weight a is 1 for all attributes that were ticked (preferred) by the respondents. n is the frequency of responses and N is the total number of responses. Based on this developed metric, the attributes were thereafter ranked in order of value. Following this, the mean responses of the participants were obtained. Finally, a t-test analysis of the opinions was conducted both for the grouped data and individual responses in each neighborhood.

5. Results

5.1. Demographic Characteristics of Respondents

This section explains the analysis of the demographic variables of the respondents. These variables include gender, age, marital status, educational qualification and

income range.

5.1.1. Gender of Respondents

Table 1 shows that the majority of the respondents (66%) were female, 31% were male and 3% did not fill their gender on the questionnaire. It follows that the succeeding analysis will predominantly feature the opinions of females in this study. This happened randomly as the researcher did not deliberately choose more females than males to participate in the study.

Figure 1 shows the gender distribution of the respondents at a disaggregated level. Male respondents were more in Edmonton Heights (14) than in Meadow Hills (8). Similarly, female respondents were more in EH (27) than in MH (20). Only one respondent did not out- fill the questionnaire in each neighborhood.

5.1.2. Age of Respondents

As Table 2 indicates, more than one-third (33.8%) of the respondents were at least 61 years old. This is the modal age group, followed by youths in the age bracket 36-44 years, who were 19.7% of total respondents. Participants aged 27-35 years were about 15.5%. The elderly in the age group 54-60 years were 14.1%. The study represented only 1 person in the age range of 45-53 years. Young people in the age group18-26 years were 12.7%. Despite the assurance of confidentiality of their data, 2 respondents chose not to reveal their age.

Figure 2 presents the age distribution of the respondents in the two neighborhoods. It is evident that elderly people that are 60+ years are more in EH (21) than in MH (3). This is true also for respondents in the age group 54-60 years, 27-35 years, and 18-26 years. However, youths that are 36-44 years old are more represented in MH (13) compared to only 1 in EH. The only 1 respondent whose age falls in the bracket 45-53 years is from MH.

Table 1. Gender of respondents

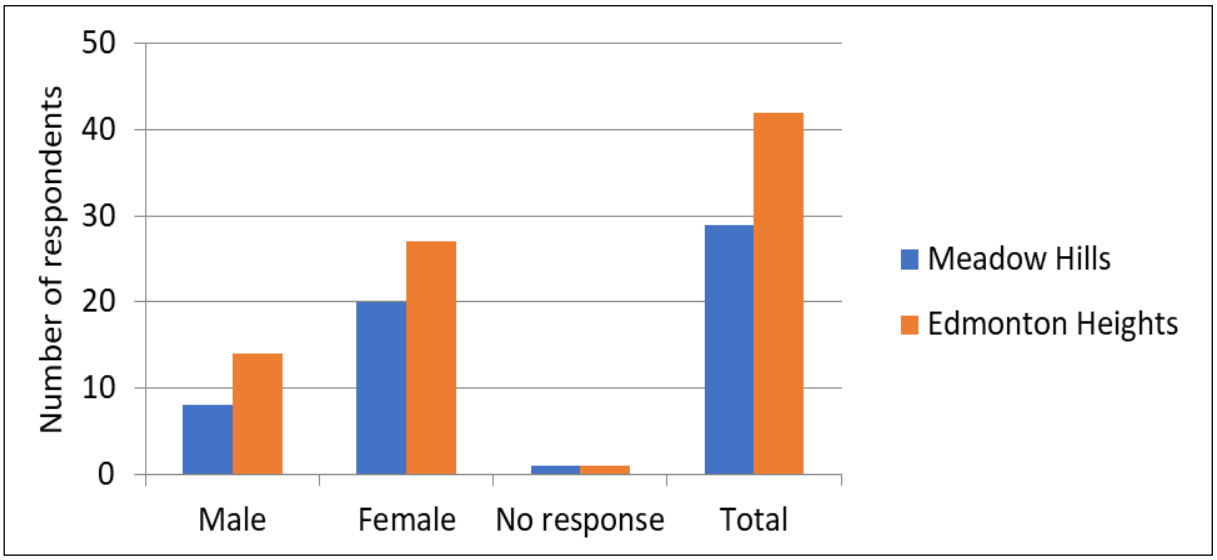
	Frequency	Percentage (%)	Cumulative Percentage (%)
Male	22	31	31
Female	47	66	97
No response	2	3	100
Total	71	100	

