Can gain motivation induce Indians to adopt electric vehicles? Application of an extended Theory of Planned Behavior to map EV adoption intention

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Abstract

This study empirically examines pathways for formation of intention to adopt electric vehicle (EV) among the middle-class people in India in the near future. With the increasing incomes, and the enhancement of lifestyles, personal vehicles on the road is increasing. To meet the net-zero target by 2070, it is crucial to convert the increasing demand for personal vehicles to a demand for EV. The state of Assam in the eastern region of India has been used as a case study. Using the Theory of Planned Behaviour (TPB) and extending it further with 'herd-behaviour' and 'cost', the role of soft gain motivators like norms and attitude is analyzed. Using Structural Equation Modeling and Mediation Analysis, subjective norms are found to be a direct and strongest pathway for formation of intention to adopt EV, followed by perceived behavioral control. Herd behaviour is another strong indirect determinant of intention. Cost of an EV is not found to directly influence intention, nevertheless it acts as a mediator for attitude. This study recommends the redesigning of the Indian government EV promotion policies, as those are found to be susceptible to various behavioral bias and might not effectively lead to an intention to adopt EV.

Keywords: Electric Vehicle, Intention, Subjective Norm, Perceived Behavioral Control, Herd Behaviour, Incentives

1. Introduction

The transport sector is one of the highest carbon emitting sectors worldwide, accounting for 25% of global CO_2 emissions, a figure that is projected to double by 2035 (McCollum et al., 2018). The transportation sector of India is one of the fastest growing carbon emission sources, alone contributing approximately 305.3 MtCO2e GHG emissions (CEEW, 2021). Per capita CO_2 emissions in India rose from 0.39 metric tons in 1970 to 1.87 metric tons in 2019 (Tiseo, 2022). With the increase in extreme climate events, the need to mitigate greenhouse gas emissions has now become crucial. Sustainable transport systems, or the use of electric vehicles (EV) is one of the most promising solutions for decarbonizing the transportation sector (De Rubens et al., 2018; Yang et al., 2019; Singh et al., 2020; Huang & Qian, 2021; Bruckmann, 2022; Munshi et al., 2022). The immediate benefits of EV adoption in India are the enhancement of national energy security by reducing dependency on imported oil (Huang &

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Qian, 2021) and the curbing of local air pollution (Yang et al., 2019). The multiple benefits associated with a shift toward EV are also a strong justification for urgent EV adoption.

At the 26th UN Climate Change Conference of the Parties (COP26) held in Glasgow in late 2021, India announced a 2070 net-zero target (Vaidyanathan, 2021), while other developed nations set targets for 2050. According to the International Energy Agency (IEA), to reach the 2050 target, 60% vehicles globally need to be electrically powered by 2030 (IEA, 2021a). With its EV30@30 Campaign, the government of India aims to diffuse electric road vehicle sales by 30% in each vehicle segments by 2030 (Munshi et al., 2022). As announced at COP26, this ambitious goal, along with India's efforts to increase its share of renewables in the energy mix, will help India to decarbonize its transportation sector.

Efforts are under way to strengthen the supporting EV charging infrastructure for faster acceptance of e-vehicles. The FAME (Faster Adoption and Manufacturing of Electric Vehicles) scheme launched by the Indian government is such an initiative. To reach net-zero by 2050, 80% of 2-wheelers and 30% of 4-wheelers in India will need to be electric (Dhar et al., 2017).

In 2019, it was found that 39% and 31% of the Indian population, respectively, had a daily commute of 0-5 km and 5-10 km due to the layout of Indian cities (Statista, 2021).Greater the size of the urban centre, greater is the daily commute distance, owing to the expansion of the growth centres in the urban fringes, the city centre being already congested with earlier infrastructure. In terms of fuel consumption, light-duty vehicles (LDV) of which India is the 5th largest market, were reported to consume around 5.7 litres of gasoline equivalent per 100 km (Lge/100 km) in 2019.

Large and small SUVs, sales of which have picked up in India, were reported to have consumed, respectively, an average of 3.7% and 2.6%, more fuel since 2017 (IEA, 2021b). The associated carbon emissions are even more alarming. The tailpipe emissions from an average passenger vehicle are about 404 gCO_2 per mile (USEPA, 2018), which amounts to 1.3 kg of CO_2emissions by 39% of urban commuters using large SUVs, and 2.5 kg of CO_2 emissions by 31% of urban commuters using small SUVs. Use of electric vehicles directly reduces these carbon emissions into our environment. Indeed, in such a scenario, India could achieve a total reduction of roughly 2.4 billion kg of CO_2 emissions per day, according to 2019 statistics. With the rising incomes of the middle-income group in India, the above mentioned figures are expected to increase. Hence the shift towards electric vehicle must be a high priority for India.

The full potential of the EV diffusion schemes and overall decarbonization of the transportation sector can be realized only through social acceptance, i.e., when people accept and adopt the same. When social acceptance of a new technology is achieved, it becomes sustainable without a huge amount of money having to be invested in incentive schemes. Government policies need to be aligned with consumers' psychological and attitudinal determinants of mobility choices and purchase decisions (Arts et al., 2011; Cui et al., 2021). In the existing literature on the barriers to EV adoption, there is currently a great deal of focus on, for example, infrastructure availability, the technical characteristics of EVs, and people's attitude and norms. This study tries to examine the gain motivators for EV adoption among the middle-income group in eastern region of India.

Based on the Theory of Planned Behaviour (TPB) (Ajzen, 1991), we consider attitude, subjective norm, and perceived behavioral control as the possible determinants of intention to adopt EVs, extending it further to see the impacts of cost and herd behavior[2]. The wide applicability and flexibility of the TPB theory makes it ideal for the study context. We pose the following questions: what are the most important gain motivators for intention to adopt EV? Might there be a tough road ahead for India with its infrastructural challenges and the technical anxiety related to the adoption of EV technology? Does the high upfront cost of EV pose a barrier to the formation of intention to buy an EV? If some members of a social circle purchase an EV, do other members tend to follow suit?

