

Gender and Generational Differences in Environmental Awareness and Travel Mode Choice: Evidence from Taiwan

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1. Introduction

Due to the environmental problems facing Taiwan such as air pollution, energy consumption, and greenhouse gas emissions, reducing car dependency and increasing transit ridership are the directions of Taiwan's transport policy. Environmental awareness and willingness to change travel behavior are keys to policy success. Research suggests that women hold greater concern about the environment and engage more in everyday pro-environmental activities such as recycling and buying green products partly owing to their altruistic, caring, and risk-averse personalities (Dietz *et al.*, 2002; Luchs and Mooradian, 2012; Tindall *et al.*, 2003; Zelezny *et al.*, 2000), but whether greater environmental concern of women contributes to gender differences in reducing car use and adopting sustainable travel modes in daily life is not clear. Available studies are limited and the evidence is mixed (Beirão and Cabral, 2008; Matthies *et al.*, 2002; Polk, 2003). In addition, recent research reveals substantial travel pattern transitions for young adults. Millennials drive less, use alternative modes more often, and have lower rates of car ownership and driving license compared to older generations. Economic recession, Internet use, and delay in completing their education and starting a career are all drivers of Millennial travel behavior changes (Blumenberg *et al.*, 2016; Garikapati *et al.*, 2016; Hong and McArthur, 2017; Kuhnimhof *et al.*, 2012; Ralph, 2017), but whether heightened environmental awareness plays a role in those changes is understudied (Hopkins, 2016; Le Vine *et al.*, 2014). Moreover, whether the influences of urban and rural settings on environmental awareness and on travel mode choice differ by age and gender should be taken into consideration (Berenguer *et al.*, 2005; Huddart-Kennedy *et al.*, 2009).

In this context, I analyze data from the 2010 Taiwan Social Change Survey: Environment (Chang *et al.*, 2012) with a structural equation modeling approach to examine whether the effects of environmental awareness on travel mode choice vary across socio-demographic and land use characteristics, focusing on gender and generational differences. The findings could be used to tailor educational campaigns for different age and gender groups in order to stimulate modal shifts and promote sustainable transportation.

2. Data and Methods

The 2010 Taiwan Social Change Survey: Environment was sponsored by the Ministry of Science and Technology and directed by Academia Sinica. Conducted between July and September, 2010, this survey collected a total of 2,209 completed questionnaires from residents in Taiwan aged 19 years or older using stratified systematic sampling and face-to-face interviewing. Respondents were asked to provide detailed socio-demographic information as well as to answer a series of attitudinal, intentional, and behavioral questions related to the environment, thus enabling an analysis of the link between environmental awareness and travel mode choice.

Respondents who had no access to cars or who cannot drive are excluded from the analysis since their usual travel modes may reflect constraints rather than choices. Respondents who were older than 65 years of age are also excluded in order to focus on a comparison of three generations: Millennials (those born between 1981 and 1991; aged 19 to 29 years in 2010), Generation X (those born between 1965 and 1980; aged 30 to 45 years in 2010), and Baby Boomers (those born between 1945 and 1964; aged 46 to 65 years in 2010). The final dataset comprises a sample of 1,629 respondents.

My conceptual model (see Figure 1), guided by the theory of planned behavior (TPB; Ajzen, 1991), illuminates how environmental attitudes affect travel behavior indirectly through environmental intention and how socio-demographic characteristics influence those attitudes, intention, and behavior mentioned above. The four environmental attitudes (each based on one Likert scale survey question) measure respondents' levels of environmental knowledge, environmental concern, perceived behavioral effects, and perceived behavioral control respectively. Environmental intention (based on one Likert scale survey question) measures the tendency to perform pro-environmental behavior. Two types of travel behavior are considered: the most frequently used travel mode (private mode, public mode, and active mode) and the frequency of reducing car or motorcycle use for environmental reasons (never, sometimes, often, and always). Two generalized structural equation models were estimated using Stata version 15.1. For the most frequently used travel mode, multinomial logistic regression was used. For the frequency of reducing car or motorcycle use and for all attitudinal and intentional variables, ordered logistic regression was used. Descriptive statistics for variables included in the models are shown in Table 1.