Source: Authors' computation

Table 2. Age of respondents

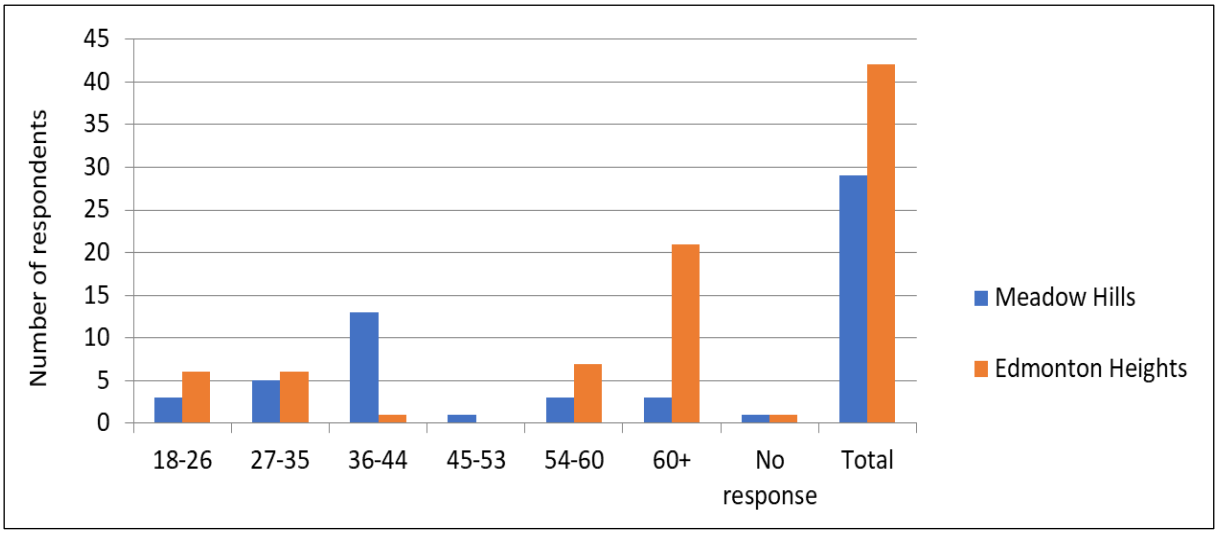
	Frequency	Percentage (%)	Cumulative Percentage (%)
18-26 years	9	12.7	12.7
27-35 years	11	15.5	28.2
36-44 years	14	19.7	47.9
45-53 years	1	1.4	49.3
54-60 years	10	14.1	63.4
60+ years	24	33.8	97.2
No response	2	2.8	100
Total	71	100	

Source: Authors' computation



Source: Authors' computation

Figure 1. Gender of respondents in each neighborhood



Source: Authors' computation

Figure 2. Age of respondents in each neighborhood

5.1.3. Marital Status of Respondents

Table 3 presents the marital status of the respondents. 30 or 42.2% claimed that they were single while 37 or 52.2% filled that they were not single. *Not single*, in the context of this study, means that the respondent was married or has a partner as of the period of administering the research instrument. Nonetheless, 4 respondents (5.6%) declined to supply information on their marital status.

When looked at across the neighborhoods, the marital status of the respondents showed that the number of single and not-single people is approximately the same in MH. But the number of not-single people is higher than single people in EH. 2 respondents did not reveal their marital status in each neighborhood. Figure 3 contains this result.

5.1.4. Education Qualification of Respondents

All the respondents have a formal education – reflecting the high literacy rate of the United States. But there are differentials in the levels of their educational qualifications. While the majority (67.7%) completed College, 23.9% stopped at high school. A minority (5.6%) did not have more than primary education, and only 2.8% did not reveal their educational attainment. Table 4 summarizes this.

