

## **A CONCEPTUAL MODEL FOR UNDERSTANDING THE BARRIERS TO THE ADOPTION OF ELECTRIC VEHICLES IN INDIA**

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### **ABSTRACT**

Electric vehicles (EVs) have entered the Indian market, but it is a long way to go as customers do not seem to be ready for EVs now. In order to increase its penetration in the Indian market and to promote the adoption of EVs, there is a need to address the barriers to adoption that prevent EVs' progress. In order to address the problem, we in this paper have come forward with a conceptual model on the basis of relevant papers that are shortlisted from the papers indexed in Google Scholar and Scopus databases. Five major barriers are highlighted in the present paper, that is, (i) noise; (ii) lack of fun; (iii) fear of explosion; (iv) lack of EV awareness; and (v) resistance to change. Its implications for adoption and suggestions are offered in the paper to deal with the barriers to adoption.

**Keywords:** Electric vehicles, sustainability, environment, transport, EV

### **1. Introduction**

The concern over the environment and climate change has risen over the last decades. Initiatives are being taken all over the world in one way or the other. United Nations has also emphasised these initiatives in its seventeen sustainable development goals [SDGs] (United Nations., 2022). Two of the goals among the seventeen sustainable goals are 'Sustainable Cities and Communities' and 'Affordable and Clean Energy'(United Nations., 2016; Richardson, 2005). Sustainable transport is interlinked with these goals and other sustainable development goals. When it comes to sustainable transport, electric vehicles (EVs) are at the forefront. The market

for electric vehicles is gaining ground in India as well as in other parts of the world (Dixit& Singh, 2022). An increased interest in electric vehicles among people from across the globe has been seen (Munshi et al., 2022). This increased interest is followed by an upsurge in the number of electric vehicle adoption (Jeon et al., 2018). However, people who are adopting it in various parts of the world or who are wanting to adopt are not fully embraced the technology wholeheartedly (Moeletsi, 2021; Tarei et al., 2021). In other words, there are some hindrances to its adoption. Not only the barriers are physical or practical in nature, but also the barriers are psychological.

Psychological hindrances and lack of awareness in the form of insecurities over electric vehicles could cause reluctance and indifference that may need to address (Ziefle et al., 2014). Identification of factors or areas that are interfering with electric vehicle adoption is required so that the deep psychological factors which are causing the behaviour that is deterring people from adoption could be linked together. Human behaviour reflects the thought process. What people are thinking who are intending to buy or use such vehicles should be found to remove those psychological barriers.

In this paper, we are trying to review the barriers that are psychological in nature and prevent future buyers and adopters to accept them completely. The paper first would describe in brief the electric vehicle. In the next section, we would enlist and elaborate on the barriers to the adoption of electric vehicles which would be followed by a conceptual model describing how the identified psychological barriers are affecting the adoption of EVs. After describing the proposed model, Discussion, Scope for Future Research and Limitations and Conclusion is mentioned towards the end.

### **Electric Vehicles**

With the skyrocketing prices of fossil fuels such as petrol and diesel and with the rising concern and awareness over the environment and climate change, brought a shift in the automotive sector (Sanguesa et al., 2021). That is, substituting conventional internal combustion engine vehicles (ICV) with EVs seems to be the right decision considering the prices and climate issues (Gärling & Thøgersen, 2001). EVs majorly are of three types: (i) Battery Electric Vehicle (BEV); (ii) Hybrid Electric Vehicle (HEV); (iii) Fuel Cell Electric Vehicle [FCEV] (*Types of electric vehicles*, 2021). HEVs are subdivided into two types: (i) Hybrid Electric Vehicle and (ii) Plug-in Hybrid Electric Vehicle [PHEV] (*Types of electric vehicles*, 2021). Apart from lowering harmful gas emissions, EVs also have several benefits, some of which are listed below (Sanguesa et al., 2021):

- (i) **Simplicity:** EVs have fewer components in comparison with ICVs and are compact in design.
- (ii) **Low Maintenance:** Due to their simplistic design, EVs do not cost much in terms of maintenance.
- (iii) **Comfortable:** As there is no internal combustion engine in EVs, there is almost no noise and no vibrations caused by the engine that makes it comfortable to ride or drive.
- (iv) **Economical:** EVs are cheaper and more economical to operate than ICVs.
- (v) **Dependable:** EVs experience fewer breakdowns and lesser wear and tear than ICVs because of their simplistic and compact engine with no noise and vibrations.

