UNDERSTANDING THE ROLE OF CULTURE IN ECO-INNOVATION ADOPTION — AN EMPIRICAL CROSS-COUNTRY COMPARISON

Completed Research Paper

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Abstract

In this paper we merge research approaches from information systems, social and environmental psychology, as well as innovation diffusion to investigate the effect of cultural factors on the adoption of eco-innovations. Specifically, we conduct an empirical study based on the Decomposed Theory of Planned Behavior and the Value Belief Norm Theory to estimate how culture influences the intention to adopt electric vehicles as a surrogate for eco-innovations. In our study we find evidence that there exist major differences in adoption behavior of eco-innovations between Germans and Chinese. Furthermore we were able to show that in contrast to prior findings on innovation adoption, primary sources' influence was the most important predictor of the intention to adopt electric vehicles.

Keywords: Cross-cultural differences, Environmental sustainability, Adoption

Introduction

The transportation sector accounts for about one quarter of total greenhouse gas (GHG) emissions in the United States and the European Union. Electric mobility can substantially reduce these emissions by using energy from renewable sources to power vehicles. On the way towards fully utilizing the potential of electric mobility, information systems (IS) play an integral part. They can, for instance, enable „green" charging through the implementation of intelligent charge control systems or increase the efficiency of electric driving through information systems within the vehicle, such as GPS or vehicle monitoring systems (Brandt 2013). Following the energy informatics research agenda by Watson et al. (2010), Brandt et al. (2012; 2013) have already begun to analyze how IS can further enhance the benefits gained from electric mobility. IS enables electric vehicles to be integrated into residential energy management systems or to be aggregated to provide substantial storage capabilities to the power grid. In their studies they were able to show that IS is used at each stage to observe, evaluate, and coordinate the behavior of the system, increasing energy efficiency and reducing waste.

The electric vehicle is just one example out of a set of new products and services that help to satisfy and express an individual's environmental values. During the past decade, research in Green IS, which seeks to reduce the environmental footprint of the IT sector and others, has been another example of this development. These „eco-friendly" goods and services have lower negative impacts on the environment than their classic counterparts and are, therefore, called eco-innovations (Pujari 2006). Yet, to date these products often do not find enough adopters to establish themselves in their respective markets, despite their obvious individual and collective benefits. Case in point: despite substantial subsidies around the globe—with the US, Germany, and China all intending to bring one million electric cars onto their streets by 2020—actual adoption of electric mobility has been slow. However, achieving a critical mass of electric vehicles across these culturally different influenced markets will be essential for successfully implementing a business environment of additional services around these vehicles. As information systems have the potential to enhance the advantages and mitigate the disadvantages of eco-innovations, as shown by Brandt et al. 2012 for the example of electric vehicles, it is important to first understand electric vehicle adoption behavior in general to effectively outline and conduct future IS research that best helps in mitigating the disadvantages.

In this paper, we therefore adapt research approaches on technology usage and acceptance that are well established within the IS community to explain the diverging role of cross-cultural factors in the decisions of individuals to adopt electric mobility as a surrogate for eco-innovations. Specifically, the paper has the following objectives:

- We introduce a comprehensive model to explain the intention of individuals to adopt electric vehicles as a surrogate for eco-innovations. This provides a starting point for future IS research to focus on issues that best supports eco-innovations.
- We shed light on how cross-cultural differences may affect these intentions, which, among other factors, are influenced by attitudes and moral norms. This is achieved by conducting a survey in Germany and China, two of the most important, but at the same time culturally very distinctive, markets for electric vehicles and breakthrough innovations in electric mobility.

In the following section we will proceed by exploring work that is related to our research. Subsequently, we will present the research model and the resulting hypotheses, after which we specify our methodological approach. Afterwards, we present the results of our survey. The last section concludes.

Background

Research on technology adoption is seen as one of the most elaborated domains in IS research (Venkatesh et al. 2003). To extend the IS knowledge base as well as identify and explain the root causes influencing technology adoption, many different research models have been applied. Most of these models originate from theories that have their roots in social psychology and behavioral science, such as the Theory of Planned Behavior (TPB) (Ajzen 1991) and the Technology Acceptance Model (TAM) (Davis 1989; Davis et al. 1989). Another popular theory in technology adoption research is Roger's (2003) Innovation Diffusion Theory (IDT), which focuses on five antecedents of technology adoption. Later, Tornatzky and

Klein (1982) showed that three of the original five antecedents had the most consistently significant relationship to innovation adoption: relative advantage, compatibility, and complexity. Building upon the original TPB, Taylor and Todd (1995a; 1995b) decomposed the belief structures and used Tornatzky and Klein's (1982) findings to decompose the attitudinal belief.

The central difference between eco-innovations and their „classical" counterparts is that some of their benefits do not immediately concern the adopter. For instance, a sustainable and environmentally friendly lifestyle, may not change the quality of life of the person in question, but improve it for future generations. Hence, eco-innovations cannot be judged using purely utilitarian measures, such as financial benefits or the desire to „belong" to a particular group, but point at a deeper moral motivation. For the special case of eco-innovation adoption, Melville (2010) elaborates on the critical role IS can play in shaping beliefs about the environment and how this belief may affect individual behavioral intention to adopt IS for sustainability. Studying the adoption of a low-involvement eco-innovation, Kranz and Picot (2011) provide evidence that intention to adopt is significantly influenced by environmental concerns. In terms of high-involvement goods like electric vehicles, Jansson (2011) and Jansson et al. (2010) combine environmental psychology research (Stern 2000) and Roger's (2003) diffusion of innovations literature to explore factors influencing adoption intention. Their primary finding is that norms, novelty seeking, and perceived innovation characteristics are the major drivers of high involvement good eco-innovation adoption.