Figure 4 reveals that respondents at EH are relatively more educated than those at MH. 27 of them are college graduates at EH against 21at MH. Also, 11 are high school leavers at EH compared to 6 at MH. Finally, 3 respondents are primary school certificate holders at EH relative to only 1 in MH. Only 1 respondent did not reveal their educational qualification in both neighborhoods.

Table 3. Marital status of respondents

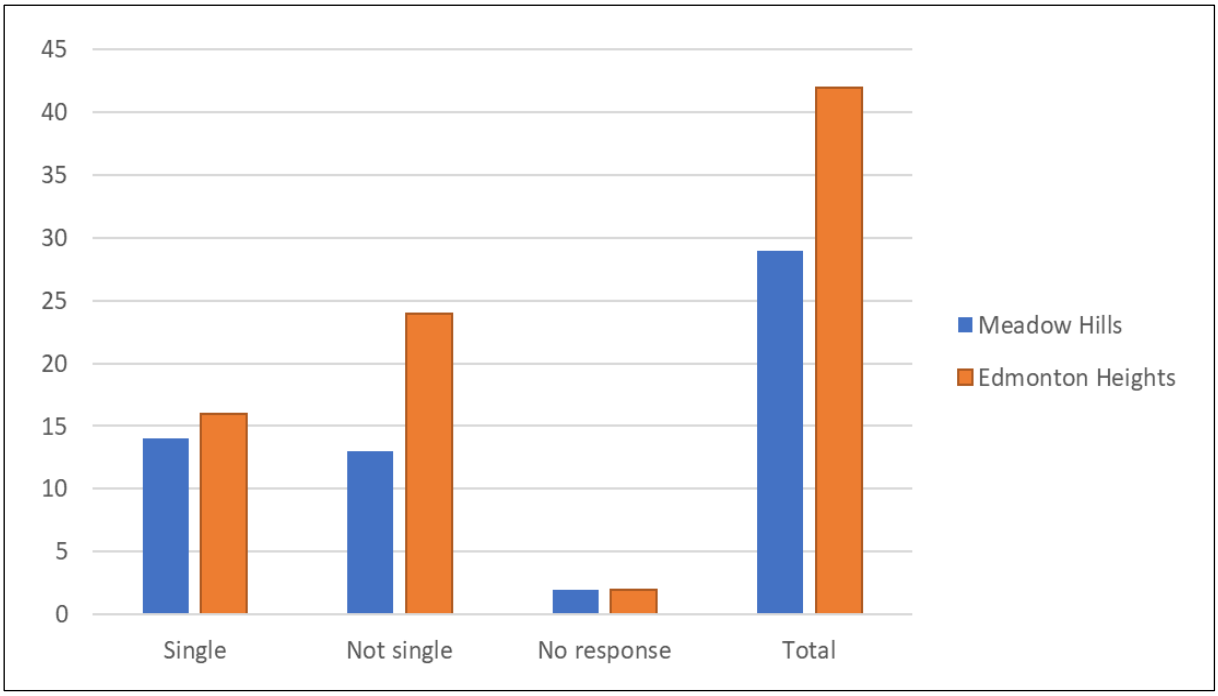
	Frequency	Percentage (%)	Cumulative Percentage (%)
Single	30	42.2	42.2
Not single	37	52.2	94.4
No response	4	5.6	100
Total	71	100	