The remainder of the article is organized as follows. We examine the theoretical background, with a focus on the TPB theory, followed by a summary of the main literature on the application of the TPB in the context of EV adoption. We then develop the hypothesis of the study, and the research model, focusing on methodology used, and analysis of data. We then discuss the findings, and policy recommendations. We conclude with a discussion of the limitations of the study, and possible future directions.

2. Theoretical Framework and Hypothesis Development

Studies have been conducted to identify different barriers to, and facilitators of EV adoption in different country-specific context such as Poland (Lewicki & Drozdz, 2021), Belgium (Afroz et al.,2015), China (Junquera et al., 2016), Malaysia (Wang et al., 2018), India (Khurana, 2019; Munshi et al., 2022; Sahoo et al., 2022). Earlier, pro-environmental behaviour was examined using socio-economic factors. It was established however that human decisions are guided not only by rationality but also by intrinsic motivators (Yazdanpanah et al., 2021). Understanding such behavioral determinants can also help with the design of EV promotion policy and to channel EV-related investments more efficiently (Yazdanpanah et al., 2015a, 2016).

In this paper, we explore the gain motivators behind individuals' pro-environmental decisions. The Theory of Planned Behaviour (TPB) theory has been widely applied to examine gain motivators in different contexts; health (Watson et al., 2014; Zemore & Ajzen, 2014), dietary choices (Arvola et al., 2008; Vermeir & Verbeke, 2008; Kim et al., 2013), conservation of water (Yazdanpanah et al., 2014a,), pro-environmental behavior (Abrahamse & Steg, 2009; Whitmarsh & O'Neill, 2010), tourism decisions (Han & Hyun, 2017), renewable energy (Yazdanpanah et al., 2015), etc.

The TPB is a crucial socio-cognitive model that explains volitional behavioral changes (Ajzen, 1991). It is an extension of the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975). According to the TRA, behavior is directly guided by intention which is, itself, formed by the interaction between attitude and subjective norm. Attitude is defined as "the degree of a person's favourable or unfavourable evaluation or appraisal of the behaviour in question" (Fishbein & Ajzen, 1975). Subjective norm is defined as "the perceived social pressure to perform or not to perform the behaviour" (Ajzen, 1991). Behaviour is thus considered as voluntary in the TRA.

This consideration, however, came in for criticism from Liao et al., (2007) who stated that behaviour was not always completely voluntary. As a response, Ajzen (1985, 1991)

[2] 'Herd behavior' is described as a social situation, where other people's decisions influence an individual's decision, and they are found to imitate one another (Chen, 2008).

incorporated the construct "perceived behavioral control" (PBC) into the TRA framework and renamed it the TPB model (Yazdanpanah & Forouzani, 2015). Fielding et al., (2008) define perceived behavioral control as "people's perception of ease or difficulty in performing the behaviour of interest". PBC is "the perceived control over the performance of a behaviour" (Ajzen, 2002).

The TPB model is highly flexible. It continues to evolve with several extensions having been formulated as required for different contexts to enhance the predictive power of the model (Yazdanpanah & Forouzani, 2015). Ajzen (1991) mentions that TPB was "in principle, open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variation in intention or behavior".

2.1 Impacts of the TPB Components on EV Adoption

According to the TPB model, intention, the central determinant of behavior, has three main components: attitude, subjective norm, and perceived behavioral control. Based on a sample of 3505 people, Mohamed et al., (2016) found that a person's attitude and perceived behavioral control have a significant and large influence on their willingness to purchase an EV. Studies have examined different components of attitude like awareness, use of EV, experience of riding an EV, social need, pro-environmental action, social message, fuel consumption, and carbon emissions, finding that these factors have a huge influence on adoption of EV (Jayaraman et al., 2015; Kaplan et al., 2016). A detailed analysis of the linkages between attitude and intention formation for EV adoption is still lacking in the literature (Singh et al., 2020). Some studies, however, have attempted to reflect how different components of attitude lead to attitude formation. For example, when a person considers EV as necessary for society at large, then attitude toward EV adoption is found to be positive (Singh et al., 2020).

Perceived behavioral control is found not to take into account intention toward EV adoption if this results from public opinion and an overly pumped-up desire for EV (Adnan et al., 2017; Mohamed et al., 2018). Afroz et al., (2015) find a strong impact of perceived behavioral control on EV purchase intention; however, its' impact is still found to be smaller than the impact of attitude on intention to adopt EV. Exploring psychological variables at the level of emotions, Moons and Pelsmacker (2015) find that reflective emotions such as, inter alia, aspects of eco-friendliness, cost economy, and fuel economy, are crucial drivers of the intention to use EV. The study also reports that reflective emotions have a greater impact than behavioral ones like driving comfort, feeling of relaxation, and enjoyment. Visceral emotions, for example, the power and throb of the engine, appearance and aesthetics of the vehicle interiors, maximum speed limit, full digital information display on the car dashboard, are not found to have no significant impact on the intention to use EV.

Singh et al., (2020) studied social determinants like peer pressure, effects of neighborhood, social responsibility, and empathy, belonging to social networks, being an acceptable member of society, collective efficacy, and external validation. According to the literature, newer technologies are adopted with the motivation of receiving external validation (Jayaraman et al., 2015; Liao et al., 2017). Kim et al., (2014), however, find social variables to be less important in terms of influencing intention towards using EV. Nevertheless, subjective norm is always proposed as an important construct in most of the theories like the Theory of Planned Behaviour, the Technology Acceptance Model, and the Diffusion of Innovation Theory.

Studies support the significant impact of family, friends, relatives, and society on the intention to adopt EV (Sang and Bekhet 2015; Liao et al., 2017).