Publication	Domain Focus		Culture	Base Model			
	Eco-Innovation Adoption	Other Technology Adoption	Reviewed Cultural Influence	TAM	(D)TPB	VBNT	Other
Davis, Bagozzi and Warshaw (1989)		X		X	X		
Taylor and Todd (1995b)		X		X	X		
Karahanna, Agarwal and Angst (2006)		X		X			
Loch, Straub and Kamel (2003)		X	X				X
Straub, Keil and Brenner (1997)		X	X	X			
Choi and Geistfield (2004)		X	X		X		
Melville (2010)	X						X
Kranz and Picot (2011)	X				X		
Jansson et al. (2010)	X					X	
Jansson (2011)	X					X	
Research Contribution	**X**		**X**		**X**	**X**	

Table 1.Research Contribution

Another important stream in technology-adoption research investigates the role of cultural values and has found either direct (Elbeltagi et al. 2005; Lee et al. 2007; Veiga et al. 2001) or moderating effects (Dinev et al. 2009; McCoy et al. 2005; Pavlou and Chai 2002) on adoption intention. Findings suggest that cultural values of individualism, masculinity, power distance, and uncertainty avoidance significantly affect behavioral intention (i.e., intention to adopt) (Dinev et al. 2009). Furthermore Straub et al. (1997) are able to show that culture influences technology adoption, as they found differing results when they conducted a survey based on TAM across three countries. To date, research that integrates findings from cross-cultural studies and eco-innovation adoption is limited. Therefore, we incorporate cultural values implicitly by comparing the differences between potential Chinese and German adopters. We have chosen these two countries as, on the one hand, their cultural values differ significantly (see Table 5), and on the other hand, both countries are important markets for electric vehicles.

The Concept of Culture

In the literature a disagreement still exists in trying to define what culture means. Kroeber and Kluckhohn (1952) identify 164 definitions of culture. House et al.'s (2004) GLOBE study defines culture as „shared motives, values, beliefs, identities, and interpretations or meanings of significant events that result from common experiences of members of collectives that are transmitted across generations. Hofstede defines culture as „the collective programming of the mind that distinguishes the members of one group or category of people from others" (Hofstede and Hofstede 2005). Further components of definitions of culture include values, beliefs, norms, material components, symbols, heroes, rituals, and practices, artifacts, and unconscious assumptions (Ferrante 2003; Hofstede and Hofstede 2005; Schein 1999).

However, the most common elements in definitions of culture are values and norms. These are shared conceptions of what is good, right, appropriate, worthwhile, and important with regard to human behavior (Ferrante 2003; Jacks and Palvia 2011). Another distinctive mark of definitions of culture is levels of culture. These levels are essential for culture studies and to what extent culture is examined. Figure 1 illustrates these levels by means of the Onion Model (Karahanna et al. 2005).
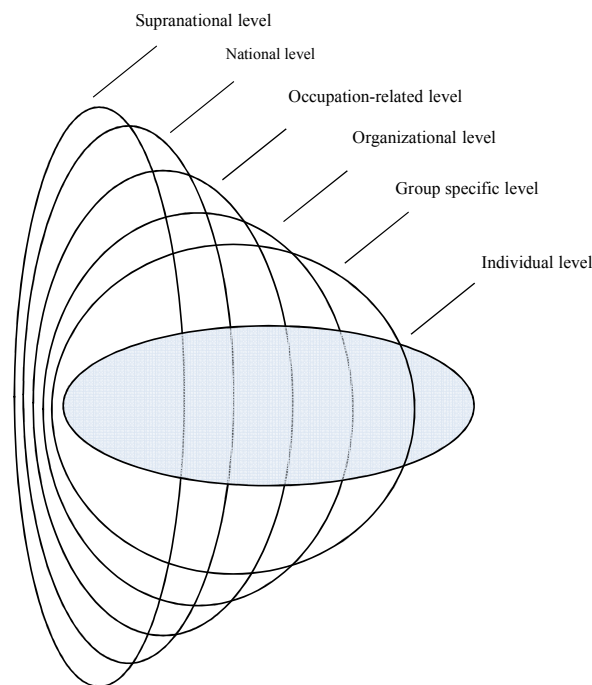

Supranational level
National level
Occupation-related level
Organizational level
Group specific level
Individual level

Figure 1.Karahanna et al. (2005): Onion Model

Hofstede's research is still the most utilized and widespread in cultural comparative studies (Zakour 2007). Smith and Bond (1999) even consider it unrivaled, for instance with respect to the survey population. Since 1968 Hofstede consulted 116,000 IBM employees, which is a yet unbeaten number. Seventy-two countries participated in the survey. However, limited to one organization only, the results are criticized as unrepresentative. In addition, cultures develop and change over time and the data collection has elapsed several decades. Hofstede's approaches only consider culture on a national level; therefore, his culture term is not free of stereotyping and does not consider the current research discourse in culture sciences. Building on the results of Hofstede, the project GLOBE (Global Leadership and Organizational Behavior Effectiveness Research Program) began a new study in 1994 (House et al. 2004). This study is considered the youngest culture research such that cultures are examined up to a very recent point in time. GLOBE's survey population covers 17,370 persons and the interviewees are limited to managers of medium-sized enterprises. Hence, the results are also subject to some restrictions. However, the population is not limited to one organizational culture, but comprises three different organizational backgrounds. Therefore, the understanding of culture is closer to the current research discourse.

