



Fear and loathing of electric vehicles: The reactionary rhetoric of range anxiety

Lance Noel^{a,*}, Gerardo Zarazua de Rubens^a, Benjamin K. Sovacool^{a,b}, Johannes Kester^a

^a Center for Energy Technologies, Department of Business Development and Technology, Aarhus University, Denmark

^b Science Policy Research Unit (SPRU), School of Business, Management and Economics, University of Sussex, United Kingdom

ARTICLE INFO

Keywords:

Electric vehicles
Range anxiety
Reactionary rhetoric
Diffusion of innovation

ABSTRACT

“Range anxiety,” defined as the psychological anxiety a consumer experiences in response to the limited range of an electric vehicle, continues to be labelled and presented as one of the most pressing barriers to their mainstream diffusion. As a result, academia, policymakers and even industry have focused on addressing the range anxiety barrier in order to accelerate adoption. Much literature recognizes that range anxiety is increasingly psychological, rather than technical, in its nature. However, we argue in this paper that even psychological and technical explanations are incomplete. We examine range anxiety through Hirschman’s Rhetoric of Reaction, which supposes that conservative forces may oppose change by propagating theses related to jeopardy, perversity, and futility. To do so, we use three qualitative methods to understand the role of range anxiety triangulated via a variety of perspectives: 227 semi-structured interviews with experts at 201 institutions, a survey with nearly 5000 respondents, and 8 focus groups, all across 17 cities in the five Nordic countries. We find evidence where consumers and experts use and perpetuate the rhetoric of reaction, particularly the jeopardy thesis. We conclude with a reexamination of the policies geared to assuage range-based barriers, which a construction of range anxiety as a rhetorical excuse would render as ineffective or inefficient, as well as future implications for diffusion theory.

1. Introduction

It has been well established that electric vehicles (EVs) have potentially substantial societal and individual benefits when compared to internal combustion engine vehicles (ICEVs). For example, EVs have several environmental benefits, namely climate change mitigation [1] and the improvement of public health [2]. In addition, EVs can help integrate intermittent renewable energy sources and provide grid storage [3,4]. Finally, EVs can provide several benefits to individual consumers, such as fuel savings, better performance and noise reduction [5–7]. Nonetheless, despite the potential benefits, global EV deployment remains distressingly low, representing less than 1% of the global fleet [8].

Recent literature has investigated the variety of barriers that EVs face, and generally found that typical barriers include price, range, charging infrastructure, and consumer perceptions. For example Sovacool & Hirsch, implementing a qualitative literature review, found that EVs faced a variety of barriers, including price, conflicting social and cultural values, and institutional inertia [6]. Secondly many transport economists have attempted to quantify the barriers in choice

experiments, typically finding that price, range, and charging infrastructure/time are the most costly barriers [9–12]. Other more recent literature have also consistently found similar yet varied barriers. For example, Graham-Rowe et al., utilizing test drives and interviews, found that price, range, aesthetics and symbolic value were the primary barriers to EV adoption [13]. Finally, Rezvani et al. conducted a comprehensive literature review, found that price, range, and consumer perceptions and knowledge to be central and consistent barriers, among various others [14].

Thus, range and range anxiety is a prominent fixture in the literature as one of the more substantial barriers to EV adoption. A litany of studies articulate how range poses a barrier to EV adoption, firstly by investigating the technical requirements of an EV (e.g., (15)), or based on the psychology and inexperience of the consumer (e.g., (16)). Curiously, however, the understanding of range anxiety is still nebulous, especially as it continues to persist as a barrier despite the increasing range of EVs, the development of public charging infrastructure, and more consumer education and experience.

Reviewing the literature, we are left with several questions about the nature of range anxiety. Is range anxiety a true barrier to EV

* Corresponding author.

E-mail address: lnoel@btech.au.dk (L. Noel).

adoption? If so, is range anxiety technical or mental, or both? Does range anxiety decrease with experience or not? We argue that these questions cannot be resolved with the current understanding of range anxiety, but instead introduce a rhetorical construction of range anxiety, based on the rhetoric of reaction, which holds that conservative forces and actors will often resist new innovations, social changes, or threats through rhetoric centering on jeopardy, perversity, and futility [17].

In doing so, we apply Hirschman's Rhetoric of Reaction to individuals in the context of diffusion of innovation [18], specifically, as part of the adoption decision process. We argue that range anxiety mirrors the reaction Hirschman describes in his book [17] and can, at times, be construed as a knee-jerk, polemic reaction, which makes range anxiety more difficult to understand scientifically, as the current literature has attempted. Therefore, this paper aims to explore the use of reactionary rhetoric in terms of individuals invoking range anxiety, utilizing a variety of qualitative and quantitative methods, including expert interviews, focus groups and surveys.

Compared to the current literature, the paper aims to make three contributions. First and foremost, the introduction of reactionary rhetoric to range anxiety gives a better and more comprehensive understanding of range anxiety, and it offers a novel addition to EV barriers literature. Secondly, rhetorical range anxiety brings a new context to the EV policy debate, since rhetorical performances and narratives about range anxiety may impact the efficacy of policy solutions to the technical and psychological aspects of range anxiety, such as public charging infrastructure investments or education and experience campaigns. Thirdly, we translate the theory of reactionary rhetoric, typically used for reactions to a societal or policy reform, to individual's reaction to an innovation, improving the understanding of consumer motivations to reject or adopt an innovation and providing a better understanding of anti-innovation reaction in the diffusion process.

