

# Does Environmental Concern Drive Adoption of Electric Car? A Cross-National Study of American and Japanese Car Owners

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**Abstract**—To understand what drives consumers to adopt electric cars, this study focuses on examining any differences exist between American and Japanese car owners. This study measures the effects of environmental concern on consumer perceived effectiveness and social innovativeness that may influence American and Japanese car owners' intentions to purchase electric vehicles. The findings reveal the relationships between the constructs are moderated by country. Environmental concern affects perceived consumer effectiveness and the effectiveness influence social innovativeness for both countries. For American, perceived consumer effectiveness and social innovativeness are related to purchase intention, but only social innovativeness is related to purchase intention for Japanese. The results suggest that marketing communication strategies should use environmental appeal such as reducing carbon emissions to target American car owners. For Japanese car owners, the communication strategies should focus on the emotional aspects of driving an electric car such as being the first among their peers to own an electric vehicle.

**Keywords**—adopt electric cars, environmental concerns, perceived consumer effectiveness, social innovativeness, purchase intention

## I. INTRODUCTION

Greenhouse gases generated from human activities are the significant driver of global warming. In the U.S., transportation accounts for 27 percent of greenhouse gas emissions (Ewing, 2022). Among other advanced economies like Germany and United Kingdom, the U.S. and Japan both lag the world in adoption of Electric Vehicles (EVs) (Economist, 2023). In the U.S., despite the tax credits offered by the government for purchasing electric cars the adoption rates have been slow (Davenport, 2023; Tankersley, 2022). Electric Vehicles (EVs) accounted for less than 1% of total car sales in the first quarter of 2023 in the U.S. car market (Hawley, 2023). The slow adoption of EVs in Japan could be attributed to the skepticism of the Japanese government and automakers toward the potential profitability and environmental superiority of electric cars (Dooley and Ueno, 2021). Without government's and the auto industry's efforts to promote EVs, EVs sales in Japan were about 2% of new cars sold in 2022 (Economist, 2023).

Besides situational factors, consumer attributes could also play an important role in adopting electric vehicles. A report by the Intergovernmental Panel on Climate Change, a group of climate scientists convened by the United Nations, shows that global average temperatures are estimated to rise as humans continue to burn coal, oil, and natural gas (Plumer,

2023). A study in 2021 surveying consumers across 24 countries including the U.S. and Japan shows that 58% of adults were conscious of their behaviors on the environment, and 85% of them would take action to tackle the issues of sustainability (Master Card, 2021). In this instance, it appears that consumers' environmental concern does not readily translate into purchase of electric vehicles. A search of literature shows that little research has been focused on the impact of environmental concern on consumer attributes toward adopting electric vehicles. To understand what drives consumers to adopt electric cars, this study proposes a conceptual framework to investigate environmental concern as the antecedent of perceived consumer effectiveness and consumer innovativeness toward adopting electric vehicles, which in turn would affect purchase intention. More specifically, this study focuses on examining any differences exist between American and Japanese car owners in adopting electric vehicles.

## II. CONCEPTUAL STRUCTURE

### A. Environmental Concern

Environmental Concern (ECON) is people's awareness of environmental issues caused by humans' behaviors that motivates consumers to select and justify their actions to practice sustainable consumption. In this instance, consumers who are concerned about the environment may choose to consume eco-friendly products to live up to their green values. However, consumers who claim to be very concerned about the environment do not necessarily translate their assertion into green purchase behavior (Rettie *et al.*, 2012). Studies of green marketing effects are mixed. Past research reveals that consumers who are more concerned about the environment are less skeptical toward green products and have more positive attitudes toward green marketing, especially among those who are highly involved in environmental activities, compared to those with low involvement. According to Pagiaslis and Krontalis (2014), environmental concern may influence various environmentally friendly and green consumer behaviors. However, past research shows that environmental concern, a belief construct, does not impact specific environmental behaviors directly but is an indirect determinant of specific environmental behaviors which can be operated through its influence on the generation of domain-specific cognition (Bamberg, 2003). In this study, environmental concern is operationalized as an antecedent of two domain-specific

belief constructs in the context of electric vehicle adoption. They are perceived effectiveness of electric vehicles and consumer innovativeness toward adopting electric vehicles.

### B. Perceived Consumer Effectiveness

According to Cho *et al.* (2013), Perceived Consumer Effectiveness (PCE) is a person's belief that he/she has the ability to achieve outcomes in a particular activity. As Ellen *et al.* (1991) argue, PCE is a domain-specific construct that "the efforts of an individual can make a difference in the solution to a problem". Research shows that PCE is positively related to environmental concern (Cho *et al.*, 2013). Results of past research also reveal that the effects of PCE on green purchase are mixed. A study by Cho *et al.* (2013) suggests that perceived consumer effectiveness does not directly impact green purchase decisions. As Cho *et al.* (2013) argue, some consumers believe that their actions might not produce any differences in addressing environmental issues. This implies that consumers lack confidence in carrying out the actions. However, research by Stanislawski *et al.* (2013) shows that PCE does impact young consumers' intentions to purchase green products. In order to understand consumers' perceptions of the efficacy of driving electric cars, PCE is operationalized as one of the predictors of intention to purchase.