Furthermore, House et al.'s (2004) culture concept is not limited to a national level. They consider culture as a dynamic concept that can change over time and has inner-cultural differences. The GLOBE study examined 62 cultures across 59 countries as they also consulted subgroups like East and West Germany. A special feature of the GLOBE study lies within the examination of culture as practices and values. Practices („as is") explain the way things are done in a certain culture, whereas values („should be") describe how things should be done in specific cultures (House et al. 2004). To explain particular attitudes and moral norms of Chinese and German cultures, we use a selection of culture dimensions by House et al. (2004).

The GLOBE study expresses cultural differences in index scales. A selection of culture dimensions of the GLOBE study is defined in Table 2. We focus our analysis on the following selection of dimensions, as they are the most commonly used dimensions in adoption literature: *power distance, in-group collectivism, uncertainty avoidance,* and *future orientation.* Because of this, we have a good, justifiable base for finding and explaining the role of culture in the context of adopting eco-innovations.

Table 2. House et al. (2004) selection of relevant culture dimensions

	Power distance	In-group collectivism	Uncertainty avoidance	Future orientation
Definition House et al. (2004)	Society members' expectations concerning unequal power sharing and the extent to which members maintain inequality in terms of power relations.	Degree to which individuals prefer memberships in small groups such as the family or prefer to identify with the collective rather than the individual sphere.	Society's reliance on social norms and procedures to alleviate the unpredictability of future events.	Social encouragement and rewarding of future oriented behaviors by members.

Research Model and Hypotheses

In the following, we develop our research model (see Figure 2). Traditional research on the adoption of technological innovations emphasizes that the technology's characteristics affect adoption or intention to adopt (Arts et al. 2011; Davis et al. 1989). However, researchers were able to prove that moral norms resulting from an individual's ecological awareness also have a strong positive impact on adoption intention, especially with eco-friendly goods and services such as alternatively-fueled vehicles (Jansson et al. 2010, Jansson 2011).

Our model builds upon the Decomposed Theory of Planned Behavior (DTPB) (Taylor and Todd 1995a), being a combination of the Theory of Planned Behavior (TBP) (Ajzen 1991) and the Innovation Diffusion Theory (Rogers 2003). All of these theories are well-established in IS research and beyond (Venkatesh et al. 2003). As we examine the adoption of an innovation that has the potential to

substantially increase environmental sustainability, we additionally incorporate the construct of moral norms, originating from the Value Belief Norm Theory (VBNT) (Stern 2000), into our model.
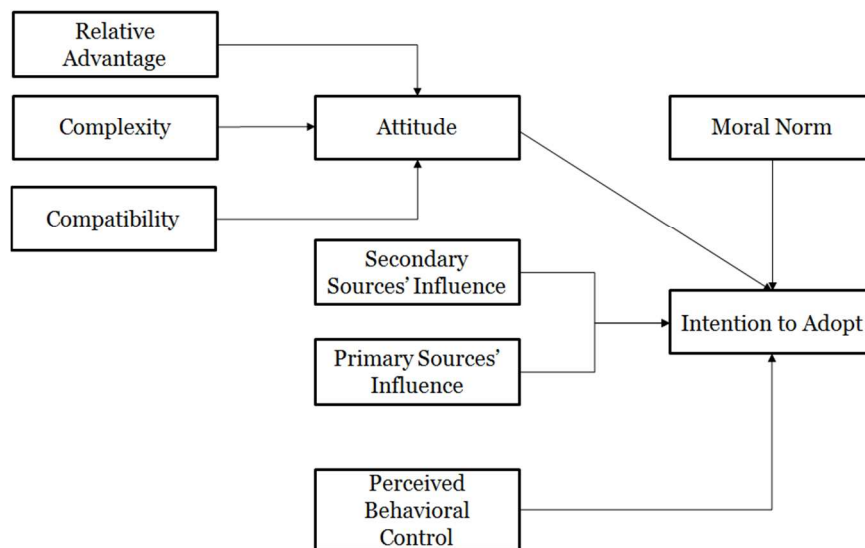

Figure 2.Eco-Innovation Adoption Model

Attitude, Perceived Behavioral Control, and Subjective Norm

Fishbein and Ajzen (1975) define attitude as the degree to which an individual assesses a behavior as being favorable or not. In terms of eco-innovation adoption attitude, this reflects an individual's view about whether an eco-innovation has reputedly less harmful impacts on the environment and is thus more or less beneficial to express the individual's green values (Jansson 2011). Consistent with previous studies that found attitude to be a significant predictor of intention (Pavlou and Chai 2002; Pedersen 2005), we suggest that a positive attitude towards using eco-innovations is positively related to the adoption intention. Hence, we contend:

> H1a: *Consumers' attitude positively influences the intention to adopt an electric vehicle.*

In terms of the influence of attitude on the behavioral intention to adopt an eco-innovation such as electric vehicles, recent studies have arrived at mixed results. While Pavlou and Chai (2002) were able to show that collectivistic cultures tend to show a stronger effect of attitude on the behavioral intention, a greater amount of researchers were able to show the exact opposite trend (Chan and Lau 2002; Kacen and Lee 2002; Tan et al. 2004; Tan et al. 2007). We, therefore, hypothesize:

