CHOOSING THE ELECTRIC CAR

Colin Whittle and Lorraine Whitmarsh

ABSTRACT

In this chapter, we draw on social science theoretical and empirical literatures to discuss the factors that influence buying and using an electric vehicle (EV), as well as how adopting an EV can impact on other travel choices or broader sustainability behaviours. We provide an overview of theories of technology adoption, which expose the interplay of individual, technological, and societal factors that dictate how rapidly a technology will spread throughout society. From the empirical literature, we show that far from being a purely economic or pragmatic decision, choosing an EV is also deeply grounded in social, moral and personality factors, such as self-presentation, norms and values, and appetite for risking the novel. Furthermore, since running an EV is not the same as running an internal combustion engine vehicle (ICEV), we explore how adopters adjust their behaviour to the technology, and also how EV ownership may trigger or undermine broader shifts in lifestyle required to achieve climate change and other sustainability goals. We therefore provide a critical reflection on the drivers, barriers, and behavioural implications of choosing an EV.

Keywords: Adoption; diffusion; behaviour change; electric vehicles; identity; innovativeness; cost

Citation

Whittle, C. and Whitmarsh, L. (2022), "Choosing the Electric Car", Parkhurst, G. and Clayton, W. (Ed.) *Electrifying Mobility: Realising a Sustainable Future for the Car* (*Transport and Sustainability, Vol. 15*), Emerald Publishing Limited, Bingley, pp. 97-115. https://doi.org/10.1108/S2044-994120220000015008

INTRODUCTION

In this chapter, we review both theoretical and empirical literatures relevant to EV adoption and show that far from being a purely economic or pragmatic decision, choosing an EV is also deeply grounded in social, moral and personality factors, such as self-presentation, norms and values, and appetite for risking the novel. We also discuss how adopters adjust their behaviour to the technology, and also how EV ownership may trigger or undermine broader shifts in lifestyle required to achieve climate change and other sustainability goals.

THEORIES OF TECHNOLOGY ADOPTION

There is an extensive literature on the factors affecting consumer acceptance of innovations, including new technologies. These range from broad socio-technical theories that describe adopter and innovation characteristics together with diffusion channels and dynamics, to more psychological theories that describe individual decision-making processes about whether to adopt and how to use an innovation. Rogers' (1995) Diffusion of Innovation theory is seminal to understanding adoption and wider diffusion; while the Technology Acceptance Model (Davis, 1989) is an example of a more social cognitive theory of consumer adoption.

Common to these theories is the recognition that adoption is not a single event but rather a development of beliefs in a changing context, which may result in one or more purchase decisions, and the subsequent use of the new product(s) (Straub, 2009). They also identify three sets of characteristics that influence both adoption and diffusion: individual characteristics (personality traits or demographic factors), innovation characteristics (its ease of use and compatibility with users' lifestyle), and contextual characteristics (e.g. media discourse, organisational needs; Straub, 2009). Rogers (1995) identified 'early adopters' of an innovation to have particular personality traits that seek change and novelty, take risks, have higher income and status, and access to change agents (e.g. media). He also identified important innovation attributes to include: its relative advantage over current alternatives, compatibility (with needs and lifestyles), complexity (ease of use), trialability, and observability (through peer use or media coverage). Davis (1989) similarly highlighted ease of use and usefulness as key attributes of successful technological innovations, while recognising that perceptions of these attributes vary across individuals. Communication channels (media and peer networks) and wider social processes then shape whether and how quickly the innovation diffuses through a population. Over time, innovations typically follow an s-shaped curve, with diffusion speeding up once a critical threshold or tipping point of early adopters has been reached and the majority of consumers start to adopt, with the late adopters (or 'laggards') finally following suit (once economic and other barriers have diminished; Rogers, 1995).

Both trying out a new product oneself and observing others buying or using it can significantly influence someone's decision to adopt. Free trials or in-store demonstrations are often use by marketers to induce consumers to adopt new products; for example, a free bus ticket to try the bus led new residents to start regularly using it (Bamberg, 2006). For some innovations, users may require specific skills which can only be acquired through familiarisation and practice. For example, cargo bike adopters are more likely to be people with proficient cycling skills (Hess & Schubert, 2019). Human beings learn from their own experience but also by observing and listening to other people (Bandura, 1977). Social norms – the informal rules that govern action, based on what is considered common and appropriate behaviour – strongly shape people's behaviour (Ajzen, 1991). People are most likely to be influenced by people in their own social circle or who they consider 'like them' (Tajfel & Turner, 1979). This includes friends, family, colleagues and neighbours; for example, 'neighbourhood effects' (i.e. consumers more likely to adopt a product if their neighbours have it) are evident for various innovations, such as solar panels (Kosugi et al., 2019). Social processes are thus central to why consumers adopt new technologies and how they become established in society.

It is the interplay of individual, technological, and societal factors that dictates how rapidly a technology will spread throughout society and how it might in turn reconfigure this wider context. While many new technologies substitute (or co-exist with) predecessors without disrupting wider routines, institutions, and infrastructures; some are more disruptive and trigger transformation of social practices, institutions, and infrastructures (Shove et al., 2012), as considered by Dijk in Chapter 5. Examples of transformative change include the transition from horse-drawn carriages to automobiles, which by creating fast, flexible, private mobility enabled new leisure functionalities of vehicles, such as racing and touring (Geels, 2005). Physical infrastructures (roads, fuel stations, etc.), dispersed urban planning, and cultural norms have grown up and now lock-in the system of automobility (Urry, 2004).

WHAT INFLUENCES THE ADOPTION OF EVS?

Costs and Leasing Options

EVs currently have a higher upfront purchase cost relative to ICEVs of comparable specification. Such upfront costs are frequently identified as being a barrier to the adoption of EVs (Brückmann et al., 2021; Coffman et al., 2017; Singh et al., 2020). However, other cost differences between EVs and ICEVs may be more favourable for EVs, such as the cost of running and the cost of maintenance; these aspects are considered as the total cost of ownership of an EV (Liu et al., 2021). Although the potential for the total cost of ownership to offset the higher upfront cost is debated and likely to differ between locations (Breetz & Salon, 2018; Coffman et al., 2017), there is some evidence that presenting a lower total cost of EV ownership (i.e. both fuel and other operating costs) than the total cost of ICEV ownership had a positive effect on intention to purchase an EV. However, only presenting fuel savings did not have an effect (Dumortier et al., 2015).

Given the importance of the upfront costs, policies that incentivise EV purchases through subsidies or tax exemptions have been found to be related to EV uptake (Kumar & Alok, 2020). However, upfront costs (and total costs of ownership) of EV purchasing could also be reduced through alternative business models, including leasing (Nurhadi et al., 2017). Only a few studies have investigated acceptance of alternative business models for EVs. For instance, Liao et al. (2018) found, that at the aggregate level, the availability of a leasing option did not increase preferences for EVs. However, in the same sample, Liao et al. (2019) found that, out of purchasing, battery leasing, and vehicle leasing, vehicle leasing was the preferred business model for EVs. In contrast, purchasing was the preferred business model for ICEVs and plug-in-hybrids. As such, different vehicle types may benefit from different business models.