As mentioned above, there are advantages of EVs to users and the environment, however, in addition to the positive side, there is a negative side as well. To put it differently, some barriers hinder the adoption of EVs among customers. In this article, we are focused on psychological barriers (barriers that are related to the mind) only. A thematic review of the literature describing the psychological barriers is presented in the article.

## **2. Review of Literature**

The following section explores and reviews the literature available on the barriers to EV adoption (see Figure 1).

### **Noise**

These days due to the advancement of technologies, EVs have evolved intensively in the past few years. One of the features of EVs is that they are noiseless, particularly at low speed (Bräunl, 2012). As there is no internal combustion engine in these vehicles, the only sound it makes is of tyres against the road and resistance against the wind (Bräunl, 2012). From one perspective, it might seem like an advantage that EVs do not create noise pollution (Cocron et al., 2011; Franke et al., 2012; Skippon & Garwood, 2011). However, there is another side to it, people have been driving ICVs for over a century and after driving such vehicles for such a long period of time, the noise coming from the engine is hardwired into the brain. The engine sound not only assists a driver in guessing the gear position but also helps pedestrians by acting as a warning signal in regards to the approaching vehicle (Cocron et al., 2011). The engine sound aid in determining a not exact but a rough guesstimate about the position of a moving vehicle in the mind, that way, pedestrians could adjust their position accordingly based on the source of the noise. Without the

engine noise, accidents could happen with pedestrians (Bräunl, 2012; Patil & Khairnar, 2021) and in order to curb it, noise is necessary.

Moreover, noises from the vehicle not only have a utilitarian value, but rather they also add to the appeal of the vehicle and increase its desirability (Viola, 2021). Thus, without the engine noises, EVs would not be able to make many noises in the automotive market.

### **Lack of Fun**

People not only drive for some particular purpose or just getting from one place to another, but they also drive for sheer pleasure. Power, noise, and other factors that make a vehicle desirable seem to be missing in EVs. Even if they find some of the attributes like power, it comes with a hefty price tag. Due to this, customers who want to buy for the pleasurable and exciting driving experience may find EVs not up to their expectations (Gelmanova et al., 2018). People perceive EVs as boring and not fun to drive (Krishna, 2021). The adrenaline rush and power a driver feels when he or she drives a conventional vehicle seems to be missing in EVs.

### **Fear of Explosion**

The introduction of batteries in vehicles revolutionised the automotive industry in the past few decades. These days, Lithium-Ion batteries are quite popular among other batteries (Duan et al., 2019). However, incidents like catching fire in batteries followed by smoke, toxic gases, jet flames and even explosion are raising significant concerns regarding fire safety issues (Sun et al., 2020). The batteries of EVs get overheated (Duan et al., 2019; Krishna, 2021; Viola, 2021) and in some instances catches fire and releases toxic gases and chemicals (Duan et al., 2019; Krishna, 2021). Due to several incidents reported in newspapers and other news media (Sun et al., 2020), people are concerned and fear its adoption (Aalund et al., 2021; Krishna, 2021; Sun et al., 2020; Viola, 2021). However, these fire incidents are mostly reported during traffic accidents, extreme weather conditions, and other situations where the battery is exposed to some harm such as leakage (Krishna, 2021; Viola, 2021). Still, people are not very comfortable driving and adopting EVs and worry about their safety. The uncertainty about the mishap and the lack of assurance concerning safety create psychological barriers.