> H1b: *Attitude is a stronger predictor for the German sample than for the Chinese one.*

Perceived behavioral control is defined as „*the ease or difficulty of performing the behavior of interest*" (Ajzen 1991). The variable „*should be read as perceived control over the performance of a behavior*" that denotes the „*subjective degree of control over performance of the behavior itself*" (Ajzen 2002). Thus, concerning eco-innovation adoption, perceived behavioral control is related to the individual's subjective degree of control over adopting and using the specific innovation. We suggest that the greater the level of perceived behavioral control, the higher the intention to adopt the eco-innovation (Kranz and Picot 2011; Pavlou and Chai 2002). Hence we contend:

> H2:   *Perceived behavioral control positively influences the intention to adopt an electric vehicle.*

Taylor and Todd (1995a) suggest assessing subjective norms from the two separate perspectives only if primary influences (e.g., friends, family) and secondary influences (e.g., mass or social media) are

assumed to differ. In terms of the intention to adopt an electric vehicle, we expect that both sources of social influence affect the adoption decision differently. Thus, we distinguish between primary and secondary sources' influence „*to capture the nuances of the social environment*" (Srite and Karahanna 2006), as the diversity of potential primary and secondary influential sources in private settings is an important adoption driver (Brown et al. 2002). Another aspect relating specifically to eco-friendly innovations is that adopting often means conforming to social norms rather than to distinct environmental concerns (Bamberg 2003). Therefore, in accordance with previous findings (Kranz and Picot 2011; Venkatesh and Brown 2001), we assume that people receiving positive messages or social pressure from primary or secondary sources are more likely to have a strong behavioral intention to adopt electric vehicles. Furthermore, focusing on Hofstede's individualism/collectivism dimension, Srite and Karahanna (2006) argue that the psychological concept of the self helps to explain the impact of individualism/collectivism on the behavior. Individuals from cultures with strong collectivistic values tend to consider their friends and family's views on a technology before adopting it more than individuals from individualistic cultures (Dinev et al. 2009; Pavlou and Chai 2002). Furthermore, cultures with a higher power distance (House et al. 2004) have been shown to adopt new technologies more readily in prior research (Dinev et al. 2009; Pavlou and Chai 2002). Thus, we contend that for the Chinese sample, both subjective norm variables should have a greater impact on intention to adopt, as the Chinese culture is more collectivistic and has a greater power distance. Hence we hypothesize:

H3:   *Secondary sources' influence positively influences the intention to adopt electric vehicles.*

H4a: *Primary sources' influence positively influences the intention to adopt electric vehicles.*

H4b: *Primary sources' influence is a stronger predictor for the Chinese sample than for the German one.*

Attitudinal Beliefs

Relative advantage measures the increased benefit of an innovation compared to existing products or services, which can refer to financial benefits, avoidance of discomfort, social prestige, or time savings (Rogers 2003). Compared to conventional vehicles, customers regard the limited driving range and higher purchasing costs as the major disadvantages of electric vehicles (Sovacool and Hirsh 2009). Positive aspects include lower GHG emissions, decreased noise emissions, and fuel savings (Peters and Hoffmann 2011, Moons et al. 2009). Across many contexts, relative advantage or similar constructs, such as utilitarian outcome (Venkatesh and Brown 2001) or perceived usefulness (Hsieh et al. 2005), have been shown to influence adoption behavior positively (Hsieh et al. 2005; Taylor and Todd 1995a). Furthermore, uncertainty avoidance has been shown to explain differences of technology adoption across different contexts (De Mooij and Hofstede 2011; Tellis et al. 2003; Yeniurt and Townsend 2003). Literature demonstrates that cultures with a higher level of uncertainty avoidance tend to adopt innovations that are expected to work more reliably than other solutions. As a result, cultures with higher levels of uncertainty avoidance are found to invest more in technology innovations. Overall, we contend:

H5a: *Perceived relative advantage positively affects the attitude towards the adoption of electric vehicles.*

H5b: *Perceived relative advantage is a stronger predictor for the Chinese sample than for the German one.*

The perceived complexity and the resulting required efforts for learning are dependent on adopters' knowledge and willingness to learn (Litfin 2000). In the context of electric vehicles, consumers have to learn using new interfaces and displays and the general usage, such as handling of plugs and charging (Peters and Dütschke 2010). A recent study also showed that the perceived complexity of electric vehicles is greater before individuals actually test electric vehicles (Moons et al. 2009). Thus, electric vehicles are regarded as more complex to adopt if consumers do not have „hands-on" experience. Furthermore, people belonging to individualistic cultures tend to be more self-confident when using a new technology (Thatcher et al. 2003) and evaluate the use of new technological services such as mobile internet (Lee et al. 2007) to be less complicated in comparison to people from collectivistic cultures. Hence, we expect individualism-oriented Germans to be more self-confident about handling electric vehicles in general than the Chinese. We therefore contend:

> *H6a:*   *Perceived complexity negatively influences the attitude towards the adoption of electric vehicles.*

> *H6b:*   *Perceived complexity is a weaker predictor for the German sample than for the Chinese sample.*

An innovation's compatibility is determined by its social and technological compatibility (Rogers 2003). Correspondingly, the usage of an electric vehicle has to be compatible with an adopter's lifestyle and consumption values (Au and Enderwick 2000) as well as with technical facilities at the consumer's home or workplace, such as the possibility to charge the vehicle. If an innovation fits with both social and technical norms and beliefs of an adopter, a positive influence on adoption behavior has been found (Taylor and Todd 1995a; Van Slyke et al. 2010).