The remaining paper is constructed as such: first, we review the current understanding of range anxiety, followed by introducing the theory of rhetoric of reaction, and then deducing the rhetoric of reaction to individuals, via diffusion of innovation theory. We then explain our methods before moving onto the results, showing the three theses of reaction in use by consumers and experts in the Nordic region. The paper concludes with a discussion of the future of range anxiety and rhetoric in EVs, and possibilities for future research.

2. Literature review and conceptual approach

In this section, we more comprehensively summarize recent literature on range anxiety, introduce our conceptual approach of the rhetoric of reaction, and lastly adapt its use for the purposes of this study.

2.1. Range anxiety in the academic literature

Range anxiety—the idea that consumers are psychologically sensitive to the limited range of an EV—is fairly well-studied, but as a concept, poorly understood. In our review of the literature, we came across various definitions and uses of the concept of range anxiety. For example, in Franke & Krems [16], range anxiety means a psychological response to the stressful situation of the battery running low (i.e. mostly focusing on the “anxiety” aspect), whereas King et al. [19] use it as a term for when a driver needs to drive a longer distance than the EV is usually capable of going in a single charge like 100 kilometers (i.e. focusing on the “range” aspect), or sometimes a combination of both [20]. Thus, in this section, we aim to develop a more complete definition of range anxiety.

On its face, the range of an EV is an obvious disadvantage when compared to a conventional ICEV. Certainly, there is a technical limitation of EVs that restricts its overall utility as compared to an ICEV. Thus, there is clearly a technical component to range anxiety – the

simple fact that the range of an EV may be insufficient to complete a trip that a consumer wants to take.

To understand the extent of this issue, a variety of researchers have investigated the capability of EVs to complete consumer trips, as compared to consumer travel surveys. Using an outdated EV range of 100 miles, Pearre et al. found that an EV could fit 95% of consumer's driving needs if people were willing to alter their behavior no more than 10 days a year [15]. Even after substantial degradation of the EV's battery, such as 20% capacity loss, EVs can still meet the daily travel needs of over 85% of all U.S. drivers, leading Saxena et al. to conclude that “range anxiety may be an over-stated concern” ([21] at 275).

Moreover, if one were to assume a reasonable amount of public charging infrastructure, then range anxiety is even less of a concern. For example, Zhang et al. found that only 290 charging locations could enable EVs to cover 98% of all driving in California (and 88% of long distance driving) [22]. Similarly, Neubauer & Wood found that even lower speed charging (i.e., level 2 charging) could help EVs come close to a 100% utilization rate, for all intents and purposes, completely obviating range anxiety [20]. While there is certainly a technical aspect of range anxiety, with a few exceptions, technical range demand is unlikely to pose a serious barrier to EV acceptance. Thus, we have to conclude that range anxiety is more than just a technical construction, and moreover, that discussions of range in general should keep in mind the overall technical sufficiency of EVs. That is, discussions of range anxiety and valuation of range should be viewed in the larger context where range is technically sufficient.

Of course, such a conclusion is not necessarily novel. With some growing recognition that range anxiety is not based on purely technical travel demand, some researchers have investigated the rationalization behind consumer's insistence on range anxiety as a primary barrier to their adoption. To distinguish between technical and the psychological aspects of range anxiety, Franke & Krems proposed three reference values for range utilization: competent, performant, and comfortable range [16], where competent and performant range focus more on EV's technical capacity of range and actual range in use, respectively, but comfortable range is more psychological, based on consumer's comfort with limited range resources. Additionally, comfortable range underscores a fear that occurs *while* driving, but psychological range anxiety can, and often more typically, will occur before consumers drive EVs, as they *expect* to experience range anxiety.

Either way, if range anxiety culminates as a psychological fear, but not a technical barrier, then it follows that experience with EVs would educate consumers that they could comfortably reach the vast majority of their trips without feeling anxious about the range left in their battery. In support of this thesis, Franke et al. found that after 12 weeks of EV use, the average consumer reduced their range safety buffer from 13.8 kms to 6.9 kms, implying that consumers became more comfortable with the range of their EV and experienced less anxiety [16]. Similarly, another study found that experienced drivers in Norway rarely considered range anxiety to be a significant problem [23]. Finally, Rauh et al. showed that experience allows EV drivers to be less psychologically stressed by situations when the remaining range of the EV is low, and urged further education and experience of consumers [24].

On the other hand, there is also evidence that experience does not decrease range anxiety or demand for additional range, implicating both the technical and psychological constructions of range anxiety. For example, in another study, Franke et al. found that after 3 months of experience, range was actually mentioned *more* often as a barrier to EV deployment [25]. Similarly, Jensens et al. found that experience with EVs *doubled* the valuation of EV driving range, making it the most critical factor for EVs, both before and after experience [26]. Buhler et al. also found that limited range was the most discussed barrier by consumers both before and after experiencing an EV, despite the fact that the average trip taken by the participants in their study was only 17 km [27], which conflicts with current understandings of psychological and technical aspects of range anxiety. These consumers may be

Download English Version:

<https://daneshyari.com/en/article/11012760>

Download Persian Version:

<https://daneshyari.com/article/11012760>

[Daneshyari.com](https://daneshyari.com)