### C. Domain Specific Innovativeness

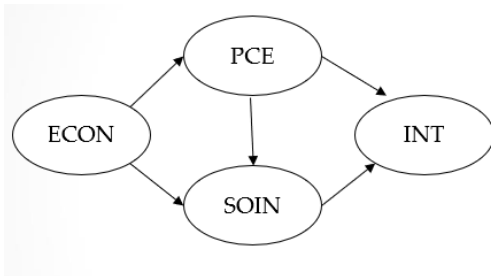


Fig. 1. Research model.

Prior research has different conceptualizations of consumer innovativeness: innate innovativeness, generalized innovativeness, domain specific innovativeness, adoptive and actualized innovativeness (Roehrich, 2014). However, consumer innovativeness may manifest itself at different levels of generality or specificity (Goldsmith *et al.*, 2003). In general, consumer innovativeness studies conceptualize innovators as early adopters of a wide range of new products or brands without measuring innovative purchasing at specific product category level (Roehrich, 2014; Goldsmith *et al.*, 2003). Instead of conceptualizing consumer innovativeness at a general innovative level, Domain Specific Innovativeness (DSI) measures consumer innovativeness within a specific domain of interest (Goldsmith *et al.*, 2003). Research suggests that domain specific innovativeness strongly influences innovative purchasing within a specific product category and has high predictive validity (Roehrich, 2014; Goldsmith *et al.*, 2003). Domain specific innovativeness has a Social Innovativeness (SOIN) dimension that uses comparison with others as measurement, i.e., people with high social innovativeness are early adopters of specific new products or brands compared to others in their social system (Roehrich, 2014). When social innovativeness is measured at specific product category

(domain specific innovativeness), its predictive power increases (Roehrich, 2014). In this study, domain specific innovativeness is another predictor used in the research model to examine whether any differences exist between American car owners' and Japanese car owners' intentions to purchase electric vehicles. See Fig. 1.

### D. Research Questions

Key constructs in this innovation-adoption process are environmental concern, perceived consumer effectiveness of electric vehicles, and consumers' attitudes toward adoption of electric vehicles in a social context. The following research questions are developed to investigate whether the key constructs would differentially influence purchase intention between American and Japanese car owners.

R1. Is the relative importance of perceived consumer effectiveness and social innovativeness in determining purchase intention differs between American and Japanese car owners?

R2. Do American and Japanese car owners exhibit different innovative behaviors in purchasing electric vehicles?

## III. RESEARCH METHODS

This study used Qualtrics online consumer panels to collect data from the U.S. and Japan. Three hundred Americans and three hundred Japanese car owners were recruited to participate in the survey. All respondents were between 25–45 years old. Questionnaire items measuring Environmental Concern (ECON) were based on Matthes and Wonneberger's (2014) measurement scale and a modified 7-items scale was developed for this study. One question assessed environmental concern: "In my opinion, it is important to protect the environment." (strongly disagree to strongly agree). A 3-item scale for measuring Perceived Consumer Effectiveness (PCE) was adapted from Stanislawski *et al.*'s (2013) measurement scale. One PCE question was included: "I can reduce carbon emissions by driving an electric car" (strongly disagree to strongly agree). Construction of the Social Innovativeness (SOIN) scale (4 items) was based on Goldsmith and Hofacker's (1991) scale. One question assessed social innovativeness: "I am excited about being the first to purchase an electric car" (strongly disagree to strongly agree). A 3-item scale for measuring purchase intention (INT) was adapted from Heidenreich and Kramer's (2015) actualized innovativeness scale. One question assessed purchase intention: "I feel I would purchase an electric car for my next new car" (very unlikely to very likely). All items were measured on a 5-point Likert scale. The questionnaire was originally constructed in English and a back-translation process was utilized for the Japanese version. In the questionnaire an electric vehicle was defined as a fully battery-powered electric car.

## IV. ANALYSIS AND RESULTS

### A. Overall Measurement Results

A Confirmatory Factor Analysis (CFA) was conducted to test the overall validity of the measurement theory. The CFA results showed a good model fit for a 17-items model, with  $\chi^2 = 259$ ,  $df = 106$ ,  $p < .00$ ; Goodness of Fit Index (GFI) = .951; Comparative Fit Index (CFI) = .982; Root Mean

Square Error of Approximation (RMSEA) = .049; Normed Fit Index (NFI) = .97. The GFI, CFI, and NFI exceeded the recommended cut-off point (> .90) and the RMSEA was also below the cut-off level (<.080).