> *H7:*   *Perceived compatibility positively affects the attitude towards the adoption of electric vehicles.*

Moral Norms

In environmental psychology, green values of potential adopters are often operationalized using Stern's (2000) Value Belief Norm Theory (VBNT). This theory contends that moral norms strongly affect the relationship between fundamental values and behavioral intention because moral norms aggregate „*personal feelings of [...] responsibility to perform, or refuse to perform, a certain behavior*" (Ajzen 1991) and thus amongst others expresses the ecological awareness of an individual (Stern 2000). Moreover, this ecological awareness was found to have a positive impact on the usage of eco-friendly means of transport (Heath and Gifford 2002; Nordlund and Garvill 2003), the acquisition of low-involvement products (Minton and Rose 1997) and the willingness to pay a premium for organic grocery products (Widegren 1998). In addition to these findings, Jansson et al. (2010) and Jansson (2011) showed that the relationship also holds true for high-involvement goods, such as alternative fuel vehicles.

In line with VBNT, we argue that values, beliefs, and behaviors of individuals, groups, and institutions are strongly influenced by their cultural surroundings and are further shaped by the way the socio-cultural surrounding accepts them as legitimate. Ecological awareness implies that an individual wants to conserve the environment. At the same time, severe environmental damage tends to be a result from long-enduring environmental damage (e.g., continuously-emitted GHGs have a long-lasting impact on the ozone layer). Therefore it is assumed that cultures with a high degree of long-term orientation should show high degrees of ecological awareness and thus a stronger moral norm than cultures that are rather short-term oriented (Clayton 2012). Thus, we state:

> *H8a:*   *Moral norms positively affect the intention to adopt electric vehicles.*

> *H8b:*   *Moral norms are a stronger predictor for the German sample than for the Chinese one.*

Methodological Approach

Sample and Data Collection Procedure

We validated our research model with data collected from an online survey. The survey was run in November 2012. To ease problems of understanding, we supplied the survey in both English and Chinese. To account for construct equivalence, we chose a reversed translation approach. Thus, the translation was performed by two English and Chinese native speakers who translated the survey back and forth independently from each other. Furthermore, before translating the survey, we conducted a pretest in October 2012 with four IS scholars. According to their feedback, we amended the wording and the order of some items. In addition, a short definition of electric vehicles and information about the importance of IS to enable an advanced electric mobility system were provided in the introduction of the survey. Subjects were recruited via social networks and German and Chinese university websites. Within two and a half weeks, 174 participants (n_{German} = 93, $n_{Chinese}$ = 81) from a total of 252 people (response rate: .69) who started the survey completed it successfully. In order to increase the response rate, participants were

given the chance to win a 3-month subscription to a music streaming service. On average, the participants were 24.3 years old; 76% were male, while 61.9% had a college degree and 38.1% had a high school degree. We were not able to measure any significant difference between male and female participants, making a bias caused by the sample imbalance rather unlikely.

Measurement of Constructs

We followed standard psychometric scale development procedures. Table 3 shows all scales used and their sources together with descriptive statistics and psychometric properties. All items were rated on reflective seven-point Likert scales with the anchors „strongly agree" (1) and „strongly disagree" (7).

We assessed reliability and validity for each reflective measure using the PLS approach (see Gefen and Straub 2005). First, we checked convergent validity. Results indicate that all items significantly loaded on their respective construct (.70 or higher). Second, we calculated values for composite reliability (CR) and the average variance extracted (AVE) to check reliability (Fornell and Larcker, 1981). For each construct, CR values were larger than .70. In addition, the AVEs of all constructs exceeded .50 (Straub et al. 2004). Third, we assessed discriminant validity using the criterion of Fornell and Larcker (1981). For all constructs, the shared variances between the variables were lower than the AVE values of the respective constructs (see square root AVEs on the diagonal in Table 3). Thus, discriminant validity could also be established. We also tested for common method bias as independent and dependent variables were provided by the same respondent. Both, the Harman's single-factor test (Podsakoff et al. 2003) and the marker variable test (Lindell and Whitney 2001) indicate that common method bias was not a threat to the validity of our study.

Table 3. Correlations and Measurement Information

Var	Source	No. Items	Mean	SD	CA	CR	AVE	1	2	3	4	5	6	7	8	9
1 ATT	Davis (1989)	3	5.27	1.15	.68	.82	.61	**.78**								
2 CLX	Taylor and Todd (1995a)	3	5.98	.87	.63	.72	.58	.08	**.76**							
3 CMP	Taylor and Todd (1995a)	3	4.66	1.41	.85	.90	.76	.40	-.10	**.87**						
4 INT	Mathieson (1991)	3	3.34	2.08	.89	.93	.81	.34	-.13	.20	**.90**					
5 MN	Stern (2000)	4	2.84	1.99	.93	.95	.83	.32	-.32	.31	.35	**.91**				
6 PBC	Taylor and Todd (1995a)	4	4.27	1.63	.66	.85	.74	.02	.11	.11	.06	.22	**.86**			
7 PSI	Mathieson (1991)	3	2.74	1.72	.88	.92	.79	.27	-.20	.15	.52	.21	-.08	**.89**		
8 RA	Taylor and Todd (1995a)	3	4.57	1.17	.69	.77	.62	.44	-.06	.40	.31	.30	.13	.23	**.79**	
9 SSI	Brown and Venkatesh (2005)	3	3.48	1.60	.70	.86	.76	.10	-.11	.20	.06	.33	.20	.10	.12	**.87**

Note:SD: standard deviation; CA: Cronbach's alpha; CR: composite reliability; AVE: average variance extracted; ATT: Attitude; CLX: Complexity; CMP: Compatibility; INT: Intention to adopt; MN: Moral Norm; PBC: Perceived Behavioral Control; PSI: Primary Sources' Influence; RA: Relative Advantage; SSI: Secondary Sources' Influence. Diagonal elements (in boldface) are the square root of AVE.