3. Preliminary Results

Table 2 summarizes the results of the two generalized structural equation models. It suggests that gender and generation matter for environmental attitudes. Other things being equal, women are less knowledgeable but more concerned about climate change. Women also express higher

beliefs in the effects and easiness of performing pro-environmental behavior. Compared to Generation X, Millennials have lower beliefs in the effects and easiness of performing pro-environmental behavior, and Baby Boomers show greater concern about environment issues and greater beliefs in the impacts of pro-environmental behavior. Furthermore, environmental knowledge and concern as well as perceived behavioral effects and control are all significantly associated with environmental intention, suggesting the effectiveness of increasing individual tendency to perform pro-environmental behavior through educational campaigns which help enhance environmental awareness of individuals. However, whether environmental intention can be a significant predictor of travel mode choice is not clear. While individuals with stronger environmental intention are more likely to reduce car or motorcycle use, it has no impact on choosing public or active modes over private mode as the most frequently used transportation methods, suggesting that the explanatory power of environmental awareness on pro-environmental behavior is reduced in the transportation setting partly due to the high costs and great inconvenience in performing sustainable travel behavior (Diekmann and Preisendörfer, 2003).

This research is still in progress. Separate generalized structural equation models for different gender and generational groups will be estimated. Discussions of findings and policy implications will be extended.

References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.
- Beirão, G., & Cabral, J. S. (2008). Market segmentation analysis using attitudes toward transportation: exploring the differences between men and women. *Transportation Research Record*, 2067(1), 56-64.
- Berenguer, J., Corraliza, J. A., & Martín, R. (2005). Rural-urban differences in environmental concern, attitudes, and actions. *European Journal of Psychological Assessment*, 21(2), 128-138.
- Blumenberg, E., Ralph, K., Smart, M., & Taylor, B. D. (2016). Who knows about kids these days? Analyzing the determinants of youth and adult mobility in the US between 1990 and 2009. *Transportation Research Part A*, 93, 39-54.
- Chang, Y. H., Tu, S. H., & Liao, P. S. (2012). 2010 Taiwan Social Change Survey (Round 6, Year 1): Environment (C00221_2) [Data file]. Available from Survey Research Data Archive, Academia Sinica. doi:10.6141/TW-SRDA-C00221_2-1
- Diekmann, A., & Preisendörfer, P. (2003). Green and greenback: The behavioral effects of environmental attitudes in low-cost and high-cost situations. *Rationality and Society*, 15(4), 441-472.
- Dietz, T., Kalof, L., & Stern, P. C. (2002). Gender, values, and environmentalism. *Social Science Quarterly*, 83(1), 353-364.
- Garikapati, V. M., Pendyala, R. M., Morris, E. A., Mokhtarian, P. L., & McDonald, N. (2016). Activity patterns, time use, and travel of millennials: a generation in transition?. *Transport Reviews*, 36(5), 558-584.
- Hong, J., & McArthur, D. P. (2017). How Does Internet Usage Influence Young Travelers' Choices?. *Journal of Planning Education and Research*, 0739456X17736811.

- Hopkins, D. (2016). Can environmental awareness explain declining preference for car-based mobility amongst generation Y? A qualitative examination of learn to drive behaviours. *Transportation Research Part A*, 94, 149-163.
- Huddart-Kennedy, E., Beckley, T. M., McFarlane, B. L., & Nadeau, S. (2009). Rural-urban differences in environmental concern in Canada. *Rural Sociology*, 74(3), 309-329.
- Kuhnimhof, T., Armoogum, J., Buehler, R., Dargay, J., Denstadli, J. M., & Yamamoto, T. (2012). Men shape a downward trend in car use among young adults—evidence from six industrialized countries. *Transport Reviews*, 32(6), 761-779.
- Le Vine, S., Jones, P., Lee-Gosselin, M., & Polak, J. (2014). Is Heightened Environmental Sensitivity Responsible for Drop in Young Adults' Rates of Driver's License Acquisition?. *Transportation Research Record*, 2465, 73-78.
- Luchs, M. G., & Mooradian, T. A. (2012). Sex, personality, and sustainable consumer behaviour: Elucidating the gender effect. *Journal of Consumer Policy*, 35(1), 127-144.
- Matthies, E., Kuhn, S., & Klöckner, C. A. (2002). Travel mode choice of women: the result of limitation, ecological norm, or weak habit?. *Environment and Behavior*, 34(2), 163-177.
- Polk, M. (2003). Are women potentially more accommodating than men to a sustainable transportation system in Sweden?. *Transportation Research Part D*, 8(2), 75-95.
- Ralph, K. M. (2017). Multimodal millennials? The four traveler types of young people in the United States in 2009. *Journal of Planning Education and Research*, 37(2), 150-163.
- Tindall, D. B., Davies, S., & Mauboules, C. (2003). Activism and conservation behavior in an environmental movement: The contradictory effects of gender. *Society & Natural Resources*, 16(10), 909-932.
- Zelezny, L. C., Chua, P. P., & Aldrich, C. (2000). New ways of thinking about environmentalism: Elaborating on gender differences in environmentalism. *Journal of Social Issues*, 56(3), 443-457.