Personal or moral norm is another determinant of intention that has been explored in the literature. Self-interest, personal principles, being pro-conservation to being open to change, and self-transcendence are some of the attributes encompassed by moral or personal norm (Singh et al., 2020). A greater level of morality at a personal level was found to be a common trait among the owners of alternative fuel vehicles compared to non-adopters of EV (Jansson, 2011). Lending support to the influence of personal norms, Rezvani et al., (2015) stated that a higher level of personal norm is associated with a higher chance of adopting EV. Going a step further, He and Zhan (2018) found that personal norms become active when the personal norm associated with the environment is activated. Adnan et al., (2018) also finds that personal norms have a significant impact on the formation of behavioral intention.

In additional to the above constructs, Indian EV adoption is considered in this study as an apt extension to the TPB theory in the context of contemporary trend in middle-class society, such as herd behaviour. For example, the influence of social media on personal lives, social media stalking, social competitiveness, and the urge to keep up with friends and relatives have put pressure on everyone to a varying degree. The overload of information available through various authentic and also inauthentic sources also makes decision making a complex task, even more so when people are deciding to invest in durables like personal vehicles. People frequently tend to imitate social trends as these are a sign of popularity and thus better choice. When people imitate, they forget to actually analyze their own needs and often overlook sustainability considerations. It is interesting to see the impact of this variable on the formation of intention.

Cost is considered to be another extension to the original TPB theory. Although the disposable income of the middle-class group is on the rise, price consciousness is still a big part of the Indian consumer mindset. People care about status signalling, but cost concerns still loom large in their minds. Specifically, the high upfront price of EVs acts as a demotivator, even though the operational cost of EVs over a period of time is lower than those of a gasoline/diesel vehicle. People still do not seem to take into account the lower operational cost over time vis-à-vis the high upfront cost of purchase. This study aims to discover if cost impacts people's gain motivations and intention formation for EV adoption.

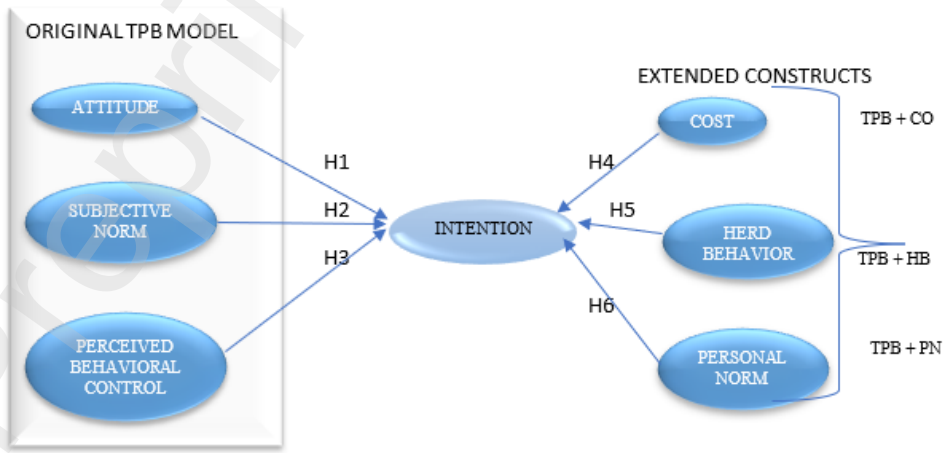


Fig 1: Conceptual Framework

Based on the findings in the literature, and the conceptual background of personal mobility choices among the Indian middle-class, the conceptual framework of the study was built as shown in figure 1. The blue arrows indicate the hypothesized pathways of intention formation. The numbers against the arrows represents the hypothesis.

3. Method and Data

3.1 Measures

The questionnaire was designed to consider all the latent constructs illustrated in the conceptual framework of the study, based on the existing literature.

Attitude is a four-indicator construct adopted from Lopes et al (2019), and Matsumori et al., (2019). Subjective norm is borrowed from Zhang et al., (2020a), and is conceptualized as 'an individual's normative beliefs' or whether other people would approve or disapprove of another person performing a given behaviour, weighted by their motivations to comply with the norms. Perceived behavioral control is adapted from Han & Hyun (2017), where perceived behavioral control is stated as an indicator of an individual's perceived degree of ease or difficulty associated with participating in a specific activity. Personal norm is adopted from Rosenthal & Ho (2020), and Zhang et al (2020a). 'Intention to adopt an EV in the future' is the dependent variable, the indicators of which are adopted from Ajzen (1991).

In addition to the indicators for latent constructs, consumers' gender, age, education level, annual household income in 2022, type of vehicle used, number of vehicles in the household, and average daily distance travelled were used as control variables in this study.

3.2 Data collection

This study is based on empirical data from the eastern region of India; the region is used as a representative study site to gauge the intention of middle-class people to adopt an EV in the future. The region was chosen because of its fast development, and increasing urbanization, which indicate that it will be a fertile potential ground for emergence of new infrastructure in the future. because of its fast development, and increasing urbanization, thus promising a fertile potential ground for emergence of new infrastructure in the future. This paper focuses particularly on the province of Assam in Eastern India, the hub of industry, health, and education for the entire north-eastern region. As this study aimed to examine the intention to adopt EVs in the future for personal use, only e-2-wheelers and e-4-wheelers are considered in the study.

This study was based on a convenience and random sampling framework. Data were collected through a combination of online and field survey. A similar sampling frame was used in prior literature (Han et al., 2017; Jiang et al., 2020). Online questionnaires were distributed by email and via WhatsApp groups using a convenience sampling frame. Offline questionnaires were distributed to office-workers and students in randomly chosen offices and colleges. Students and office staff were also used as behavioral study sample in previous literature (Astuti et al., 2019; Liu et al., 2019). A dual mode of data collection was used to ensure efficient, and timely collection of data. Both student and office workers were surveyed in order to have a better representation of the future potential consumers of e-vehicles.