Results

To test the research model, we used partial least squares (PLS) via the software SmartPLS version 2.0.M3 (Ringle et al. 2005). We have chosen variance-based PLS instead of covariance-based structural equation modeling (SEM); As we split our complete sample in two minor sub-samples (German and Chinese), PLS is particularly suitable for this study as it is prediction-oriented and robust to relatively small sample sizes

(Chin, 1998), and also better predicts and identifies key „driver" constructs (Hair et al. 2011). To calculate the significance of parameter estimates, a bootstrapping resampling procedure was performed (n = 3,000 samples).

Table 4.Results of Model Estimation and Model Comparison

	Sample				
	Complete Sample	Chinese Sample	German Sample	Sample Comparison	
Path	Path Coefficients			t-value	p (two-tailed)
Attitude →Intention to Adopt (H1)	.157**	-.011	.369**	3.58	0.0004**
Perceived Behavioral Control →Intention to Adopt (H2)	.074	-.126	.127	1.10	0.2742
Secondary Sources of Influence →Intention to Adopt (H3)	-.090	-.026	.005	0.28	0.7772
Primary Sources of Influence →Intention to Adopt (H4)	.447**	.833**	.090	2.44	0.0151**
Relative Advantage → Attitude (H5)	.298**	.492**	.252**	0.28	0.7784
Complexity → Attitude (H6)	.018	.090	-.075	1.52	0.1298
Compatibility → Attitude (H7)	.230**	.209	.284**	2.97	0.0032**
Moral Norm → Behavioral Intention (H8)	.222*	.222	.297**	1.22	0.2224

Significance levels: **$p < .05$, * $p < .10$

For conducting the group comparisons we estimated the structural model for the Chinese and German sub-samples separately. We tested whether the parameter estimates obtained for both sub-samples significantly differ using t-tests suggested by Chin (2000). The idea is to test whether the differences in the parameter estimates between the two samples are different from zero. Overall, the proposed model receives ample support. It accounts for 28% (complete sample), 33% (Chinese sample) and 43% (German sample) of the variance of the attitude toward electric vehicles and for 37% (complete sample), 79% (Chinese sample) and 38% (German sample) of the variance of the intention to adopt electric vehicles. Results for each hypothesized effect or group difference are provided in Table 4.

Discussion and Conclusion

Our study proposed and tested a research model that integrated research from information systems, social and environmental psychology, and innovation diffusion. Overall, our model was able to successfully account for an ample amount of the variance in intention. We could find differing varieties of the tested factors between the Chinese and the German sample. According to Hofstede's study and the GLOBE study, the countries are based on different national cultures. We propose several reasons for the differences between intentions to adopt in Germany and China and take House et al.'s GLOBE study (2004) as a reference. In the following, we shortly want to draw some attention first to intriguing findings regarding the analysis of the complete sample and underpin why the further analysis of the two subsamples is of great importance to better understand adoption behavior. We then focus on the differences between the two culturally different influenced subsamples in more detail and discuss the role of culture in the context of the results.

Focusing on the complete sample, an intriguing finding of our study was that, in contrast with prior findings on innovation adoption, primary sources' influence was the most important predictor of the intention to adopt electric vehicles. The non-significant effect of *perceived behavioral control* on

intention was unexpected. Supporting this finding, Ajzen (1991) argues that a strong impact of other constructs (e.g., PSI and attitude) may lessen the effect of perceived behavioral control. Moreover, although secondary sources' influence is regarded as important in the early adoption stage, our study could not establish a significant relationship. This may result from limited media interest in electric vehicles.

Table 5. Summary of General Hypotheses and Results

No.	Hypothesis	Supported?
H1a	Consumers' attitude positively influences the intention to adopt an electric vehicle.	Yes
H2	Perceived behavioral control positively influences the intention to adopt an electric vehicle.	No
H3	Secondary sources' influence positively influences the intention to adopt electric vehicles.	No
H4a	Primary sources' influence positively influences the intention to adopt electric vehicles.	Yes
H5a	Perceived relative advantage positively affects the attitude towards the adoption of electric vehicles.	Yes
H6a	Perceived complexity negatively influences the attitude towards the adoption of electric vehicles.	No
H7	Perceived compatibility positively affects the attitude towards the adoption of electric vehicles.	Yes
H8a	Moral norms positively affect the intention to adopt electric vehicles.	Yes

Furthermore, by pointing out differences in significance between the complete sample and the individual sub-samples for the same construct, our results provide clear evidence that regarding different culturally-influenced subsamples individually is of great importance to better understanding the adoption behavior in terms of eco-innovation adoption.