Psychological factors may also play a role in preferences for EV leasing versus purchasing. Huang and Qian (2021) investigated the relationship of two psychological traits, need for uniqueness (distinguishing self from others through choice and use of consumer goods) and risk aversion, with intentions to lease an EV or share an EV (i.e. a business-to-consumer model). They found that a need for uniqueness had a positive relationship with intention to lease or share an EV. This relationship was mediated, however, by the view that EVs can symbolise personal success and that EVs are a part of the future. In contrast, risk aversion was negatively associated with the intention to lease or share an EV, although not with purchasing an EV. This suggests that, in the Chinese market, the risk-averse may feel that leasing or sharing an EV is too risky for them compared to purchasing one. Generally, though, the intention to lease or share an EV was positively associated with intention to buy an EV.

Range and Charging Concerns

Although charging infrastructure and the driving range of EVs have increased to meet the vast majority of trip needs (Hirst et al., 2021), concerns for range continue to be cited by participants (Axsen et al., 2017; Giansoldati et al., 2020) and experts (Noel et al., 2020) as one of the main barriers to EV adoption. Accordingly, greater driving range has been found to be positively associated with EV adoption intentions (Liao et al., 2018; Yang & Chen, 2021). However, despite its identified importance, studies have highlighted that battery capacity is not a stand-alone concern and interacts with other elements of the EV to form range anxiety (broadly considered to be a negative reaction to the perceived abilities of an EV to meet the requirements of an individual's desired journey(s); Chen et al., 2020), including concerns for the availability of charging stations (Kumar & Alok, 2020), and the speed at which the battery can charge (Giansoldati et al., 2020; Noel et al., 2020). For instance, shorter charging times and greater availability of public charging infrastructure can reduce battery capacity concerns (Coffman et al., 2017; Dimitropoulos et al., 2013). As such, range anxieties may be somewhat assuaged by the availability of public, rapid charging stations (Brückmann et al., 2021; Zhang et al., 2021), although it has been suggested that concerns related to the availability, location, payment process, and operability of EV public rapid charge points could still generate negative experiences, at least for newer EV drivers (Chamberlain & Al Majeed, 2021). Furthermore, in an EV field trial, trust in the EV's range estimator was found to be negatively associated with stress about range when the battery became low (Pan et al., 2019).

Related to range anxiety is the EV owner's concern for the battery's state of charge (SOC) before they undertake a journey (Pan et al., 2019). Individual differences have also been found in charging behaviour and state of charge; with those who are risk-averse ensuring they have battery charge in excess of what is required for their journey and those who are risk-seekers balancing their battery's state of charge with the current price of charging (Pan et al., 2019). Such concerns for state of charge have also been found to relate to acceptance of smart charging, which is discussed in the Smart charging section below.

Environmental Credentials

An attribute which is often used to distinguish EVs from ICEVs is their relative impacts on the environment. Often, EVs are presented as way of decarbonising transport and for reducing air pollution (e.g. UK Government, 2021), but there are negative environmental implications as well, including those related to battery production and disposal (Hirst et al., 2021), or increased manufacturing emissions (Chen et al., 2021). It is beyond the scope of this chapter to discuss the technical aspects of these implications, however, their impact on EV adoption has been investigated. For instance, Noel et al. (2019) found, across five Nordic countries, there was a willingness-to-pay value of between €16,000 and €25,000[1] for EVs that are charged exclusively by renewables or hydropower. Indeed, in some studies, the perceived environmental benefits of EVs were found to be of more importance to EV adopters than the fact the running costs were lower than the ICEVs' (Khurana et al., 2020; White & Sintov, 2017). Likewise, the desire for price value and for range confidence were found to be less influential factors for EV purchase intentions than the EV's environmental performance (Degirmenci & Breitner, 2017). However, although the participants felt that EVs could be environmentally sustainable and desired it for their EV, they also felt that the electricity used to charge the batteries would need to come from renewable sources (Degirmeci & Breitner, 2017). Indeed, in focus groups, the environmental sustainability of EVs was discussed, particularly the benefits of reduced air pollution at the point of use, but also issues with how batteries are produced and recycled (Axsen et al., 2017; Kester et al., 2019). Swiss research also found that concerns about the unsustainability of EVs was the second most common barrier to EV adoption (after high purchase price; Brückmann et al., 2021). Kester et al. (2019) pointed to how the participants in their focus groups desired answers about the relative environmental consequences of EV adoption and so argued that there is a need for trustworthy communications which can meet the varied environmental information needs of potential EV adopters.

Demographics and Early Adopters

Those who have adopted an EV are considered to be early adopters (Rogers, 1995). Studies have explored the characteristics of early adopters to gain an indication of what factors are associated with the actual adoption of EVs. For instance, in a sample of 340 early EV adopters, Hardman et al. (2016) found that the majority identified as male (92.6%)[2] had an income of over $90,000 per year (76.5%), had a university degree or higher (85.1%), and were between the ages of 35 and 64 (73.8%). Such characteristics were also found in early EV adopters in Sweden (Vassileva & Campillo, 2017). However, unlike previous early adopter studies, Hardman et al. (2016) then made a distinction between the type of EV owned and compared the groups in terms of their socio-economic characteristics. Compared to early adopters of low-end EVs (which the authors of the study defined as $30–40,000 with a range of <100 miles), early adopters of high-end EVs (defined as EVs costing $70,000–105,000 with a range of 270 miles) were found to be older, with a greater majority having a university degree or higher (92.3% vs. 78.9%), and a higher annual income (although both groups could be considered to have relatively high incomes).

Innovativeness

Morton et al. (2016) define innovativeness, at a general level, as 'a characteristic which relates to an individual's basic tendency to adopt new innovations' (p. 19). As the EV represents an innovation, a number of studies have investigated how an individual's degree of innovativeness relates to their intentions towards, and perceptions of EVs. Morton et al. (2016) found, in a UK sample that innate innovativeness (operationalised as the amount of technology they wished to own in the near future) was (weakly) positively associated with preferences for EVs. Likewise, in China, innovativeness was found to have a positive, mediated relationship with intentions to purchase EVs via an increased perception of monetary benefits and a decreased perception of risks (of the technological limitations of EVs). It also had a direct, positive association with EV purchase intentions (He et al., 2018). Also in China, Yang and Chen (2021) explored the association between innovativeness and preferences for the different aspects of an EV, rather than the EV as a whole. They found that across two cities in China, innovativeness was negatively associated with a preference for charging availability, which the Yang and Chen (2021) argue indicates less concern for technical risks or practical barriers. Different findings were then found between the cities. In the larger city, innovativeness was also negatively associated with preference for reliability, but positively associated with a preference for reduction of CO_2 emissions. However, in the smaller city, innovativeness was negatively associated with driving range and charging time preferences. These differences demonstrate that innovativeness can be differentially associated with different aspects of an EV and that this may vary by location. Overall, though, innovators seem more willing than later adopters to overlook certain practical barriers in adopting an EV.