Prior to the formal data collection process, a pilot study was conducted with around 183 samples. We sent out a total of 220 questionnaires and received around 183 completed ones, with a response rate of 83.18% (=183/220). In the second and the formal round of data collection we received a total of 330 completed responses out of the 400 distributed. After eliminating the incomplete questionnaires, the survey was closed with a total 317 valid responses for further analysis, a response rate of 79.25% (= 317/400).

4. Results and Analysis

4.1 Sample description

Table 1: Summary of demographic characteristics of the sample in second wave (n = 330)

Demographic Characteristic	**Category**	**Count**	**Percentage**
Gender	Female	164	49.7%
	Male	163	49.4%
Age	18-25	87	26.4%
	26-35	131	39.7%
	36-45	46	13.9%
	46-60	64	19.4%
Education Level	School Level	9	2.7%
	Higher Secondary	24	7.3%
	Graduate	102	30.9%
	Post-Grad & above	193	58.5%
Annual Household Income (INR)	<2,50,000	84	25.4%
	2,50,000-500000	82	24.8%
	50,0000-7,50,000	37	11.2%
	7,50,000-10,00000	36	10.9%
	10,00000-12,50,000	19	5.7%
	12,50,000-15,00000	18	5.4%
	>15,00000	33	10%
Residence	Village	46	13.9%
	Town	190	57.6%
	City	89	26.9%
No. of Vehicles in Household	None	36	10.9%
	One	115	34.8%
	Two or more	169	51.2%
Avg. Daily Distance Travelled	<10 km	131	39.7%
	10-20 km	100	30.3%
	20-50 km	59	17.8%
	50-100 km	15	4.5%
	>100 km	10	3%

Table 1 provides a summary of the characteristics of the sample used in the study.

The study sample had an equal distribution of genders, with 49.4% males, and 49.7% females, while 0.6% of the sample did not disclose their gender. There were more sample participants among the younger age groups (26.4%) among the 18-25s, and 39.7% among the 26-35s than the older age groups, 13.9% in the 36-45s and 19.4% in the 46-60s. The majority of the sample were highly educated with 58.5% having a post-graduate or higher level of education, and 31% a graduate degree.

The sample was widely distributed and covered a range of average annual household incomes. In terms of annual income, 25.4% of respondents earned less than 2,50,000 Indian rupees (INR)[3] and a similar proportion (25%) also earned INR 2,50,000-500,000. This means that the annual income of almost half the sample was less than INR 500,000. One reason for the low income could be that a significant proportion of the sample were still students and yet to enter the job market. Thus, this finding should not pose a financial barrier to vehicle purchase decisions in the future. Some 22.2% of the sample earned an income of INR 500,000-10,00,000, while almost a quarter (21.15%) earned INR 10,00,000 and over INR15,00,000 annually.

The study found that 27.8% of the sample did not use any personal vehicle at the time of the survey. Personal cars were used by 16%, bikes/scooters by 28.8%, and multiple personal vehicles by 25.4%. In terms of vehicle ownership in the household, 51.2% owned multiple personal vehicles, 34.8% owned atleast one vehicle, and 10.9% owned none. The middle-class sample owned many vehicles despite 69.99% of them needing to travel less than 20 kms a day. Of the remaining people sampled, 17.8% travelled between 21 and 50 km daily, and a small proportion, 4.5% between 51 and 100 km, and 3% further than 100 km. This also indicates that the personal vehicles were used more for non-necessary and within city travel. Hence, some current concerns like battery range anxiety, as pointed out in several studies, should not be an issue in the eastern region in India. A majority of the sample (57.6%) reside in big towns, 27% are residents of cities, and 14% live in rural areas.

4.2 Measurement model

Most of the scales for latent constructs were adopted from past studies, except for 'herd behavior' and 'cost'. Confirmatory factor analysis (CFA) was carried out to examine convergent validity, internal reliability and discriminant validity of constructs in this study using AMOS trial version 26 of IBM SPSS.

The convergent validity and internal reliability of the indicators are examined by the composite reliability (CR) value, Cronbach's alpha value, the average variance extracted (AVE), and the factor loadings of all the indicators. The indicators with low factor loading (<0.4) were dropped from further analysis (Hulland, 1999). An indicator 'AT2' for 'attitude' and two indicators 'PBC3' and 'PBC4' for 'perceived behavioral control' are thus removed from subsequent analysis. Most of the other indicators have a factor loading of atleast 0.6.

Table 2: Factor loadings of indicators

	Indicator	**Standardized Loadings**

[3] 1 USD = 82.03 INR based on the commercial exchange rate on 19/10/2022 (Bloomberg.com)

AT1	My adoption of electric vehicle (EV) in the future will result in stopping further damage to the environment	1
AT4	It feels satisfying for me to adopt EV and reducing vehicular emissions on my part	0.95
SN2	If my close ones encourage me to adopt EV, I will follow	1.25
SN3	If the government provides incentive to adopt EV, I will follow	0.98
SN4	The government encourages to adopt EV for the sake of climate change mitigation but does not provide incentives. I will still adopt EV	1
PBC1	It will not take me too much time to figure out the technicalities of using an EV	1.35
PBC2	If I am willing, I have the confidence to drive an EV	1
CO1	The price of EV will determine my intention to buy EV	0.81
CO2	The price of EV will determine if I am capable to buy an EV or not	0.81
CO3	Incentives like subsidies, low-interest loans, lower toll tax, and parking facilities will facilitate me to purchase EV	1
HB1	The use of social media platforms will help me to gain visibility regarding my adoption of EV	1.03
HB2	My adoption of EV will help me get appreciation in my social circles	1.26
HB3	Members in my social circle have already adopted EV. It might be better for me to adopt one too	1.25
HB4	It might feel out of trend not to buy an EV when it is available in the market	1
PN1	I have the obligation to reduce my CO_2 emissions from using petrol/diesel vehicles	0.46
PN2	Adopting EV and reducing CO_2 emissions is consistent with my moral principles	0.63
PN3	I would feel guilty if I do not adopt EV and try to mitigate climate change from my side	1