Table 6. Summary of Culture-Specific Hypotheses and Results

No.	Hypothesis	Supported?
H1b	Attitude is a stronger predictor for the German sample than for the Chinese one.	Yes
H4b	Primary sources' influence is a stronger predictor for the Chinese sample than for the German one.	Yes
H5b	Perceived relative advantage is a stronger predictor for the Chinese sample than for the German one.	No
H6b	Perceived complexity is a weaker predictor for the German sample than for the Chinese sample.	No
H8b	Moral norms are a stronger predictor for the German sample than for the Chinese one.	No

As mentioned before, we proposed the hypothesis H1b that attitude is a stronger predictor for the German sample than for the Chinese one. The items of our questionnaire determined e.g., whether the participants had a positive attitude towards electric vehicles and whether they were open/prepared to spend money for them. We were able to find support for this hypothesis as the two samples differ significantly in answering behavior of the relevant items and we could only identify a strong and significant path coefficient for the German sample. We base our argumentation on the Chinese sample's lack of a significant effect, thus implying that the effect must at least be weaker than for the German sample. The result can be explained by the culture dimension of future orientation, which indicates to what degree cultures are caring for the environment. Cultures with a high future orientation, such as in Germany, „*have a strong capability and willingness to imagine future contingencies, formulate future goal states, and seek to achieve goals and develop strategies for meeting their future aspirations*" (Askanasy et al. 2004). In contrast, a culture such as the Chinese one, with low future orientation or high present orientation, is free of past worries or future anxieties (Askanasy et al. 2004).

Hypothesized in H4b, primary sources' influence is a stronger predictor for the Chinese sample than for the German one. We were able to find support for this hypothesis as the two samples also differ

significantly in answering behavior of the related items, and we could only identify a strong and significant path coefficient for the Chinese sample. In line with previous rationale, we base our argumentation on the German sample lacking a significant effect in this case, thus implying a weaker effect of this predictor for the German sample than for the Chinese one. This result is not unexpected: as mentioned before, primary sources comprise family and friends who are influencing one's attitude. According to the GLOBE study, the result can be explained with the individualism and collectivism dimension. In collectivistic cultures, families and friends are the main drivers influencing the formation of an individual's opinion. Thus, for the Chinese, being significantly more family oriented than Germans, primary sources' influence logically should be a stronger predictor.

We further hypothesized in H5b that the perceived relative advantage is a stronger predictor for the Chinese sample than for the German one. Although our results were not able to fully support this hypothesis, we can provide evidence that perceived relative advantage is a strong predictor of electric vehicle adoption in the complete sample, as well as in both sub-samples. The path coefficient of the Chinese sample is indeed stronger than that of the German sample. However, the sample comparison shows that the samples do not differ significantly. Regarding the culture dimension uncertainty avoidance, Germany and China's scores for uncertainty avoidance for practices is significantly higher than those of other national cultures. House and Javidan (2004) demonstrated that these cultures tend to enjoy scientific progress. We could not find a suitable explanation for this result based on culture. We assume that the anxiety of using electric vehicles still is great. Thus, uncertainty avoidance is more focused on avoiding the risk related to using one (e.g., anxiety that the vehicle cannot drive after a certain distance) than avoiding environmental pollution.

Furthermore, our results clearly state that perceived complexity is of no importance to the adoption decision for either the German sample or the Chinese one. Because electric vehicles are usually assumed to be more complex than their conventional counterparts, this might initially be an intriguing finding. However, the non-significant effect of secondary sources' influence (media influence) might be a reason why the interviewed candidates were not able to clearly estimate an electric vehicle's degree of complexity.

Table 7.Indices of Culture Dimensions of Results of the GLOBE Study (Germany and China)

	Practices (as is)		Values (should be)	
	Germany	China	Germany	China
Power distance	5.40	5.04	2,62	3.10
Collectivism	4.27	5.80	5.2	5.09
Uncertainty avoidance	5.19	4.94	3.63	5.28
Future orientation	4.11	3.75	5.04	4.73

Higher scores indicate a greater expression of the culture dimension.

Our last hypothesis regarding cultural differences in adoption behavior was that moral norms are a stronger predictor for the German sample than for the Chinese one. According to the results of the questionnaire, this hypothesis cannot be supported. To clarify the result, cultures who have a higher power distance like the Chinese are more accepting of inequality, rules, and given instructions. De Luque and Javidan (2004) also found out that cultures with high uncertainty avoidance show less tolerance for breaking rules. We assume that a construct such as moral norms is therefore more fitting to the Chinese culture.

The following limitations should be considered when interpreting the results. First, constructs such as moral norms tend to be biased by social desirability. This especially holds true for the Chinese culture, as the Chinese pay much attention to maintaining the respect of others. Nevertheless, due to assured anonymity, social desirability may not be a major concern. Second, the study's sample is younger and more educated than the general population. Hence, as in most non-randomized surveys, there are issues concerning the generalizability to the entire population of the results. However, as early adopters tend to be young and educated, the results are reliable for this important market segment. Third, we studied only

one particular eco-innovation. Hence, future research should generalize the findings by examining other eco-innovations.