Environmental Identity, Symbolism, and Social Influence

As noted, the environmental credentials of EVs are frequently discussed. Accordingly, individuals' environmental beliefs, concerns, identities, and values have each been extensively investigated in terms of how they relate to many aspects of EVs, including the individuals' perceptions, intentions, attitudes, adoption, and preferences of, and towards, EVs with mixed findings (Coffman et al., 2017;

Kumar & Alok, 2020; Singh et al., 2020). In terms of self-identity, for instance, relatively early studies found that more strongly self-identifying as pro-environmental was positively associated with positive beliefs about the functionality, pleasantness, and lifestyle fit of EVs (Schuitema et al., 2013) and that believing an EV would have a positive outcome for their self-identity was positively associated with participants' intentions to adopt an EV (Noppers et al., 2014).

It has been argued that EVs can have symbolic meanings for the user, which might be used to express – or need to align with – their self-identities (Rezvani et al., 2015). In line with this, White and Sintov (2017) proposed that the more an EV is perceived as symbolising or reflecting a pro-environmental or innovative self-identity, the more likely adoption will be. They then found that those who believed owning an EV would symbolise their pro-environmental identity had more favourable perceptions of EVs, indicated a greater willingness to buy, and a higher willingness to pay than those who did not believe the symbolism as strongly. This was also found, although not as strongly and not for willingness to pay, for the belief that owning an EV would symbolise being a social innovator (measured as EV adoption symbolising being a trendsetter and acting for the good of society). These symbolic attributes of the EV were more consistent and strongly associated with the outcomes than the instrumental factors (including purchase costs, maintenance costs, and fuel costs), psychological factors (concern about climate change, car identity, and past pro-environmental behaviours), and demographic factors. Furthermore, these symbolic beliefs mediated the positive relationship between concern for climate change and willingness to buy an EV. These findings suggest that these participants were motivated by the perceived symbolism of the EV and that those who had a greater concern for climate change had stronger perceptions of the EV as a symbol of pro-environmental and social innovator identities and so, a stronger intention towards EV adoption.

Alongside considerations of what an EV symbolises, further social influences have been found to have a role in EV adoption. Pettifor et al. (2017) identified three forms of social influence within the vehicle choice literature. These were interpersonal communication (i.e. the exchange of information relating to the vehicle), the neighbourhood effect (i.e. gaining information by observing proximal users of the vehicle), and social norms (both perceptions of what others do (i.e. descriptive norms) and of what they approve or disapprove of (i.e. injunctive norms). From a meta-analysis of these studies, a small to medium effect size was found, suggesting that both choice of ICEVs and alternative fuel vehicles (AFVs) (including EVs) were affected by all three social influences. The strength of the effect was equal for each social influence type. In line with this, Jansson et al. (2017) used sales data to investigate the influence from neighbours (operationalised as the percentage that were AFVs out of all the cars owned by neighbours), family members, and co-workers (operationalised as the percentage of family members and co-workers, respectively, who owned an AFV). The associations of family member and co-worker influences became non-significant once demographic variables were entered. However, the neighbour influence still had a significant, positive relationship with purchase of an AFV, suggesting that observing use of AFVs can have a positive association with adoption of an AFV.

Experience and Trust

Through a literature review and consultation with experts, Shao et al. (2016) argued that consumers lacking trust in the claims made in the marketing of sustainable products may act as a barrier to the adoption of more environmentally sustainable products. In line with this, Yang et al. (2020) found that trust in an EV brand was positively associated with perceiving benefits of the EV. This association was stronger than the one between product knowledge and perceived benefits. Brand trust was also negatively associated with perceiving risks of EVs.

Experience of an EV may provide the opportunity for individuals to overcome concerns about the functionality of EVs and gain knowledge of them (Burgess et al., 2013; Schmalfuß et al., 2017). Indeed, from a literature review Li et al. (2017) identified experience of EVs as being a positive factor in EV adoption, although it has not always influenced participants' attitudes or intentions. Generally, early trials of EVs have found that, following experience, positive perceptions of the performance aspects of EVs (such as acceleration, low noise) and running costs increased, but concerns about low range remained a barrier to interest in EV adoption (Jensen et al., 2013; Skippon et al., 2016). However, such trials may be limited in their duration and by the driving range capabilities of the EV trialled at the time. In contrast, Philipsen et al. (2019) compared EV range concerns in participants who had different extents of ICEV driving and EV driving experience. They found that those with two or more years of experience driving an EV were significantly less concerned about low battery levels and inadequate driving range than those with no EV experience. Likewise, the experienced EV drivers felt comfortable with significantly lower levels of charge than both those with no EV experience and those with some, but less, EV driving experience. In terms of trust, only the less experienced ICEV drivers (<5 years') were significantly lower than the EV experienced group in terms of their trust in the vehicle's battery charge indicator. Those with more ICEV experience (>5 years') and those with less EV experience (<2 years') did not significantly differ from experienced EV drivers and all three indicated high levels of trust. As such, greater experience of EVs may play a role in reducing concerns for range and state of charge among EV owners.

Smart Charging

It is possible, if the number of EV batteries being charged increases, that acceptance of an EV might, in turn, necessitate the acceptance of some form of utility controlled, smart charging (Spencer et al., 2021). Broadly, smart charging means that the EV battery's charging system communicates with a smart electricity grid such that charging is coordinated by the electricity grid. Unidirectional smart charging (i.e. grid-to-vehicle or V1G) controls the flow of electricity to the EVs depending on current electricity supply and demand (Spencer et al., 2021). Extending this, bidirectional smart charging (i.e. vehicle-to-grid or V2G), would also allow for electricity to flow (discharge) from the EV battery to the electricity grid. Such smart charging models represent a transition from user-controlled charging models (e.g. time of use; Delmonte et al., 2020) and are intended to help prevent the risk of the electricity grid becoming overloaded from everyone charging their EVs at the same time, such as in the evening when returning from work (Spencer et al., 2021).

Acceptance of unidirectional smart charging has been investigated in EV owning (Delmonte et al., 2020; Will & Shuller, 2016) and EV trialling (Schmalfuß et al., 2015) populations. Similar concerns and benefits were raised across the studies. Participation in unidirectional smart charging was expected, by participants, to come with some monetary savings, however, the potential savings were seen as being relatively negligible and not adequate compensation for the perceived loss of flexible use of their EV; indeed, it was felt savings would need to be substantial for it to motivate them (Delmonte et al., 2020; Schmalfuß et al., 2015; Will & Shuller, 2016). Although those who trialled EVs and unidirectional smart charging felt the system was trustworthy (Schmalfuß et al., 2015), EV owners expressed concerns for privacy (Delmonte et al., 2020; Will & Shuller, 2016) and for their desired charging levels not being met (Delmonte et al., 2020). In all three studies, motivators to participate related to the potential societal benefits (as explained to them by the researchers) that their participation in unidirectional smart charging might create and the feeling that they would be acting morally by participating in the unidirectional smart charging (Delmonte et al., 2020; Will & Shuller, 2016).