The values for average variance extracted (AVE) and composite ratio (CR), which establish convergent validity of the indicators (Hair et al., 2014) are indicated in table 3. The AVE value of each construct is atleast 0.5, and the minimum value of CR is 0.637. All other constructs have a CR value higher than 0.745. The reliability of the internal consistency is established by the values of Cronbach's alpha ranging from 0.84 to 0.95, which exceeds the minimum recommended threshold of 0.7 (Hair et al., 2014). The AVE value is an indicator of validity of the measurement model. An AVE value of atleast 0.5 is recommended. From the table above, we see that the AVE values of the latent constructs meet the desired range of 0.5. The validity of the constructs in the TPB model is established.

Table 3: Reliability & Validity Assessment of Indicators

Construct	**Average Variance Extracted (AVE)**	**Composite Ratio (CR)**
Attitude	0.640	0.842
Subjective Norm	0.511	0.806

Perceived Behavioral Control	0.5	0.637
Cost	0.611	0.823
Herd Behavior	0.542	0.823
Personal Norm	0.542	0.775
Intention	0.648	0.846

Table 4: Goodness of Fit Indicators for TPB & its Extensions

	Chisq/DF	**Cronbach α**	**RMSEA**	**AGFI**	**CFI**
TPB	2.23	0.896	0.062	0.912	0.967
TPB + CO	2.51	0.903	0.069	0.883	0.947
TPB + HB	2.65	0.914	0.072	0.876	0.939
TPB + PN	1.88	0.915	0.053	0.928	0.976
TPB + CO + HB	2.78	0.930	0.075	0.850	0.921
TPB + CO + HB + PN	2.52	0.928	0.069	0.845	0.924

The measurement model also exceeds the recommended cut-offs for goodness of fit, as indicated by Chisq/DF equal to 2.23, root mean square error of approximation (RMSEA) equal to 0.062, and comparative fit index (CFI) equal to 0.967

4.3 Structural equation modeling

In accordance with the hypothesis proposed in the study (table 5), we fit the established measurement model into a structural equation model in AMOS. The maximum likelihood estimation method is used to fit the SEM model. As shown in table 4, good values for the indicators of model fit such as CFI, adjusted goodness of fit (AGFI), and RMSEA were achieved. According to Bentler (1989; cited in Pakmehr et al., 2020), the AGFI needs to be larger than 0.8, the CFI greater than 0.9, and the RMSEA less than 0.08. Thus the TPB model used in the context of the study has a good fit.

Table 5: Results of structural equation model

Hypothesized paths	**Standardized estimates**	**p-value**	**Conclusion**
Original TPB model pathways			
H1: Favorable attitude towards the use of EV → Intention to adopt EV in the future	0.107	0.383	Rejected
H2: Higher subjective norm → Higher intention	0.484	0.005	Supported
H3: Higher perceived behavioral control → Greater is the intention to adopt EV in the future	0.235	0.028	Supported
Extensions of Original TPB model			
H4: Higher cost of EV → Lower intention	0.124	0.267	Rejected
H5: Positive herd behaviour → Intention	-0.053	0.751	Rejected
H6: Strong personal norm → Intention	-0.103	0.715	Rejected

The standardized β coefficients for the hypothesized paths leading to intention formation are indicated in table5. Subjective norm has a positive and significant influence on intention

formation toward EV adoption (β = 0.484, p = 0.005). This supports hypothesis H2. Perceived behavioral control is another significant factor influencing intention (β = 0.235, p = 0.028), thus supporting hypothesis H3. Attitude however is not found to be a significant construct influencing the formation of intention (β = 0.107, p = 0.383). Hence, hypothesis H1 is not supported.

In the first extension of the TPB, TPB + CO model, subjective norm is found to be significant (β = 0.509, p = 0.009), thus supporting H2. H4 is not supported by data in the direct formation of intention to adopt an EV in the future.

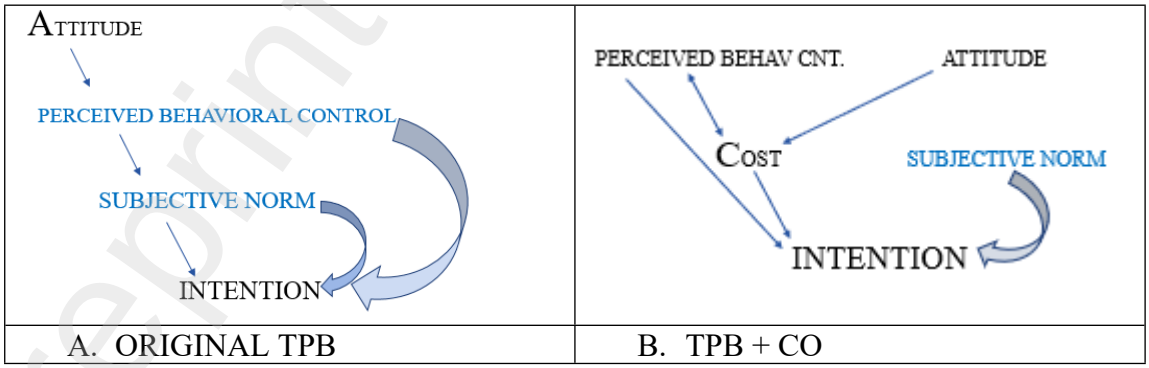
In the second extension, TPB + HB model, H2 was found to be positive and significant at 5% level of significance (β = 0.613, p = 0.044). H3 is also supported as perceived behavioral control is a significant pathway for intention formation at 10% level of significance (β = 0.209, p = 0.089). H5 is not found to be a significant pathway in directly influencing intention.