### **Lack of EV awareness**

EVs are a step in changing the existing automotive industry scenario. Without a proper strategy, this change cannot happen positively and swiftly. One of the important aspects of change management is to teach the audience about the change that is about to happen (Elving, 2005),

particularly in developing countries. Increasing awareness about EVs is vital to the adoption of EVs(Wang et al., 2018). To put it differently, one of the major barriers to electric vehicle adoption is the lack of awareness about EVs. Due to the lack of awareness about electric vehicles, people are not adopting them (Larson et al., as cited in Kushwah & Tomer, 2021). The awareness range differs from country to country. In a 2008 survey, in the US, around 70 per cent of the consumers were not so acquainted with plug-in hybrid electric vehicles (Axsen & Kurani, 2008), but as time passed, the awareness has been increased substantially (Miller et al., 2022). Some research had been conducted around general awareness. However, it is found that even if consumers are aware of electric vehicles, they lack knowledge of the benefits of EVs. For example, the low maintenance and running cost of electric vehicles should be highlighted in order to encourage the adoption of EVs(Rastogi et al., 2021). Additionally, not only the electric vehicles but also the factors attached to them, and their awareness influence the purchase and adoption decision. That is, a study conducted has shown that around 80 per cent of the respondents do not have enough information regarding where and how to charge EVs (Chlebišová et. al., as cited in Simonik et al., 2012). To increase awareness, EV manufacturers and dealers should arrange events and programs that would educate people about the benefits of EVs(Shetty et al., 2020).

### **Resistance to Change**

Change is the only constant. Nonetheless, due to uncertainty about the future, insecurities develop and promote resistance and the maintenance of the status quo. The same is the case with EVs. As EVs have entered the market, people are apprehensive about their adoption and directly or indirectly not open to adopting EVs. It has been found that resistance to change is linked with purchase intention for EVs(Gia Ninh, 2021). With conventional vehicles, people have become familiar and comfortable, whereas EVs are new and right now it is not time tested. Being a developing country, people from India look from an economical point of view when making buying decisions. EVs cost, high prices of batteries, and low reselling costs are creating a resistance to adopting EVs (Bohnsack et al., as cited in Gia Ninh, 2021). There are several factors that could act as a promotor of resistance or barriers when it comes to adopting EVs. The resistance could be overcome by educating people about EVs, especially about the advantages EVs could bring to them as a whole (Digalwar et al., 2021).