Source: Authors' computation

Table 4. Education qualification of respondents

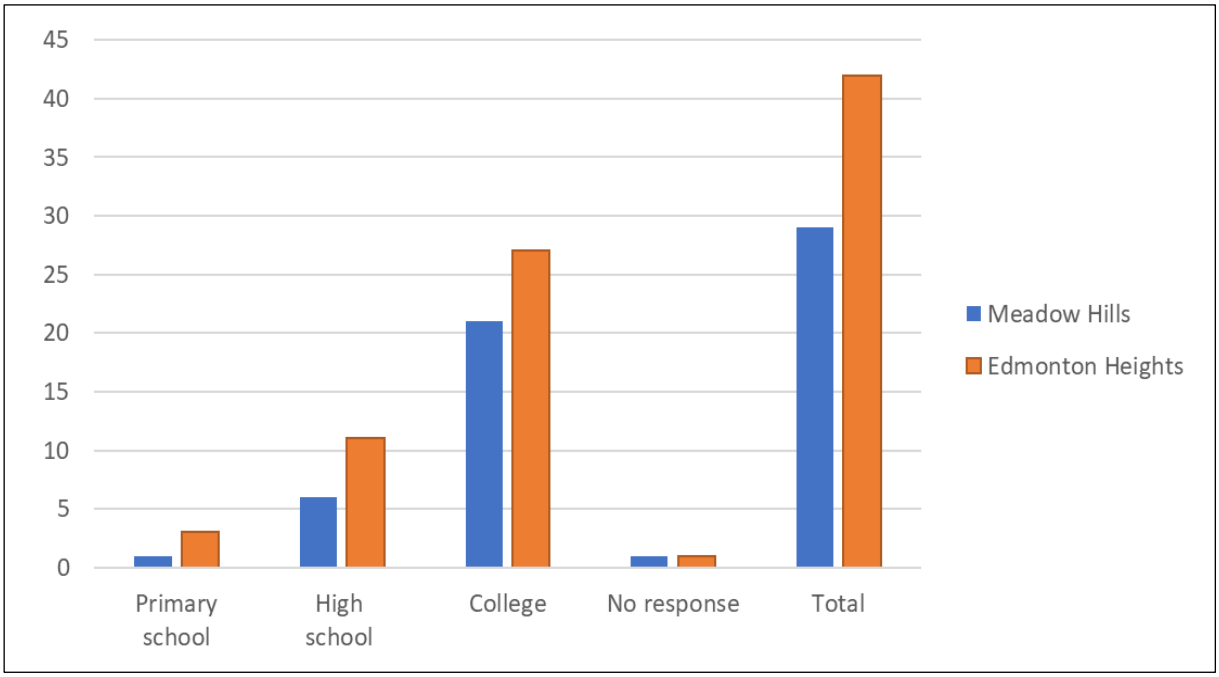
	Frequency	Percentage (%)	Cumulative Percentage (%)
Primary school	4	5.6	5.6
High school	17	23.9	29.5
College	48	67.7	97.2
No response	2	2.8	100
Total	71	100	

Source: Authors' computation



Source: Authors' computation

Figure 3. Marital status of respondents in each neighborhood



Source: Authors' computation

Figure 4. Education qualification of respondents in each neighborhood

Table 5. Annual income of respondents

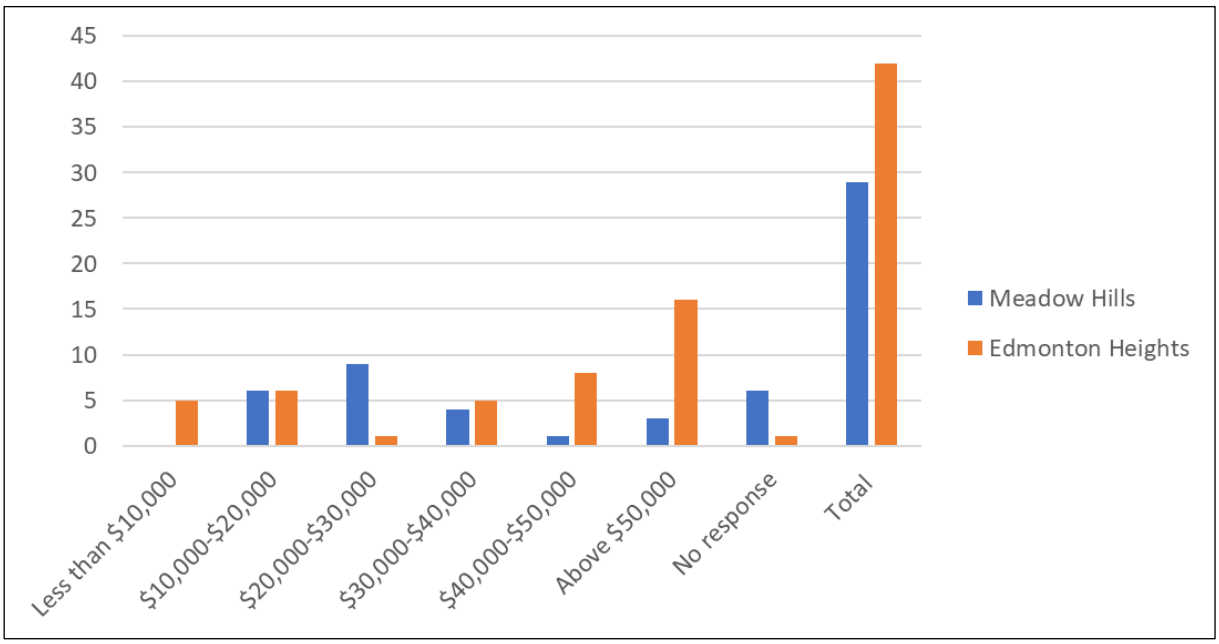
	Frequency	Percentage (%)	Cumulative Percentage (%)
Less than $10,000	5	7.0	7.0
$10,000-$20,000	12	16.9	23.9
$20,000-$30,000	10	14.0	37.9
$30,000-$40,000	9	12.7	50.6
$40,000-$50,000	9	12.7	63.3
Above $50,000	19	26.8	90.1
No response	7	9.9	100
Total	71	100	