In the third extension of the TPB model, TPB + PN two significant pathways influencing intention are found. Perceived behavioral control is found to be significant at the 5% level, (β = 0.233, p = 0.045) and subjective norm is also found to be a significant pathway in the formation of intention at 5% level of significance (β = 0.512, p = 0.037). Personal norm is again not found to directly influence the formation of intention.

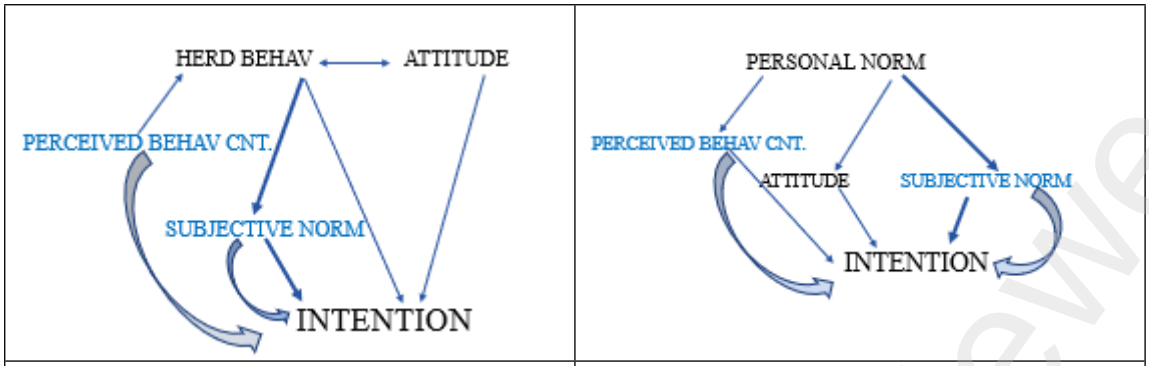
In the combined extended model, TPB + HB + CO model, H3 is supported at 5% level of significance (β = 0.560, p = 0.012), and H1 is supported at 10% level of significance (β = 0.625, p = 0.070). H4 and H5 are again rejected as a direct pathway for intention formation. The four structural models as found in this study are shown in appendix 2.

4.4 Mediated Pathways

From the results of the structural models, we find that none of the three extended constructs: cost, herd behavior, and personal norm have a direct influence on the formation of intention to adopt an EV in the future. This by no means implies that we can ignore the extended constructs. The results of the mediation analysis explain why. The central tenet of the mechanism of mediation is that it engages a third variable which acts as an intermediary in the association between the independent variable and the dependent variable by transmitting the impact of the former on the latter (MacKinnon et al., 2010).



A. ORIGINAL TPB | B. TPB + CO



C. TPB + HB D. TPB + PN

Fig 2: Mediated Pathways in the TPB model and its extensions

Figure 2 illustrates the step-wise mechanism of the intention formation process in the context of the decision to adopt an EV. The constructs in blue also have a direct effect on intention, while those in black have no direct effect on intention. The curved arrows indicate a direct effect and the straight arrows indicate a mediated pathway. The thicker the arrows, the stronger the size of the effect.

In the original TPB model (fig 2A), though attitude has no direct effect on intention formation, it is mediated by perceived behavioral control, which in turn, is mediated by subjective norm.

In the TPB + CO extended model (fig 2B), cost is found to be partially mediated by perceived behavioral control. Cost also acts as a mediator for attitude and perceived behavioral control. The effect sizes of these mediated pathways are indicated in table 6.

The earlier structural model analysis indicated no direct impact of herd behavior on intention, but as seen in the TPB + HB model (fig 2C), herd behavior is fully mediated by subjective norm with an effect size of 0.3977. Herd behavior also partially mediates perceived behavioral control with an effect size of 0.1529 and attitude with an effect size of 0.1878.

Personal norm is also found to be fully mediated by subjective norm with an effect size of 0.3967, and partially mediated by perceived behavioral control with an effect size of 0.1034 in the TPB + PN model (fig 2D). Personal norm is also partially mediated by attitude with an effect size of 0.1831.

Table 6: Mediation pathways leading to formation of intention for adoption of EV.

Pathways	**Mediator**	**Effect**	**Size**
TPB			
Attitude → Intention	Perceived behavioral control *	Partial	0.0969
Perceived behavioral control → Intention	Subjective norm ***	Partial	0.2688
TPB + HB			
Herd behavior → Intention	Subjective norm **	Full	0.3977
Herd behavior → Intention	Attitude **	Partial	0.1615
Attitude → Intention	Herd behavior **	Partial	0.1879

Perceived behavioral control → Intention	Herd behavior **	Partial	0.1529
TPB + CO			
Cost → Intention	Perceived behavioral control **	Partial	0.1495
Perceived behavioral control → Intention	Cost **	Partial	0.1500
Attitude → Intention	Cost **	Partial	0.1069
TPB + PN			
Personal norm → Intention	Subjective norm **	Full	0.3967
Personal norm → Intention	Perceived behavioral control **	Partial	0.1034
Personal norm → Intention	Attitude **	Partial	0.1831

***significant at 1% level of significance, **significant at 5% level of significance, *significant at 10% level of significance

5. Discussion

In the context of the eastern region of India, the subjective norm and perceived behavioral control are the most important gain motivators directly influencing the intention to adopt EV among the middle-class. This answer the first research question of the study, namely: what are the most important gain motivators for developing an intention to adopt EV?

Attitude does not influence intention directly, this differs from previous studies which have reported a positive and direct effect of attitude on intention (Shi et al., 2017; Adnan et al., 2018; Asadi et al., 2021). The impact of attitude on intention is realized only after herd behavior or perceived behavioral control are triggered. One explanation for this is the high cohesiveness of people's activities in the towns and smaller cities. Hence, the fact of other people purchasing an EV can reinforce the positive attitude toward buying one.