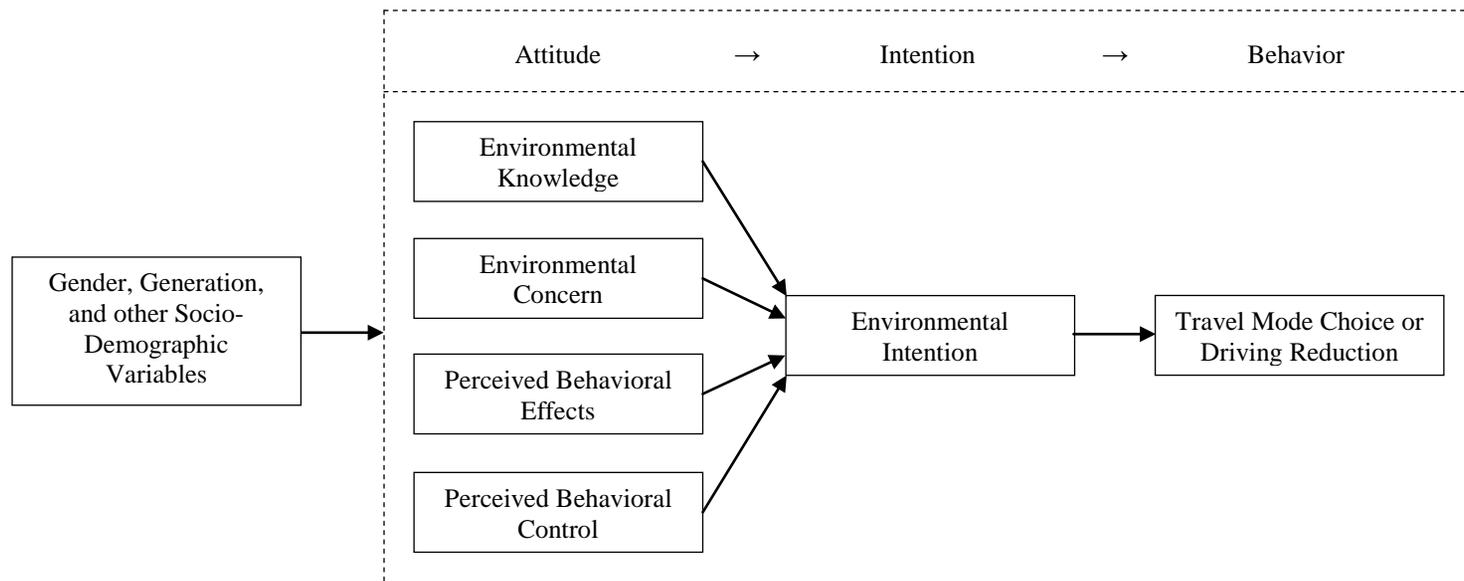


FIGURE 1 Conceptual Model for Structural Equation Modeling Analysis

TABLE 1 Descriptive Statistics for Variables Considered

Variable	Meaning	(n=1,629)	Mean	S.D.	Min	Max
<i>Travel Modes</i>						
private mode	Most frequently used travel mode is car or motorcycle (yes=1)		0.85	0.36	0	1
public mode	Most frequently used travel mode is bus, train, or metro (yes=1)		0.07	0.25	0	1
active mode	Most frequently used travel mode is walking or bicycling (yes=1)		0.08	0.27	0	1
driving reduction	Frequency of reducing car or motorcycle use for environmental reasons (1: never; 4: always)		2.00	0.86	1	4
<i>Socio-Demographic Characteristics</i>						
female	Being a female (yes=1)		0.47	0.50	0	1
millennial	Being a Millennial: Aged 19 to 29 years in 2010 (yes=1)		0.26	0.44	0	1
generation X	Being a Generation Xer: Aged 30 to 45 years in 2010 (yes=1)		0.38	0.49	0	1
baby boomer	Being a Baby Boomer: Aged 46 to 65 years in 2010 (yes=1)		0.36	0.48	0	1
education years	Years of schooling		12.75	3.47	2	25
monthly income	Monthly income category (1: none; 10: NT\$100,000 or more)		4.25	2.29	1	10
spouse	Having a spouse or steady partner (yes=1)		0.59	0.49	0	1
children aged 1-6	Living with child(ren) aged 1 to 6 years (yes=1)		0.19	0.39	0	1
religious beliefs	Having religious beliefs (yes=1)		0.73	0.44	0	1
urbanization level	Urbanization level of residence (1: country village; 4: big city)		2.49	1.08	1	4
<i>Environmental Awareness</i>						
knowledge	Environmental knowledge: Every time we use coal or oil or gas we contribute to climate change. (1: definitely no true; 4: definitely true)		3.19	0.58	1	4
concern	Environmental concern: How much do you worry about possible disasters caused by climate change? (1: not at all; 5: very much)		4.24	0.85	1	5
perceived effects	Perceived behavioral effects: How much do you think your pro-environmental behavior helps improve the quality of the environment in Taiwan? (1: not at all; 4: very much)		2.88	0.49	1	4
perceived control	Perceived behavioral control: How easy do you think it is for you to carry out pro-environmental behavior in daily life? (1: not easy at all; 4: very easy)		3.03	0.47	1	4