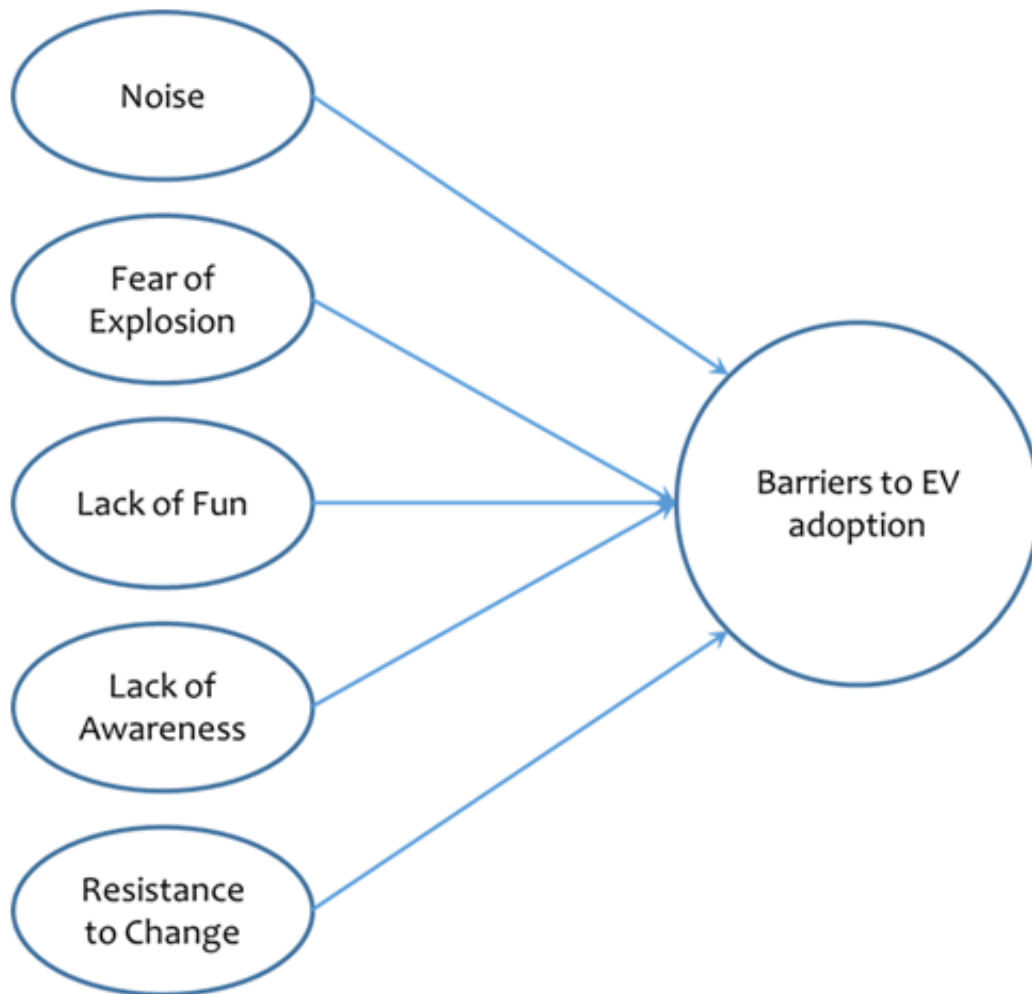
### **3. Method**

The present study follows a two-step process. The first step was the review of the literature and the second was the development of a theoretical model as per the understanding gained from the

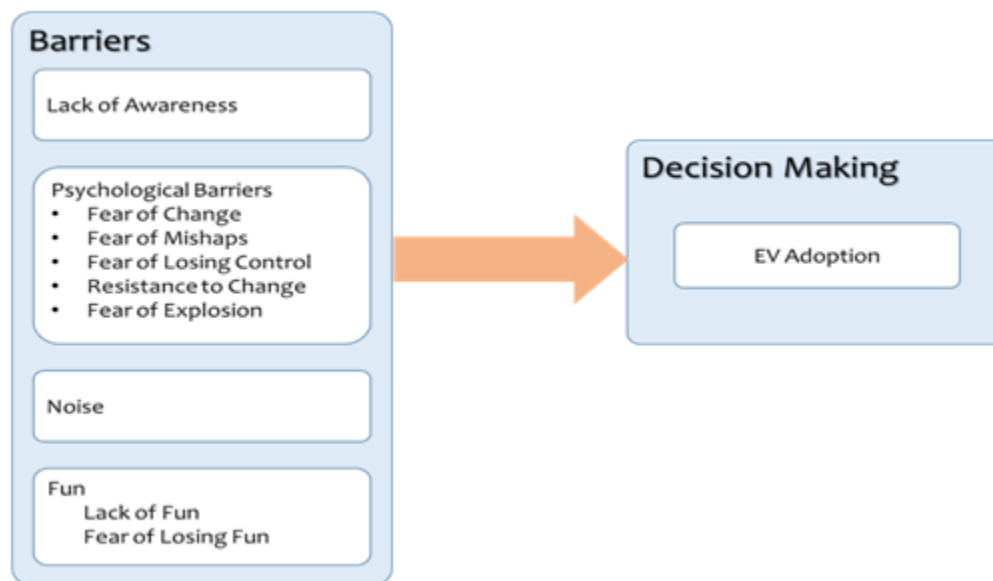
review of the literature. For the review of relevant literature, we first searched the two databases (i.e., Scopus & Google Scholar) using keywords such as ‘electric vehicles in India’, ‘electric cars in India’, and ‘barriers to electric vehicles’. Papers that seem relevant were sorted. Abstracts of these sorted papers were read and if found appropriate for the present study, twenty papers were selected and reviewed. The prominent themes as per the research aim were conceptualised and linked together on the basis of prior research in the relevant area the linked concepts were formed into a model supported by existing research.

#### 4. The Conceptual Model

**Figure 1 Barriers to Adoption**



**Figure 2 The Proposed Model of Psychological Barriers to EV Adoption**



We in this paper proposed a theoretical model based on the understanding gained subsequent to reviewing the literature relevant to this study. The proposed model revolves around the lack of awareness, fear, and insecurities regarding the entry of EVs into the market. When there is a lack of awareness and an element of novelty, fear and insecurities develop. Psychological insecurities interfere with the decision-making process and promote status quo bias (Samuelson & Zeckhauser, 1988; Van Ruth, 2019). Research suggested that when faced with complex decision-making, people tend to prefer to maintain the status quo (Fleming et al., 2010). Due to the fear and insecurities people have in their minds regarding EVs, people are finding it difficult to decide on EVs and as it is difficult to make a decision regarding EVs, they prefer to maintain the status quo. This status quo bias is causing slow progress when it comes to the adoption of EVs in India.