To date, there have been relatively few studies on acceptance of bidirectional smart charging, that is, V2G (Sovacool et al., 2018). There has been some investigation of the individual characteristics that predict acceptance of V2G in general (Bailey & Axsen, 2015; Chen et al., 2020), however, the primary variables investigated in the V2G acceptance literature relate to the specific contract attributes. The contract is between the EV owner, and the aggregator (i.e. the V2G control system, Will & Schuller, 2016) and studies have investigated the level of acceptance and perceptions of different potential attributes of this contract, including plug-in-time (minimum amount of time the EV will be required to be connected to the grid for), guaranteed minimum battery level (either the minimum charge or the minimum range that the aggregator will guarantee for the owner), the number of discharges in a session, and remuneration. In terms of plug-in time, Huang et al. (2021) found a negative association between plug-in-time and V2G acceptance, which increased exponentially as the plug-in times increased. Furthermore, higher rates of guaranteed driving range (Geske & Schumann, 2018) and battery charge (Bailey & Axsen, 2015; Huang et al., 2021) have both been positively associated with V2G acceptance, while feeling more concern about having sufficient charge at the start of a trip was negatively associated with willingness to participate in V2G (Geske & Schumann, 2018). Participants have also shown concern for how the regular discharging will degrade their battery (Axsen et al., 2017).

Indeed, in the study of Dutch EV drivers (Huang et al., 2021), the number of discharging cycles was negatively associated with acceptance of V2G and was the strongest association out of the other attributes, indicating it was of great concern to the EV owners.

Given that the three outlined contract attributes have been considered inconveniences, remuneration is often considered to be compensation for meeting the contract and for the service of supplying electricity to the grid. Indeed, focus group participants in five countries (Norway, Finland, Denmark, Iceland, and Sweden) indicated that they would expect remuneration for possible battery degradation (Kester et al., 2019) and remuneration has been found to positively relate to willingness to participate in V2G schemes (Bailey & Axsen, 2015; Geske & Schumann, 2018; Huang et al., 2021; Parsons et al., 2014). Furthermore, an early willingness-to-pay study with non-EV owners found that as the required plug-in-times increased and the guaranteed minimum driving ranges decreased, the amount of remuneration participants required for acceptance increased (Parsons et al., 2014). This was also found more recently with prospective (intending to buy in the next three years) EV owners where acceptance of lower levels of guaranteed battery charge and a greater number of battery discharging cycles was found to need commensurate increases in monetary compensation (Kubli et al., 2018).

There are some early indications from one project in Nordic countries that having V2G capabilities could promote EV adoption (Chen et al., 2020; Noel et al., 2019), but equally EV options without V2G have also been preferred (Huang et al., 2021). There are other concerns as well, such that participation in V2G should be voluntary and that it should not disrupt people's routines (Kester et al., 2019), as well expressions of concern for privacy, loss of control, and a desire for energy to be generated by renewable sources (Axsen et al., 2017; Bailey & Axsen, 2015).

The research on V2G is complicated by the relatively early nature of the technology and business models. Indeed, participants' knowledge and awareness of V2G, in particular, was found to be low in the studies that assessed it (Axsen et al., 2017; Gong et al., 2021). However, it is expected that the vehicle owners would be key actors in V2G models (Sovacool et al., 2020) and so it is important to consider the implications of the models for the owners and their subsequent levels of acceptance (Sovacool et al., 2018). Indeed, the potential implications of utility controlled, smart charging models like V1G and V2G point to the wider trend of increased connectivity between residents and the electricity grid via smart grids and residential smart energy technologies (Carmichael et al., 2021). Indeed, EVs may become a further device for facilitating individuals' 'prosumerism' (Kubli et al., 2018). As such, the factors influencing adoption and use of an EV may extend beyond the costs, functions, environmental, and symbolism dimensions of the vehicle itself and necessarily include what the vehicle is connected to and how that connection might then introduce the owner as an active participant in the (smart) electricity grid (Will & Schuller, 2016). As such, it could be of interest to EV acceptance research to consider these aspects further.

DOES BUYING OR OWNING AN EV INFLUENCE OTHER BEHAVIOURS?

In most of the studies in the previous section, the adoption of the EV was primarily considered as the 'end-point' of the decision-making process (smart charging, excepting). Importantly, however, adoption of an EV can also be considered as a 'starting-point' for decision-making, with EV adoption having implications for both travel behaviours as well as other, non-travel behaviours. This is because, for many ICEV drivers, adopting an EV for the first time (either as a sole or additional vehicle in the household) will be accompanied by novel requirements, such as managing the battery's state of charge, and locating and then operating charging stations (Chamberlain & Majeed, 2021; Delmonte et al., 2020). For example, in contrast to ICEV owners use of petrol stations, EV owners have been found to regularly charge their vehicles at home and overnight, regardless of remaining capacity; if available, others will charge at their workplace or charge at specific times when electricity is cheaper (Delmonte et al., 2020). Detouring to reach faster charging stations has also been observed (Sun et al., 2016). Even for existing EV owners, the introduction of smart charging may disrupt charging habits with EV owners reporting that using the (unidirectional) smart charging required them to change their daily routines and start planning ahead for what their charging requirements would be (Schmalfuß et al., 2015). Accordingly, the adoption of an EV might be considered a 'mobility milestone' (Rau & Manton, 2016), a moment where one's existing travel behaviours are disrupted and potentially change, as has been seen with ICEV adoption (Scheiner & Holz-Rau, 2013; Rau & Manton, 2016). The implications of this are considered in this section.

Many travel behaviours are habitual, with the same mode being automatically and unconsciously selected for a journey that is undertaken regularly (such as a commute or shopping trip; Verplanken et al., 1997). Such habitual behaviours can be beneficial because they reduce the need for decision-making, thus conserving cognitive resources. However, habits can act as strong impediments to changes in lifestyle, effectively 'locking in' behaviour (Marechal & Lazaric, 2011). Indeed, travel habits were found to weaken the association between intentions and travel mode selection, indicating that having a habitual travel mode reduced the conscious decision-making for travel behaviour (Gardner, 2009). However, the habit discontinuity hypothesis poses that habits can become disrupted if the context in which they are usually performed (e.g. the location or time of day) is changed (Verplanken et al., 2008). This can prompt a reconsideration of options and the potential for a change in behaviour (Chatterjee et al., 2012; Thomas et al., 2016; Verplanken et al., 2018).

An example of the potential for habit discontinuity, following EV adoption, to create an opportunity for further change was found by Nicolson et al. (2017). They investigated whether or not an EV owner opened an email containing advice on energy saving and time-of-use tariffs. They found a significant, negative association between length of time owning the EV (3–50 months) and opening the email. In particular, among those who had bought their EV up to three months ago, over 70% opened the email. Whereas, among those who had bought their EV between three and four months ago, only 40% opened the email. This statistically significant decline in engagement demonstrates a potential period of time in which EV adopters may be more receptive to information on alternative products and behaviours. The authors of the study also highlight how their findings are evidence that habit discontinuity can follow not just life events, but also EV purchases.