intention	Environmental intention: I do what is right for the environment, even when it costs more money or takes more time. (1: disagree strongly; 5: agree strongly)		3.90	0.66	1	5

TABLE 2 Structural Equation Models for Environmental Awareness and Travel Mode Choice

(n=1,629)	Model 1				Model 2	
	public mode vs. private mode		active mode vs. private mode		driving reduction	
	β	S.E.	β	S.E.	β	S.E.
female →	0.594***	0.211	0.263	0.195	0.276***	0.098
millennial →	0.465*	0.272	-0.150	0.295	-0.210	0.138
baby boomer →	0.766***	0.285	0.394*	0.235	0.428***	0.125
education years →	0.185***	0.039	-0.007	0.034	0.067***	0.018
monthly income →	-0.009	0.052	-0.201***	0.054	-0.035	0.024
spouse →	-0.577**	0.260	0.111	0.244	0.107	0.126
children aged 1-6 →	-0.028	0.308	-0.302	0.278	-0.212*	0.123
religious beliefs →	-0.188	0.216	0.157	0.235	0.118	0.109
urbanization level →	0.571***	0.108	0.190**	0.087	0.188***	0.047
intention →	0.225	0.184	0.179	0.172	0.380***	0.079

	knowledge		concern		perceived effects		perceived control		intention	
	β	S.E.	β	S.E.	β	S.E.	β	S.E.	β	S.E.
female →	-0.248**	0.110	0.356***	0.100	0.493***	0.130	0.300**	0.130	0.076	0.127
millennial →	0.310*	0.162	-0.047	0.137	-0.601***	0.188	-0.382**	0.190	0.197	0.185
baby boomer →	0.008	0.130	0.310**	0.127	0.917***	0.174	0.186	0.164	0.165	0.160
education years →	0.060***	0.018	-0.004	0.016	0.052**	0.023	0.038*	0.023	0.108***	0.021
monthly income →	0.017	0.026	-0.043*	0.026	-0.049	0.031	-0.007	0.034	0.071**	0.032
spouse →	0.202	0.132	-0.103	0.125	0.163	0.159	0.191	0.173	0.377**	0.157
children aged 1-6 →	0.186	0.131	0.045	0.134	-0.064	0.154	-0.076	0.157	-0.180	0.164
religious beliefs →	-0.004	0.123	0.223**	0.108	0.317**	0.140	-0.190	0.142	0.253*	0.140
urbanization level →	0.103**	0.050	-0.111***	0.043	-0.143**	0.057	-0.049	0.058	0.105*	0.058
knowledge →	--	--	--	--	--	--	--	--	0.283**	0.123
concern →	--	--	--	--	--	--	--	--	0.167**	0.077
perceived effects →	--	--	--	--	--	--	--	--	0.402***	0.146
perceived control →	--	--	--	--	--	--	--	--	0.988***	0.154

Note: *, **, *** denote statistical significance respectively at the 10%, 5%, and 1% level; -- denotes not included in the model.