Regarding perceived behavioral control, it can be said that it is only when an individual believes in their own abilities to drive an EV, having a positive attitude toward EV helps to form EV adoption intention. The presence of a positive attitude without the belief in being able to comfortably drive an EV does not lead to an intention to buy one. This is an indication of a higher weight on personal ease than on a strong feeling toward environmental protection.

Similarly, the high impact of subjective norm on intention may be due to the collective nature of society in eastern India. External validation by society is crucial as it unconsciously drives behavior. This is more so for the middle-class group living in towns or small cities. Though an individual might deny requiring society's input for their decisions, or imitating others' decisions, these parameters feed unconsciously in an individual's decision-making process. This could be because of social competition, or because of an individual's eagerness to enhance their social status. Thus, we see that if members of a social circle adopt an EV, due to the strong presence of subjective norms, there is a high possibility of the other members of the social circle following suit. If an individual does not seek external validation for their action, then herd behaviour might not lead to intention formation for EV adoption.

The big towns will become the engines of growth in the coming years, as the scarcity of space drives industrial enterprises outwards away from the already saturated cities. Hence EV promotion needs to be equally focussed in the big towns. There needs to be increased investments in EV supporting infrastructure which is currently almost non-existent in the big towns of eastern India. The government has failed to expedite the setting up of an EV-friendly ecosystem in this region. This study posed a question as to whether infrastructure challenges and technical anxiety might present a tough road ahead for adoption of EVs. The answer is 'no'. No anxiety related to EV infrastructure is found in the analysis. People are open to adapting to the new technology, provided the government's plan of introducing EV-related facilities is realized according to the roadmap already laid out.

Another question posed in this study is whether the high upfront cost of an EV could pose a challenge to the formation of intention for EV adoption. Interestingly, cost is not found to be a significant barrier in the intention formation process for the adoption of EVs. Herd behavior and personal norm, as directly and fully mediated by subjective norms, also become an impactful indirect determinant of intention to adopt an EV. Hence these variables, if ignored, on account of there being no direct relationship between them, will seriously bias the results.

6. Policy Recommendations and Conclusion

The Indian state governments of, inter alia, Assam, Meghalaya, Odisha, and Bihar, have rolled out special incentive schemes for early adopters of EVs. For instance, in Assam, a subsidy of maximum upto INR 20,000 is announced for an e-2-wheeler which is priced at INR 1,50,000; a subsidy of maximum upto INR 1,50,000 is announced for e-4-wheelers priced at INR 15,00,000. The subsidy is announced for "early adopters", - however, the number of early adopters eligible to take advantage of the subsidy is not specified. The subsidy is paid as a reimbursement. Reimbursement policies, however, do not give people a feeling of financial benefit, and offering a financial benefit is why governments devised these schemes in the first place. People generally value an upfront financial gain more than receiving a cash back at some undefined future date. This is because people often tend to assess their gain or loss from a transaction, (which in this case, is self-investing upfront and receiving cash back later), based on a present reference point[4]. People are more risk-averse when it involves the expectations of a gain. Monetary gain in terms of reimbursement in the future is perceived as a risk, as disutility is higher at the present, in terms of the current point of reference (Wilkinson & Klaes, 2012). In addition, the hassle of official paperwork required to claim the reimbursement is also more likely to psychologically demotivate people.

The government has also announced an incentive to waive off the registration fee and the road tax for e-vehicles. However, the sum of the registration fee and road tax together, is much lower than the upfront price of an electric car/bike. A buyer spending thousands of rupees on an e-vehicle would thus not care too much about saving a few hundred via the waivers. According to behavioral theories, people try to save more on purchases worth smaller amounts but tend to attempt to bargain less on expensive purchases.

The policy of offering incentive deals on the purchase price of EV for early adopters is also subject to much behavioral bias. Due to the lack of information, it is often impossible for buyers

[4] Reference points are usually the present level of welfare or assets. Many a times when people are not adjusted to the present time, they anchor on to the past for a reference point.

to keep a track of how many people have already bought the vehicle before them, under the incentive scheme, and whether they qualify as early adopters. In buying a durable good like a personal vehicle, people often a while to consider the different options available and to find one that suits their needs. Racing to be an early adopter in order to qualify for the incentive could be rash; buyers could later realize the car is unsuitable for their needs. Moreover, the timeline set for claiming the purchase subsidy for the early adopters is unrealistic, as the ecosystem for EV adoption is yet to be set up.

Subjective norms and perceived behavioral control are the direct determinants of intention and policies should thus aim to trigger these two aspects to activate gain motivation. Once motivation is activated, policies may be needed to trigger a positive attitude toward EV adoption. The question thus arises as to how policies can trigger subjective norms. For instance, an EV can be positioned as status symbol among the range of cars in the market. This would theoretically enhance how "other people" view an EV owner optimally at the local level of a neighborhood or a municipality, where the possibility of people knowing one another increases.

People are generally competitive by nature. When people in their social circle achieve something, they often believe they can do it too. This behavioral characteristic can be used to trigger perceived behavioral control. For instance, instead of providing a general subsidy, a subsidy should perhaps be targeted at the friends and relatives of the buyers of an EV. This will reinforce the perceived behavioral control of the second-phase buyers in the social network. The subsidies can then be continued on with a slight reduction to the third-phase buyers. The creation of such a chain will facilitate the working of the intention formation mechanism where subjective norm mediates perceived behavioral control, and perceived behavioral control, in turn, mediates attitude, and subjective norm is the strongest determinant of intention to buy an EV. Providing generalized subsidies reduces the chances of the development of such a social motivation chain to put EVs on to the road instead of gasoline/diesel vehicles.