Source: Authors' computation

Table 6. Ranking of value attributes by the two underserved communities.

Attribute	Edmonton Heights		Meadow Hills	
	Value	Rank	Value	Rank
Safety	54.29	1	57.93	1
Comfort	47.14	4	51.73	3
Exterior Design	10.48	8	13.79	6
Interior Design	10	9	-27.14	11
Eco-friendliness	6.19	10	-24.14	11
Price	51.43	3	55.86	2
Distance	-5.24	11	14.48	5
Economy	14.29	5	-13.79	10
Resale Value	-9.05	12	13.1	7
Charging	52.86	2	-4.13	8
Space	11.43	7	-6.9	9
Accident	13.33	6	47.59	4

Source: Authors' computation



Source: Authors' computation

Figure 5. Annual income of respondents in each neighborhood

5.1.5. Income of Respondents

As presented in Table 5, respondents demonstrate large differences in their annual income levels. Some 26.8% of respondents earn above $50,000 per annum. This is followed by 16.9% earning between $10,000 and $20,000. Another 14% claimed to receive $20,000-$30,000, while an equal number of respondents (12.7%) has their incomes fall in each of ranges of $30,000-$40,000 and $40,000-$50,000. However, 7% are relatively poor with an annual income of less than $10,000. About 10% decided not to make their annual income public. In general, with 52.2% of the respondents earning at least $30,000 per annum, it can be inferred that most participants in this study are in the upper middle- income class.

According to Figure 5, the number of respondents with annual income in the range $30,000-$40,000 is higher in MH than in EH. For the income range of $10,000-$20,000, the number of respondents that claims it per annum is the same in the neighborhoods. But those with at least $30,000 are more in EH than in MH. There is no respondent earning less than $10,000 in MH, but there are 5 in EH. 6 respondents in MH and 1 in EH skipped the question asking about their income level.

5.2. Priority Index

The computed priority indices on the value attributes of EVs are summarized in Table 6. In the Edmonton Heights community, the priority ranking for value attributes desirable in electric buses are safety, charging stations' availability, affordable pricing, comfort, and economy while in Meadow Hills, safety, price affordability, comfort, accident-free status, and distance traveled per recharge are the priority ranking for desirable attributes in electric buses.

Conversely, the five least prioritized traits in electric buses in Edmonton Heights are exterior design, interior design, eco-friendliness, distance traveled per recharge, and finally resale value. In Meadow Hills, however, charging stations' availability, space and economy follow in that order while interior design and eco-friendliness tie at the joint list of desirable attributes in electric buses in that underserved community. It is instructive to note that while safety and price affordability are among the top three preferred attributes in both neighborhoods, eco-friendliness is common in both neighborhoods as the least desirable attributes to be found in electric buses.