As well as disrupting existing behaviour, adoption of an EV may cause – or 'spillover' to – changes in other behaviours or adoption of further technologies. Behavioural spillover is considered to be the potential for one pro-environmental behaviour to influence subsequent pro-environmental behaviours (Nash et al., 2017). With *positive* spillover, it is argued that engaging in a new pro-environmental behaviour may enhance someone's self-image as a pro-environmental person. This will then motivate further behaviours congruent with this self-image (Nash et al., 2017; Thøgersen & Noblet, 2012). However, with *negative* spillover, engaging in a new pro-environmental behaviour might be felt to compensate for, or give moral license to, other behaviours that are less pro-environmental (Nash et al., 2017).

Negative spillover is conceptually similar to rebound effects investigated in energy efficiency studies (Nash et al., 2017; Sorrel, 2009). For instance, with EVs, it has been suggested that there could be a negative spillover or rebound effect wherein the lower running costs, the higher upfront cost (needing justification through use), or the perception that the adoption of an EV compensates for further, less environmental behaviours, encourages increased usage (compared to previous, ICEV use or previous active travel or public transport use; Langbroek et al., 2017). This could either be of the vehicle itself (direct rebound) or of other energy consuming products (indirect rebound; Seebauer, 2018). Such rebound effects could offset the potential energy savings of EVs over ICEVs and exacerbate problems of congestion and local air pollution from non-exhaust particulates (Langbroek et al., 2017).

Investigation into rebound effects, negative spillover, and EVs seem to have been limited, so far, to primarily cross-sectional studies, which prevent causality being established. However, they have shown differences in travel behaviour between EV users and non-users. For instance, in a relatively early study, Langbroeck and colleagues (2017) used travel diaries to compare travel behaviour of EV users and ICEV users over one day in 2014. It was found that EV use was positively associated with a greater number of trips (controlling for demographic and location variables). Furthermore, EV use was positively associated with a higher proportion (out of all modes used) of car use. As such, although they did not drive a significantly further distance than the ICEV users, EV users drove more frequently and made less use of other modes of transport. Klöckner et al. (2013) found similar main effects in an early survey of EV owners and ICEV owners. However, they also found that self-reported, annual mileage had a significant interaction with the number of cars in the household, such that those with more cars in their household had higher annual mileage. However, this interaction was stronger for EV owners; for the 'two car' and 'more than two car' households the annual mileages of EV and ICEV owners were not significantly different, however, for 'one car' households, the annual mileage of EV owners was significantly lower than ICEV owners. As noted, these studies are not able to assess whether these differences are due to the EV ownership or pre-existing travel preferences. Longitudinal evidence is required to enable causal understanding of how EV adopter behaviour may or may not change in response to the EV adoption.

Rather than directly investigate the potential for rebound effects between EV adoption and subsequent behaviours, Seebauer et al. (2019), using expert interviews and survey data from EV owners in Austria, investigated the common factors that are associated with both the purchase of an EV and direct and indirect rebound effects. They found that environmental values and product knowledge were positively associated with both the purchase of an EV and the avoidance of direct rebound effects. Pro-environmental concern was also positively associated with avoidance of indirect rebound effects (see also Seebauer, 2018). In contrast, social norms (the feeling of expectation to acquire energy efficient technology) was positively associated with purchase of an EV, but negatively associated with the avoidance of indirect rebound. The authors of the study suggest this is due to 'moral licensing' wherein the individuals feel they have met their energy efficiency obligation through the EV purchase and so do not need to be as concerned with energy efficiency in other areas.

As noted, EVs may be increasingly considered as being a part of the residential energy management. In line with this, and related to positive spillover, Cohen et al. (2019) found that adoption of EVs and adoption of a photovoltaics were positively correlated and, compared to those who did not own photovoltaics, those who owned photovoltaics were 21% more likely have plans to purchase an EV in the next five years. As such, the authors of the study argue that photovoltaics and EV technologies are q-complementary, which is the perceived benefits of one are (perceived to) increase with the adoption another. The authors of the study point to the potential for load shifting and charging EVs at times of higher PV generation as the possible perceived benefits and suggest that the desire for these increased benefits motivated the adoption of the EVs.

The implications of EV adoption are significant within the context of a broader shift to sustainable mobility. This is a shift which requires reducing the overall demand for travel, as well as shifting to more sustainable modes of transport (including public transport and active travel; EASAC, 2019). Applying Canters' (2014) sustainable travel hierarchy of 'avoid, shift, improve', EV adoption represents the lowest order category of 'improve', wherein some benefits are attained (such as reduced exhaust emissions at point of use), but other issues are not addressed, such as the rising demand for personal travel and its associated problems of congestion, obesity, accidents, and inequality of access (Whittle et al., 2019). As such, although EVs can be disruptive by implying new technology, user practices, infrastructure, and regulations (Geels, 2002), they do not disrupt or threaten the broader mobility regime in the way that active or shared mobility or virtual interactions can and do (Whittle et al., 2019). In light of the emerging and rapidly accelerating risks (notably from climate change), there is a need to go beyond incremental innovations in mobility systems and embrace more significant changes that can address these risks, including reducing travel demand through broader lifestyle changes, urban design, and digital technologies (CCC, 2019; IPCC, 2018).

CONCLUSIONS

This chapter has provided a critical reflection on the drivers, barriers and behavioural implications of choosing an EV. We have shown that choosing an EV is an outcome of several considerations, including economic and pragmatic factors (upfront cost and infrastructure availability), but also social, moral and personality factors (e.g. environmental values, risk preferences, social status, and identity). Assuming current trends of EV development and policy support, the costs, range and supporting infrastructure of EVs are likely to soon become competitive with ICEVs (BloombergNEF, 2021). As such, cost and functional barriers to EVs adoption by mainstream consumers will be reduced (Coffman et al., 2017). In the meantime, leasing options for EVs may overcome initial cost barriers to adoption for some consumers. The lower running and maintenance costs (Hardman et al., 2016) and the perceived environmental benefits (Degirmenci & Breitner, 2017) are aspects of EVs which are compared favourably to ICEVs. Since EVs are becoming more commonplace, familiarity and trust will increase and social norms will evolve, facilitating their adoption. Users' roles in innovation processes are therefore to act not only as 'economic actors' to drive up demand and bring down costs but also as 'social actors' to embody and augment social norms around adoption and 'domestication' of new vehicle technologies and modes (cf. Lie et al., 1996). There is also the potential role of EV users as 'prosumers' supporting a wider sustainable energy transition by smart charging EVs, although achieving this would require raising awareness, providing incentives, and ensuring data security.