The noise of the engine and the vehicle is not just giving an idea regarding the proximity of the vehicle, speed, and power of the vehicle, but it is a source of safety. The nature of sound and its relative position to the listener act as a safety barrier to human beings and other species. In electric vehicles, this safety parameter is missing and creates fear and insecurities in people's minds regarding their safety while being on the road. Similarly, the incidents that are reported

related to mishaps (such as fire, the release of toxic gases and flames, etc.) caused by EV batteries also make people uncomfortable and promote fear and restlessness when it comes to trying EVs. Along the same line, there is a fear to lose the fun that people usually experience while driving ICVs. Even though this fear is not overpowering, it is there and contributes to the avoidance of the new entrant.

The lack of awareness and knowledge about EVs worsen the situation by intensifying fear and insecurities and further stimulating status quo mode. These psychological fear and insecurities make decision-making tough in regard to replacing ICVs with EVs, buying new EVs, and adopting it. In general, when people are faced with complex decisions, they incline to choose the status quo, which is, maintaining the same status in which they are present. The status quo mode is accompanied by resistance to the adoption of EVs.

## **5. Discussion**

The present paper proposes and discusses a conceptual model of how psychological barriers could affect the adoption of EVs negatively. The model discusses five major psychological barriers based on the prominent themes that surfaced while we reviewed the relevant literature as per the research aim for this study. The five psychological barriers that surfaced have a common theme that is, fear. To be precise, fear of change, fear of mishaps, fear of losing fun and control. This fear and insecurity make decision-making difficult and complex (Van Ruth, 2021; Samuelson & Zeckhauser, 1988). When decision-making gets complex, research evidence has suggested that then people tend to maintain the status quo (Fleming et al., 2010). In other words, they just do not make any decisions and continue with their existing position. The same is happening with the EVs in India as of now. There are psychological fears and insecurities among different stakeholders associated with EV. These fears and insecurities are interfering with the decision-making when it comes to the adoption of EVs. And as existing research suggests due to difficulty in decision-making, people in India are rather preferring to maintain the status quo. This status quo state is hindering the adoption of EVs in India. EVs are making progress, however, slow, and gradual. There is a need for intervention in order to tackle the status quo.

By providing honest and enough knowledge about EVs backed up by evidence, fear and insecurities could be reduced. Awareness should be increased about EVs, and the myths need to be busted. Reducing uncertainty and ensuring the interest of all stakeholders could lead to more acceptance and eventually adoption of EVs in India.

## **6. Scope for Future Research and Limitations**



The present model proposed in this paper, even though supported by several past research, has not been tested empirically. Additionally, the link between psychological barriers and the adoption level of EVs is not direct in the present model. A scale of psychological barriers based on the construct mentioned in the model could be constructed along with the EV adoption. There are several limitations to this conceptual research. As mentioned earlier, the model is based upon the conceptualisations and research support drawn from the review of relevant literature. That is, this needs to be empirically tested. The model is not straightforward. It is an indirect model. The review of literature has its limitations. We limited this research to three databases (i.e., Scopus, and Google Scholar) and the papers that we found suitable were based on our research purpose and the knowledge and experience that we have.

## **7. Conclusion**

The proposed model tries to explain the role of psychological barriers that seem to be affecting the adoption of EVs in India (however, the model could be applied anywhere in the world as it is based on the general concepts applicable across the world). The model also attempts to describe the process and the linkages of how psychological barriers in the case of EVs could lower the adoption of EVs among customers. The model could be used to explain one of the major causes of lower adoption of EVs and it suggests the antecedents that could cause hindrance in the adoption. By taking care of antecedents of slow adoption, slow adoption could be prevented. In this case, the antecedents are the five variables (i.e., noise, resistance to change, lack of fun, lack of awareness, and fear of explosion) and together these form a psychological barrier to EV adoption as per our literature review. So, if we focus on the antecedents, which is the starting point in this model, and deal with them by reducing them, it will ultimately positively affect adoption.

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