Notwithstanding these limitations, our paper contributes to IS research in three major ways: First, we extended prior research by providing empirical evidence that culture does have a strong impact on attitude and norms as well as intention to adopt eco-innovations. For this, we used the GLOBE study as a basis, as it is the most elaborated culture study within the current research discourse. Second, the study determined that primary sources' influence has a very strong impact on intention to adopt eco-innovations. Third, in cultures with a high degree of collectivism, primary sources' influence is a much stronger predictor for the intention to adopt eco-innovations than in individualistic cultures. These insights help the IS community to focus research on its vital role in enhancing the advantages and mitigating the disadvantages of eco-innovations. From a practitioner perspective, the results imply that advertising of new eco-innovations should concentrate on the „greenness" of the product to emphasize environmental awareness in line with moral norms. Furthermore, for markets in cultural regions with a high degree of collectivism, a new product launch might be accompanied by a concentrated social media campaign to actively influence individual's social peers.

Acknowledgments

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Appendix

		Table 8. Overview of Model Constructs and Items	
Construct	**Source**	**English**	**Chinese**
Familiar with EV	Self-developed	Are you familiar with electric vehicles?	您对电动汽车熟悉吗?
		No, I do not know any electric vehicles	不，我对电动汽车一无所知
		Yes, I have heard of electric vehicles	是,我听说过电动汽车
		Yes, I have tried an electric vehicle	是，我试开过一辆电动汽车
		Yes, I own an electric vehicle	是,我拥有一辆电动汽车
		Please indicate your level of agreement to the following statements (strongly disagree, neutral, strongly agree)	请表明您对下面的说法的同意度(非常不同意，中立，非常同意)
Relative Advantage	Taylor and Todd (1995a); Taylor and Todd (1995b)	An electric vehicle will be of no benefit to me	电动汽车对我来说没有好处
		The advantages of an electric vehicle outweigh the disadvantages	电动汽车的优点比缺点多
		Overall, using an electric vehicle will be advantageous	总共来说，使用电动汽车会有好处
Complexity	Taylor and Todd (1995a); Taylor and Todd (1995b)	It will be difficult to learn how to use an electric vehicle	很难学会驾驶一辆电动汽车。
		An electric vehicle will be easy to operate	使用一辆电动汽车很简单
		It will be frustrating to learn how to use an electric vehicle	学习使用电动汽车会让人沮丧
Compatibility	Taylor and Todd (1995a); Taylor and Todd (1995b)	Using an electric vehicle will fit well with how I use my car	驾驶电动汽车和我驾驶其他车一样。
		An electric vehicle is compatible with my lifestyle	电动汽车和我的生活方式是兼容的
		An electric vehicle will fit well with my lifestyle	电动汽车很适合我的生活方式
Secondary Sources' Influence	Brown and Venkatesh (2005)	Media and advertising consistently recommend using electric vehicles	媒体和广告一直推荐使用电动汽车
		Media is full of reports, articles and news suggesting buying electric vehicles is a good idea	媒体上满是声称买电动车是个好主意的报告和文章
		I read/saw news reports that using electric vehicles is a good idea	我读过/看过声称使用电动车是好主意的新闻报告
		Media and advertising consistently recommend buying electric vehicles	媒体和广告一直推荐购买电动汽车
Primary Sources' Influence	Mathieson (1991)	My friends and family would think that I should buy an electric vehicle	我的朋友们和家庭认为我应该买一辆电动汽车
		My friends and family would think that I should use an electric vehicle	我的朋友们和家庭认为我应该使用一辆电动汽车
		My friends and family think that we should all buy electric vehicles	我的朋友们和家庭认为我们全都应该买电动汽车
		My friends and family think that we should all use electric vehicles	我的朋友们和家庭认为我们全都应该使用电动汽车
Moral norm	Stern (2000)	I feel morally obliged to buy an electric vehicle instead of a conventional	我感到有道德义务购买电动汽车, 而

		vehicle	不是传统上的汽车
		If I would buy a new vehicle, I would feel a moral obligation to buy an electric one	如果我要买一辆新汽车，我会出于道德义务去买电动汽车
		I would feel guilty not using an electric vehicle	我如果不使用电动车我会感到有罪恶感
		I feel a moral obligation to use an electric vehicle	我感到我有道德义务去使用一辆电动汽车
Perceived behavioral control	Taylor and Todd (1995a); Taylor and Todd (1995b)	I have the resources, knowledge and ability to purchase an electric vehicle	我有资源，知识和能力去购买一辆电动车
		I have the resources, knowledge and ability to operate an electric vehicle	我有资源，知识和能力去使用一辆电动车
		I would be able to purchase an electric vehicle	我会有能力去购买一辆电动车
		I would be able to operate an electric vehicle	我会有能力去使用一辆电动车
Intention to use	Mathieson (1991)	I would buy an electric vehicle rather than a conventional vehicle	我会更愿意买一辆电动汽车 而 不是传统车
		My intention would be to use an electric vehicle rather than a conventional vehicle	我打算使用一辆电动汽车而不是传统车
		I plan to buy an electric vehicle rather than a conventional vehicle	我计划买一辆电动车，而不是传统车
Attitude towards use	Davis (1989)	The following questions refer to your attitude towards electric vehicles	下面的问题针对您对电动汽车的态度
		Using an electric vehicle is a_____(bad/neutral/good) idea	使用一辆电动汽车是一个_____(坏/中立/好)主意
		I think buying an electric vehicle is a_____(bad/neutral/good) idea	我认为购买一辆电动汽车是一个_____(坏/中立/好)主意
		I_____(dislike/neutral/like) the idea of using an electric vehicle.	我_____(不喜欢/中立/喜欢)使用电动车这个主意
		Purchasing an electric vehicle would be a _____(foolish/neutral/wise) idea	购买一辆电动汽车是一个(愚蠢/中立/高明)的主意