Linked to this, the adoption of an EV can act as a moment of change to disrupts habits and provide an opportunity to promote sustainable choices. However, in the absence of a pro-environmental intervention (e.g. encouraging time-of-use tariff adoption) at that moment of habit disruption, EV adoption could be associated with a greater frequency of car use, which would undermine broader shifts in lifestyle required to achieve climate change and other sustainability goals. Further research is needed to explore how best to trigger positive behavioural spillover following EV adoption, and to avoid negative spillover or moral licensing. More pressing, though, in the light of climate change and other risks, is the need to explore how electric mobility, as just part of the sustainable travel hierarchy, can support wider shifts in practices that mitigate these risks and promote multiple sustainability goals.

NOTES

1. Noel et al. (2019) argue that such a high willingness-to-pay may reflect the hypothetical nature of the choice experiment and the participants' desire to choose the option that would improve society.

2. The authors of the study (Hardman et al., 2016) noted that such a higher percentage may be inflated due to a response bias and the survey not capturing instances when the EV purchase might have been made as a couple or as a family.

REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior & Human Decision Processes*, *50*(2), 179–211.

Axsen, J., Langman, B., & Goldberg, S. (2017). Confusion of innovations: Mainstream consumer perceptions and misperceptions of electric-drive vehicles and charging programs in Canada. *Energy Research & Social Science*, *27*, 163–173.

Bailey, J., & Axsen, J. (2015). Anticipating PEV buyers' acceptance of utility controlled charging. *Transportation Research Part A: Policy and Practice*, *82*, 29–46.

Bamberg, S. (2006). Is a residential relocation a good opportunity to change people's travel behaviour? Results from a theory-driven intervention study. *Environment & Behavior*, *38*(6), 820–840.

Bandura, A. (1977). *Social learning theory*. Prentice Hall.

BloombergNEF. (2021). Electric Vehicle Outlook 2021. https://about.bnef.com/electric-vehicle-outlook/

Brückmann, G., Wicki, M., & Bernauer, T. (2021). Is resale anxiety an obstacle to electric vehicle adoption? Results from a survey experiment in Switzerland. *Environmental Research Letters*, *16*, 124027.

Burgess, M., King, N., Harris, M., & Lewis, E. (2013). Electric vehicle drivers' reported interactions with the public: Driving stereotype change? *Transportation Research Part F: Traffic Psychology and Behaviour*, *17*, 33–44.

Breetz, H. L., & Salon, D. (2018). Do electric vehicles need subsidies? Ownership costs for conventional, hybrid, and electric vehicles in 14 US cities. *Energy Policy*, *120*, 238–249.

Canters, R. (2014). Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I). https://www.eltis.org/discover/news/factsheet-sustainable-urban-transport-avoid-shift-improve-s-i-0

Carmichael, R., Gross, R., Hanna, R., Rhodes, A., & Green, T. (2021). The demand response technology cluster: Accelerating UK residential consumer engagement with time-of-use tariffs, electric vehicles and smart meters via digital comparison tools. *Renewable and Sustainable Energy Reviews*, *139*, 110701.

CCC. (2019). *Net Zero: The UK's contribution to stopping global warming*. UK Committee on Climate Change.

Chamberlain, K., & Al Majeed, S. (2021). Evaluating the barrier effects of charge point trauma on UK electric vehicle growth. *World Electric Vehicle Journal*, *12*(3), 152.

Chatterjee, K., Sherwin, H., Jain, J., Christensen, J., & Marsh, S. (2012). Conceptual model to explain turning points in travel behavior: Application to bicycle use. *Transportation Research Record*, *2322*(1), 82–90.

Chen, C. F., de Rubens, G. Z., Noel, L., Kester, J., & Sovacool, B. K. (2020). Assessing the socio-demographic, technical, economic and behavioral factors of Nordic electric vehicle adoption and the influence of vehicle-to-grid preferences. *Renewable and Sustainable Energy Reviews*, *121*, 109692.

Chen, Z., Carrel, A. L., Gore, C., & Shi, W. (2021). Environmental and economic impact of electric vehicle adoption in the US. *Environmental Research Letters*, *16*(4), 045011.

Cohen, J., Azarova, V., Kollmann, A., & Reichl, J. (2019). Q-complementarity in household adoption of photovoltaics and electricity-intensive goods: The case of electric vehicles. *Energy Economics*, *83*, 567–577.

Coffman, M., Bernstein, P., & Wee, S. (2017). Electric vehicles revisited: A review of factors that affect adoption. *Transport Reviews*, *37*(1), 79–93.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319–340.

Degirmenci, K., & Breitner, M. H. (2017). Consumer purchase intentions for electric vehicles: Is green more important than price and range? *Transportation Research Part D: Transport and Environment*, *51*, 250–260.

Delmonte, E., Kinnear, N., Jenkins, B., & Skippon, S. (2020). What do consumers think of smart charging? Perceptions among actual and potential plug-in electric vehicle adopters in the United Kingdom. *Energy Research & Social Science*, *60*, 101318.

Dimitropoulos, A., Rietveld, P., & Van Ommeren, J. N. (2013). Consumer valuation of changes in driving range: A meta-analysis. *Transportation Research Part A: Policy and Practice*, *55*, 27–45.

Dumortier, J., Siddiki, S., Carley, S., Cisney, J., Krause, R. M., Lane, B. W., Rupp, J. A., & Graham, J. D. (2015). Effects of providing total cost of ownership information on consumers' intent to purchase a hybrid or plug-in electric vehicle. *Transportation Research Part A: Policy and Practice*, *72*, 71–86.

EASAC. (2019, March). *Decarbonisation of transport: Options and challenges*. The European Academies' Science Advisory Council website.

Gardner, B. (2009). Modelling motivation and habit in stable travel mode contexts. *Transportation Research Part F: Traffic Psychology and Behaviour*, *12*(1), 68–76.

Gardner, B., & Abraham, C. (2007). What drives car use? A grounded theory analysis of commuters' reasons for driving. *Transportation Research Part F*, *10*, 187–200.

Geske, J., & Schumann, D. (2018). Willing to participate in vehicle-to-grid (V2G)? Why not! *Energy Policy*, *120*, 392–401.

Geels, F. W. (2002). *Understanding the dynamics of technological transitions: A co-evolutionary and socio-technical analysis.* Twente University Press.

Geels, F. W. (2005). Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. *Technological Forecasting & Social Change*, *72*(6), 681–696.

Giansoldati, M., Monte, A., & Scorrano, M. (2020). Barriers to the adoption of electric cars: Evidence from an Italian survey. *Energy Policy*, *146*, 111812.

Gong, S., Cheng, V. H. S., Ardeshiri, A., & Rashidi, T. H. (2021). Incentives and concerns on vehicle-to-grid technology expressed by Australian employees and employers. *Transportation Research Part D: Transport and Environment*, *98*, 102986.

Graham-Rowe, E., Gardner, B., Abraham, C., Skippon, S., Dittmar, H., Hutchins, R., & Stannard, J. (2012). Mainstream consumers driving plug-in battery-electric and plug-in hybrid electric cars: A qualitative analysis of responses and evaluations. *Transportation Research Part A: Policy and Practice*, *46*(1), 140–153.