5.3. Value Attributes of EVs

Table 7 provides evidence of the attributes of EVs expected by the respondents. It is revealed that safety is the foremost priority of the people of Meadow Hills and Edmonton Heights – 93% of them agreed so. This is hardly surprising because no matter the features of a transportation mode, the safety of drivers and passengers remains the ultimate goal. The second most important attribute of EVs is price. 89% want EVs to be inexpensive to buy. It goes that affordability is the main driver of preferences of people for using EVs. Close to this is charging. People are aware that EVs would require batteries to charge, so the majority (85%) prefer that the charging stations are easy to access. This shows that people have a long-term objective in their decisions to replace normal vehicles with EVs.

Comfort is also considered a major attribute of EVs. 82% agree that EVs should be comfortable to use. People do not want to trade off comfort for anything else. Economy and distance are other areas of priority. While 77% prefer EVs to have cheap maintenance costs, 73% would love that EVs can travel for fairly long distances (at least 200 miles per trip). It follows that people require EVs to perform similar functions as the traditional vehicles on the road and at the same time do not command huge costs of maintenance.

However, factors least considered by the respondents as important include designs and resale value. Unlike normal vehicles, exterior and interior design do not attract people markedly to EVs. Neither is the resale value. In essence, people's initial priorities are not bound by the aesthetics of EVs or whether the used value of the car will be appreciable enough. They are rather after affordability, comfort and safety of the vehicles. Also, space is not a significant side attraction in people's preferences for EVs. Only 61% perceived that EVs must be spacious to transport many people at the same time.

The mean responses are consistent with the percentage interpretations above. Again, a 2-point scale was used to generate the mean responses. Respondents that agreed to an attribute have their priority marked 2 while those that disagreed have their priority marked 1. Mean response of 1.7 is considered high enough to conclude that the respondents are united in their preferences. In this font, attributes marked as significant by the respondents include safety, comfort, price, distance, eco-friendliness, economy, charging stations and accident vulnerability. The standard deviations of these attributes are low enough to indicate high statistical confidence in the perceptions of respondents.

5.4. Attributes of EVs (T-Test Analysis)

The t-statistics show the extent of statistical significance in the perceptions of respondents. As Table 8 indicates, the t-statistic for each attribute is larger than the lower and upper bounds of the critical values (confidence intervals). This implies that all the variables are statistically significant at 5%. That is, the opinions of the respondents should not be taken for granted. Where there is consensus that an attribute matters, urban planners and policymakers should trust the judgment. And where there is a disagreement that an attribute is noteworthy, the judgment should not be taken to have occurred only by chance. These generalizations are captured under Section 5.3.

A closer look at Table 8 indicates that attributes such as safety, comfort, price and charging have very high t-statistics, suggesting that the differences in perceptions of respondents are highly statistically significant at 5%. That is, those that considered these attributes as priorities should be taken seriously and those against them should not be ignored. But because the majority considered these factors as important, the researcher establishes that safety, comfort, price and charging are the main determinants of people's preferences for EVs. On the other hand, factors such as exterior design, interior design, space and resale value have relatively lower t-statistics, confirming the magnitudes of mean opinions of respondents on these factors.

Table 7. Attributes of EVs preferred by respondents

Attribute	Number of respondents that consider it a priority	Number of respondents that do not consider it a priority	Mean	S.D.
Safety	66 (93%)	5 (7%)	1.93	0.26
Comfort	58 (82%)	13 (18%)	1.82	0.39
Exterior design	42 (59%)	29 (41%)	1.59	0.50
Interior design	43 (61%)	28 (39%)	1.61	0.49
Eco-friendliness	50 (70%)	21 (30%)	1.70	0.46
Price	63 (89%)	8 (11%)	1.89	0.32
Distance	52 (73%)	19 (27%)	1.73	0.45
Economy	55 (77%)	16 (23%)	1.77	0.42
Resale value	42 (59%)	29 (41%)	1.59	0.50
Charging	60 (85%)	11 (15%)	1.85	0.36
Space	43 (61%)	28 (39%)	1.61	0.49
Accident	51 (72%)	20 (28%)	1.72	0.45