**B. Two-group Measurement Model**

For more than one group, prior to any comparison of the relationships between the variables of the proposed model, metric invariance between American and Japanese samples was examined. The results suggested that full metric invariance was established. The chi-square difference test results ( $\Delta \chi^2 = 21.9, df = 13, p = .057$ ) satisfied the conditions for metric invariance that allowed valid comparisons of relationships between the U.S. and Japanese samples.

**C. Two-group Structural Model**

Structural Equation Modeling (SEM) was conducted to examine the overall theoretical model specification. The one group model provided a satisfactory fit of data with  $\chi^2 = 259, df = 107; p = .000; GFI = .95; CFI = .98; RMSEA = .049; TLI = .97$ . Next, the procedures turned to a test of moderation using the country classification variable. The results indicated that the moderation model was significantly different from the totally free model ( $\Delta \chi^2 = 36.6, df = 18, p = .05$ ). Thus, it indicated the model was moderated by country.

**D. Addressing the Research Questions**

The results showed that not all the relationships between the constructs were significant and the SEM structural paths also revealed that not all constructs were positively related in both samples. In answering research question 1, the findings showed that the environmental concern had a significant positive relationship with Perceived Consumer Effectiveness (PCE) for both samples (American  $\beta = .739$ , Japanese  $\beta = .57$ ). However, environmental concern had no impact on social innovativeness (SOIN) for both samples. The results also showed that there was a negative relationship between the two constructs. A positive relationship between PCE and SOIN was detected for both samples (American  $\beta = .717$ , Japanese  $\beta = .60$ ). The relationship between perceived consumer effectiveness and intention to purchase (INT) was not significant for Japanese sample ( $\beta = n.s$ ) but showed a positive relationship in the American sample ( $\beta = .288$ ). The results also showed that a positive relationship was established between SOIN and INT for both samples (American sample  $\beta = .563$ , Japanese sample  $\beta = .64$ ). Furthermore, an independent *t*-test between the two groups shows that American car owners and Japanese car owners did differ in purchase intention (INT) ( $t(608) = 42.4, p < .001$ ). See the Table 1.

Table 1. Comparisons of standardized coefficients and t-values

	Standardized Coefficients				t-value	
	USA		Japan		USA	Japan
ECON→PCE	.739	P<.001	.57	P<.001	12.99	9.07
ECON→SOIN	-.003	ns	.10	ns	-.037	1.54
PCE→SOIN	.717	P<.001	.60	P<.001	7.98	7.99
PCE→INT	.288	P<.001	.06	ns	4.57	.91
SOIN→INT	.563	P<.001	.64	P<.001	7.94	8.35

**V. DISCUSSION AND CONCLUSION**

This study measures the effects of environmental concern on consumer perceived effectiveness and social innovativeness that may influence American and Japanese car owners' intentions to purchase electric vehicles. The findings reveal outcomes of the relationships between the constructs are moderated by country. American car owners and their Japanese counterparts differ in the set of behavioral beliefs underlying innovativeness. The results support Bamberg's (2003) assumption that environmental concern is an indirect determinant of specific environmental behaviors which can be operated through its influence on the generation of domain-specific cognition. This suggests that driving an electric vehicle may help solve environmental problems. However, environmental concern has no effects on car owners' social innovativeness. The strong effects of social innovativeness on both samples suggest that this age cohort (25–45 years old) of car owners are more likely to take the lead and influence other car owners on adopting EVs in both countries. The impact of perceived consumer effectiveness on purchase intention from the American sample may suggest that American car owners' innovative behaviors are reinforced by the positive environmental effects of driving an electric vehicle on the environment. Results from the Japanese sample may suggest that perceived consumer effectiveness operates as a mediator between environmental concern and social innovativeness in the adoption process. In this instance, perceived effectiveness is not a direct predictor of intention to purchase. The findings also show that Japanese car owners have higher intentions to purchase electric cars than their American counterparts (Japanese Mean = 2.8; American Mean = 2.6). This may also suggest that Japanese car owners are more innovative than American owners in the adoption process.

The differences between American and Japanese car owners may offer insight into segments that are of interest to American and Japanese marketers wishing to expand the reach of electric vehicles. This study shows country differences do exist and these differences may have implications for marketing communication strategies. To target American car owners, marketing communication strategies should use environmental appeal such as reducing carbon emissions. For Japanese car owners, the communication strategies should focus on the emotional aspects of driving an electric car such as being the first among their peers to own an electric vehicle.

**CONFLICT OF INTEREST**

The authors declare no conflict of interest.

**AUTHOR CONTRIBUTIONS**

Muk and Chung conduct the research together; Chung ran the data; both authors analyzed the data; Muk wrote the paper; both authors had approved the final version.

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