Hardman, S., Shiu, E., & Steinberger-Wilckens, R. (2016). Comparing high-end and low-end early adopters of battery electric vehicles. *Transportation Research Part A: Policy and Practice*, *88*, 40–57.

He, X., Zhan, W., & Hu, Y. (2018). Consumer purchase intention of electric vehicles in China: The roles of perception and personality. *Journal of Cleaner Production*, *204*, 1060–1069.

Hess, A.-K., & Schubert, I. (2019). Functional perceptions, barriers, and demographics concerning e-cargo bike sharing in Switzerland. *Transportation Research Part D*, *71*, 153–168.

Hirst, D., Winnett, J., & Hinson, S. (2021, June). Electric vehicles and infrastructure. The House of Commons Library.

Huang, B., Meijssen, A. G., Annema, J. A., & Lukszo, Z. (2021). Are electric vehicle drivers willing to participate in vehicle-to-grid contracts? A context-dependent stated choice experiment. *Energy Policy*, *156*, 112410.

Huang, Y., & Qian, L. (2021). Consumer adoption of electric vehicles in alternative business models. *Energy Policy*, *155*, 112338.

IPCC. (2018). Special Report: Global Warming of 1.5 Degrees. https://www.ipcc.ch/sr15/chapter/spm/

Jansson, J., Pettersson, T., Mannberg, A., Brännlund, R., & Lindgren, U. (2017). Adoption of alternative fuel vehicles: Influence from neighbors, family and coworkers. *Transportation Research Part D: Transport and Environment*, *54*, 61–73.

Jensen, A. F., Cherchi, E., & Mabit, S. L. (2013). On the stability of preferences and attitudes before and after experiencing an electric vehicle. *Transportation Research Part D: Transport and Environment*, *25*, 24–32.

Kester, J., de Rubens, G. Z., Sovacool, B. K., & Noel, L. (2019). Public perceptions of electric vehicles and vehicle-to-grid (V2G): Insights from a Nordic focus group study. *Transportation Research Part D: Transport and Environment*, *74*, 277–293.

Khurana, A., Kumar, V. V. R., & Sidhpuria, M. (2020). A study on the adoption of electric vehicles in India: The mediating role of attitude. *Vision*, *24*(1), 23–34.

Klöckner, C. A., Nayum, A., & Mehmetoglu, M. (2013). Positive and negative spillover effects from electric car purchase to car use. *Transportation Research Part D: Transport and Environment*, *21*, 32–38.

Kosugi, T., Shimoda, Y., & Tashiro, T. (2019). Neighborhood influences on the diffusion of residential photovoltaic systems in Kyoto City, Japan. *Environmental Economics & Policy Studies*, *21*, 477–505.

Kubli, M., Loock, M., & Wüstenhagen, R. (2018). The flexible prosumer: Measuring the willingness to co-create distributed flexibility. *Energy Policy*, *114*, 540–548.

Kumar, R. R., & Alok, K. (2020). Adoption of electric vehicle: A literature review and prospects for sustainability. *Journal of Cleaner Production*, *253*, 119911.

Langbroek, J. H., Franklin, J. P., & Susilo, Y. O. (2017). Electric vehicle users and their travel patterns in Greater Stockholm. *Transportation Research Part D: Transport and Environment*, *52*, 98–111.

Li, W., Long, R., Chen, H., & Geng, J. (2017). A review of factors influencing consumer intentions to adopt battery electric vehicles. *Renewable and Sustainable Energy Reviews*, *78*, 318–328.

Liao, F., Molin, E., Timmermans, H., & van Wee, B. (2018). The impact of business models on electric vehicle adoption: A latent transition analysis approach. *Transportation Research Part A: Policy and Practice*, *116*, 531–546.

Liao, F., Molin, E., Timmermans, H., & van Wee, B. (2019). Consumer preferences for business models in electric vehicle adoption. *Transport Policy*, *73*, 12–24.

Liu, Z., Song, J., Kubal, J., Susarla, N., Knehr, K. W., Islam, E., Nelson, P., & Ahmed, S. (2021). Comparing total cost of ownership of battery electric vehicles and internal combustion engine vehicles. *Energy Policy*, *158*, 112564.

Marechal, K., & Lazaric, N. (2011). Overcoming inertia: Insights from evolutionary economics into improved energy and climate policies. *Climate Policy*, *10*, 103–119.

Morton, C., Anable, J., & Nelson, J. D. (2016). Exploring consumer preferences towards electric vehicles: The influence of consumer innovativeness. *Research in Transportation Business & Management*, *18*, 18–28.

Nash, N., Whitmarsh, L., Capstick, S., Hargreaves, T., Poortinga, W., Thomas, G., Sautkina, E., & Xenias, D. (2017), Climate-relevant behavioral spillover and the potential contribution of social practice theory. *WIREs Climate Change*, *8*, e48.

Nicolson, M., Huebner, G. M., Shipworth, D., & Elam, S. (2017). Tailored emails prompt electric vehicle owners to engage with tariff switching information. *Nature Energy*, *2*, 17073.

Noppers, E., Keizer, K., Bolderdijk, J., & Steg, L. (2014). The adoption of sustainable innovations: Driven by symbolic and environmental motives. *Global Environmental Change*, *25*, 52–62.

Noel, L., Carrone, A. P., Jensen, A. F., de Rubens, G. Z., Kester, J., & Sovacool, B. K. (2019). Willingness to pay for electric vehicles and vehicle-to-grid applications: A Nordic choice experiment. *Energy Economics*, *78*, 525–534.

Noel, L., de Rubens, G. Z., Kester, J., & Sovacool, B. K. (2020). Understanding the socio-technical nexus of Nordic electric vehicle (EV) barriers: A qualitative discussion of range, price, charging and knowledge. *Energy Policy*, *138*, 111292.

Nurhadi, L., Borén, S., Ny, H., & Larsson, T. (2017). Competitiveness and sustainability effects of cars and their business models in Swedish small town regions. *Journal of Cleaner Production*, *140*, 333–348.

Pan, L., Yao, E., & MacKenzie, D. (2019). Modeling EV charging choice considering risk attitudes and attribute non-attendance. *Transportation Research Part C: Emerging Technologies*, *102*, 60–72.

Parsons, G. R., Hidrue, M. K., Kempton, W., & Gardner, M. P. (2014). Willingness to pay for vehicle-to-grid (V2G) electric vehicles and their contract terms. *Energy Economics*, *42*, 313–324.

Pettifor, H., Wilson, C., Axsen, J., Abrahamse, W., & Anable, J. (2017). Social influence in the global diffusion of alternative fuel vehicles – A meta-analysis. *Journal of Transport Geography*, *62*, 247–261.

Philipsen, R., Brell, T., Biermann, H., & Ziefle, M. (2019). Under pressure—Users' perception of range stress in the context of charging and traditional refueling. *World Electric Vehicle Journal*, *10*(3), 50.