Source: Authors' computation

Table 8. T-test analysis of attributes of EVs (Grouped)

Attribute of EV	t-statistic	Standard error	95% confidence interval	
			Lower	Upper
Safety	63.10	0.03	1.87	1.99
Comfort	39.31	0.05	1.72	1.91
Exterior design	27.09	0.06	1.47	1.71
Interior design	27.49	0.06	1.49	1.72
Eco-friendliness	31.24	0.05	1.60	1.81
Price	49.94	0.04	1.81	1.96
Distance	32.74	0.05	1.63	1.84
Economy	35.54	0.05	1.68	1.87
Resale value	27.09	0.06	1.47	1.71
Charging	42.66	0.04	1.76	1.93
Space	27.49	0.06	1.49	1.72
Accident	31.96	0.05	1.61	1.83

Source: Authors' computation

Table 9. T-test analysis of attributes of EVs (Individual)

Attribute of EV	Mean score		Mean difference	t-statistic	p-value
	Meadow Hills	Edmonton Heights			
Safety	1.97	1.94	0.03	54.55	0.000
Comfort	1.86	1.79	0.07	42.43	0.000
Exterior design	1.69	1.52	0.17	20.36	0.005
Interior design	1.76	1.50	0.26	45.67	0.005
Eco-friendliness	1.76	1.67	0.09	44.61	0.002
Price	1.93	1.86	0.07	38.56	0.000
Distance	1.72	1.74	-0.02	39.46	0.000
Economy	1.86	1.71	0.15	54.67	0.006
Resale value	1.66	1.55	0.11	55.43	0.002
Charging	1.79	1.88	-0.09	44.31	0.000
Space	1.66	1.57	0.09	30.25	0.004
Accident	1.79	1.67	0.12	33.57	0.002

Source: Authors' computation

Table 9 summarizes the difference in perceptions of MH and EH respondents on the value attributes of EVs. The people of MH expressed higher degrees of interest in almost all the EV attributes than EH residents. It is only on distance and charging that the mean scores of EH respondents are higher, hence the negative mean differences. All the t-statistics are high and the probability values (p-values) are all less than 5%. This implies that the differences in opinions of respondents in the two neighborhoods on expected attributes of EVs are significant. Consequently, MH residents are more likely to assess a given EV for the attributes captured in this study.

6. Conclusions

This study elicited respondents' perceptions about the value attributes of EVs in two underserved communities (Meadow Hills and Edmonton Heights) in Huntsville, Alabama, U.S.A. It identified the socio-economic characteristics of the residents and ranked the value attributes of EVs as perceived by the respondents. This has provided insights into the unpopular status of EVs on the major roads of sampled neighborhoods. The bottom-top approach to planning employed in this study is believed to promote diversity, inclusion, and social justice. The findings of this study would assist major stakeholders such as car manufacturers, transportation planners, and metropolitan authorities.

The deployment of EVs as a means of transportation is expected to change the face of transportation nationwide. Not only would such innovation reduce carbon emissions and reverse the propensities of global warming, it enhances the sustainability of ecosystems. In addition, the consequent fall in oil prices due to less demand for petroleum products (majorly petrol) would drastically reduce fossil fuel pollution, making the environment more suitable to support life. The price of buses would also decrease over time as more resources are deployed into research and development by electric car manufacturers. The government would require a new model of funding road maintenance as the number of gas taxes declines over time. City planners and engineers might redesign existing infrastructure to give room for charging stations. Notably, there are opportunities for investment in the value chain of EVs. As the cities become cleaner, public transportation is expected to be more affordable and efficient.

7. Future Work

There is a need for an in-depth study of the value attributes of EVs, especially those that might not have been captured in this study. These form the limitations of this work and include such attributes as noise and environmental pollution, running cost, battery durability, recharge, and others regarding speed, and smooth driving at high speed, especially on slopes. The scope of this work can also be extended to include many other neighborhoods whose residents earn below the minimum average monthly wage. Such a study will ensure that all spectrums of society are captured.

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