Appendix 1. Survey statements on the indicators of latent constructs

Please read the statements carefully. There are no correct or wrong responses. We are only interested in your personal opinion regarding each statement (1 = strongly agree to 7 = strongly disagree). (The indicators were presented as codes without mentioning the name of the construct that the indicator intends to measure)

1. Indicators for 'attitude towards EVs'

- AT1: My adoption of electric vehicle (EV) in the future will result in stopping further damage to the environment
- AT2: Being able to stop further damage to the air quality and climate at large is good
- AT3: I think adopting EV to reduce vehicular emission is a smart measure
- AT4: It feels satisfying for me to adopt EV and reducing vehicular emissions on my part

2. Indicators for 'subjective norms'

- SN1: People in my social circle thinks that adopting EV in the future is good
- SN2: If my close ones encourage me to adopt EV, I will follow
- SN3: If the government provides incentive to adopt EV, I will follow

- SN4: The government encourages to adopt EV for the sake of climate change mitigation but does not provide incentives. I will still adopt EV

3. Indicators for 'perceived behavioral control'

- PBC1: It will not take me too much time to figure out the technicalities of using an EV
- PBC2: If I am willing, I have the confidence to drive an EV
- PBC3: Whether or not to drive an EV is completely upto me
- PBC4: It will not take me long to find charging stations near me to charge my EV

4. Indicators for 'cost'

- CO1: The price of EV will determine my intention to buy EV
- CO2: The price of EV will determine if I am capable to buy an EV or not
- CO3: Incentives like subsidies, low-interest loans, lower toll tax, and parking facilities will facilitate me to purchase EV

5. Indicators for 'herd behaviour'

- HB1: The use of social media platforms will help me to gain visibility regarding my adoption of EV
- HB2: My adoption of EV will help me get appreciation in my social circles
- HB3: Members in my social circle have already adopted EV. It might be better for me to adopt one too
- HB4: It might feel out of trend not to buy an EV when it is available in the market

6. Indicators for 'personal norms'

- PN1: I have the obligation to reduce my CO_2 emissions from using petrol/diesel vehicles
- PN2: Adopting EV and reducing CO_2 emissions is consistent with my moral principles
- PN3: I would feel guilty if I do not adopt EV and try to mitigate climate change from my side

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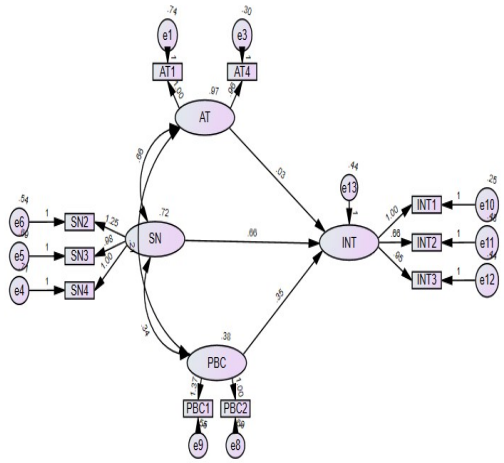
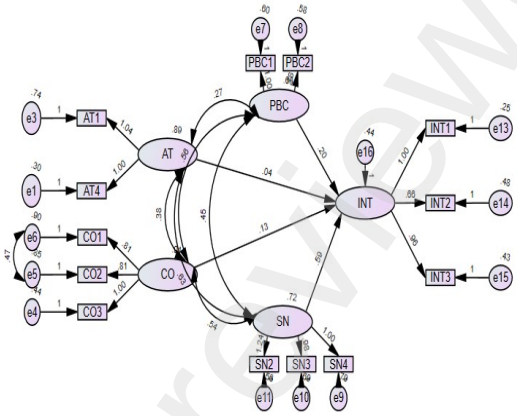
Appendix 2. Structural models analyzed in the study

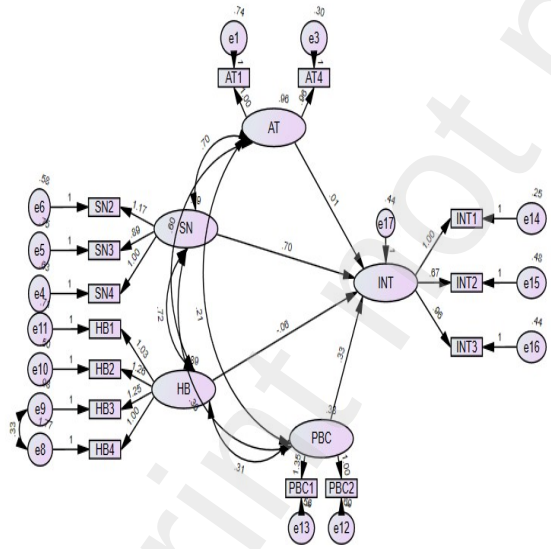
Original TPB model
Supported in this study



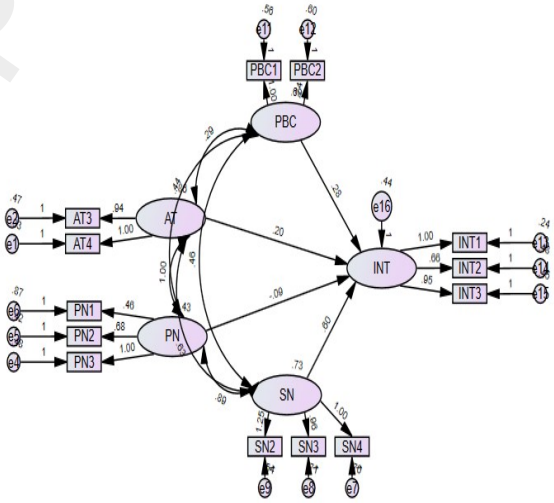
TPB + CO
Supported in this study



TPB + HB
Supported in this study



TPB + PN
Supported in this study



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