Rau, H., & Manton, R. (2016). Life events and mobility milestones: Advances in mobility biography theory and research. *Journal of Transport Geography*, *52*, 51–60.

Rezvani, Z., Jansson, J., & Bodin, J. (2015). Advances in consumer electric vehicle adoption research: A review and research agenda. *Transportation research part D: Transport and Environment*, *34*, 122–136.

Rogers, E. M. (1995). *Diffusion of innovations*. Free Press.

Seebauer, S. (2018). The psychology of rebound effects: Explaining energy efficiency rebound behaviours with electric vehicles and building insulation in Austria. *Energy Research & Social Science*, *46*, 311–320.

Seebauer, S., Kulmer, V., & Fruhmann, C. (2019). Promoting adoption while avoiding rebound: Integrating disciplinary perspectives on market diffusion and carbon impacts of electric cars and building renovations in Austria. *Energy, Sustainability and Society*, *9*(1), 1–11.

Scheiner, J., & Holz-Rau, C. (2013). Changes in travel mode use after residential relocation: A contribution to mobility biographies. *Transportation*, *40*(2), 431–458.

Schmalfuss, F., Mair, C., Döbelt, S., Kaempfe, B., Wuestemann, R., Krems, J. F., & Keinath, A. (2015). User responses to a smart charging system in Germany: Battery electric vehicle driver motivation, attitudes and acceptance. *Energy Research & Social Science*, *9*, 60–71.

Schmalfuß, F., Mühl, K., & Krems, J. F. (2017). Direct experience with battery electric vehicles (BEVs) matters when evaluating vehicle attributes, attitude and purchase intention. *Transportation Research Part F: Traffic Psychology and Behaviour*, *46*, 47–69.

Schuitema, G., Anable, J., Skippon, S., & Kinnear, N. (2013). The role of instrumental, hedonic and symbolic attributes in the intention to adopt electric vehicles. *Transportation Research Part A: Policy and Practice*, *48*, 39–49.

Shao, J., Taisch, M., & Ortega-Mier, M. (2016). A grey-DEcision-MAking Trial and Evaluation Laboratory (DEMATEL) analysis on the barriers between environmentally friendly products and consumers: Practitioners' viewpoints on the European automobile industry. *Journal of Cleaner Production*, *112*, 3185–3194.

Shove, E., Pantzar, M., & Watson, M. (2012). *The dynamics of social practice: Everyday life and how it changes*. Sage.

Singh, V., Singh, V., & Vaibhav, S. (2020). A review and simple meta-analysis of factors influencing adoption of electric vehicles. *Transportation Research Part D: Transport and Environment*, *86*, 102436.

Skippon, S. M., Kinnear, N., Lloyd, L., & Stannard, J. (2016). How experience of use influences mass-market drivers' willingness to consider a battery electric vehicle: A randomised controlled trial. *Transportation Research Part A: Policy and Practice*, *92*, 26–42.

Sorrell, S. (2009). Jevons' Paradox revisited: The evidence for backfire from improved energy efficiency. *Energy Policy*, *37*(4), 1456–1469.

Sovacool, B. K., Kester, J., Noel, L., & de Rubens, G. Z. (2020). Actors, business models, and innovation activity systems for vehicle-to-grid (V2G) technology: A comprehensive review. *Renewable and Sustainable Energy Reviews*, *131*, 109963.

Sovacool, B. K., Noel, L., Axsen, J., & Kempton, W. (2018). The neglected social dimensions to a vehicle-to-grid (V2G) transition: A critical and systematic review. *Environmental Research Letters*, *13*(1), 013001.

Spencer, S. I., Fu, Z., Apostolaki-Iosifidou, E., & Lipman, T. E. (2021). Evaluating smart charging strategies using real-world data from optimized plugin electric vehicles. *Transportation Research Part D: Transport and Environment*, *100*, 103023.

Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of Educational Research*, *79*(2), 625–649.

Sun, X. H., Yamamoto, T., & Morikawa, T. (2016). Fast-charging station choice behavior among battery electric vehicle users. *Transportation Research Part D: Transport and Environment*, *46*, 26–39.

Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. In W. G. Austin & S. Worchel (Eds), *The social psychology of intergroup relations* (pp. 33–37). Brooks/Cole.

Thøgersen, J., & Noblet, C. (2012). Does green consumerism increase the acceptance of wind power? *Energy Policy*, *51*, 854–862.

Thomas, G. O., Poortinga, W., & Sautkina, E. (2016). Habit discontinuity, self-activation, and the diminishing influence of context change: Evidence from the UK understanding society survey. *PLoS One*, *11*(4), e0153490.

UK Government. (2021). Decarbonising transport: A better, Greener Britain. https://www.gov.uk/government/publications/transport-decarbonisation-plan

Urry, J. (2004). The 'system' of automobility. *Theory, Culture & Society*, *21*(4–5), 25–39.

Vassileva, I., & Campillo, J. (2017). Adoption barriers for electric vehicles: Experiences from early adopters in Sweden. *Energy*, *120*, 632–641.

Verplanken, B., Aarts, H., & van Knippenberg, A. (1997). Habit, information acquisition, and the process of making travel mode choices. *European Journal of Social Psychology*, *27*, 539–560.

Verplanken, B., Roy, D., & Whitmarsh, L. (2018). Cracks in the wall: Habit discontinuities as vehicles for behavior change. In B. Verplanken (Ed.), *The psychology of habit*. Springer.

Verplanken, B., Walker, I., Davis, A., & Jurasek, M. (2008). Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *Journal of Environmental Psychology*, *28*, 121–127.

White, L. V., & Sintov, N. D. (2017). You are what you drive: Environmentalist and social innovator symbolism drives electric vehicle adoption intentions. *Transportation Research Part A: Policy and Practice*, *99*, 94–113.

Whittle, C., Whitmarsh, L., Haggar, P., Morgan, P., & Parkhurst, G. (2019). User decision-making in transitions to electrified, autonomous, shared or reduced mobility. *Transportation Research Part D: Transport and Environment*, *71*, 302–319.

Will, C., & Schuller, A. (2016). Understanding user acceptance factors of electric vehicle smart charging. *Transportation Research Part C: Emerging Technologies*, *71*, 198–214.

Yang, J., & Chen, F. (2021). How are social-psychological factors related to consumer preferences for plug-in electric vehicles? Case studies from two cities in China. *Renewable and Sustainable Energy Reviews*, *149*, 111325.

Yang, C., Tu, J. C., & Jiang, Q. (2020). The influential factors of consumers' sustainable consumption: A case on electric vehicles in China. *Sustainability*, *12*(8), 3496.

Zhang, B., Niu, N., Li, H., Wang, Z., & He, W. (2021). Could fast battery charging effectively mitigate range anxiety in electric vehicle usage? Evidence from large-scale data on travel and charging in Beijing. *Transportation Research Part D: Transport and Environment*, *95*, 102840.