

# Effects of attitudinal and sociodemographic factors on pro-environmental behaviour in urban China

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## SUMMARY

China currently faces severe environmental challenges, and information regarding the predictors of pro-environmental behaviour in China is needed to manage them. This study addresses this need by modelling the sociodemographic and attitudinal factors predicting pro-environmental behaviour in urban China. Pro-environmental behaviour was modelled as a function of environmental attitude (measured using the new environmental paradigm) and various sociodemographic characteristics. Respondents who were employed, holding leadership positions, living in larger cities and single were more likely to participate in pro-environmental behaviour. These results accord with previous studies suggesting being female, younger, highly educated and having environmentally oriented attitudes increased the odds of participating in pro-environmental behaviour. The rapid urbanization and economic development in China may significantly impact pro-environmental behaviour in the future.

*Keywords:* China, environmental attitude, new environmental paradigm, odds ratio, pro-environmental behaviour

## INTRODUCTION

Environmentalism emerged as a global phenomenon in the late 1960s and early 1970s (Buttel 2002; Mertig *et al.* 2002). Since then, scholars have recognized the fundamental importance of exploring how knowledge, beliefs, and attitudes influenced human response to ecological degradation and pollution (Maloney *et al.* 1975). This awareness led to less public support for the human exemptionalism paradigm (HEP), the notion that humans are free to do as they please because they are exempt from the laws of nature (Catton & Dunlap 1978a; Dunlap & Michelson 2002). Endorsing the HEP implied thinking: (1) humans are separate from environments, (2) environments have only instrumental value, (3) environmental resources are inexhaustible, and (4) humans can control

environments (Dunlap & Michelson 2002). Environmental sociologists suggested a new environmental paradigm (NEP) was emerging among the USA public (Catton & Dunlap 1978b; Dunlap *et al.* 2000). This paradigm rejected the HEP by emphasizing limits to growth, anti-anthropocentrism, belief in future ecocrisis, belief in a fragile nature and rejection of human exemptionalism. Accepting the NEP was consistently related to pro-environmental behaviour (Buttel 1987; Dunlap *et al.* 2000).

Several sociodemographic factors may also be correlated with pro-environmental behaviour. Females are more likely to engage in pro-environmental behaviour due to cultural and social-structural factors that make them on average more aware of the interconnections between causes and consequences of environmental harm (Stern *et al.* 1993; Hunter *et al.* 2004). More educated people are more likely to engage in pro-environmental behaviour because they are exposed to more information about environmental harm through schooling (Scott & Willits 1994). The relationships between income, environmental attitudes and behaviour have been important topics within environmental sociology. Early research suggested a positive relationship between people's income and pro-environmental attitudes and behaviour because environmental quality was often considered a luxury good for which people have more degrees of freedom to emphasize when their material needs are well satisfied (Van Liere & Dunlap 1980; Scott & Willits 1994). However, citizens of poorer countries may have similar or even more pro-environmental attitudes (Brechtin & Kempton 1994; Dunlap & Mertig 1995; Brechtin 1999), and may be willing to make similar or larger economic sacrifices for environmental protection partly because they more likely have direct experiences with the consequences of environmental degradation (Dunlap & York 2008). Mixed results regarding the relationship between people's age and pro-environmental behaviour have also been reported (Scott & Willits 1994; Stern *et al.* 1995; Tindall *et al.* 2003).

Cross-cultural and international research on the predictors of pro-environmental behaviour is critical for future conservation success but is, as yet, limited in scope (Schultz *et al.* 2000; Leung & Rice 2002). Globalization has made expanding this research into international and non-western contexts absolutely essential, and no place is more important

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for this research than China (Liu & Diamond 2005). China's economy has grown faster than in other major nations over the past three decades, fuelling unprecedented environmental degradation and pollution (Liu & Diamond 2005; Liu 2010). China is already the world's largest contributor to atmospheric sulphur oxides and chlorofluorocarbons, as well as CO<sub>2</sub> emissions (Liu & Diamond 2008), and acid rain fell on more than a quarter of Chinese cities during the 1990s (World Bank 2001; Feng *et al.* 2002). China is also the world's largest importer of tropical rainforest logs (ITTO [International Tropical Timber Organization] 2006), and accounts for 33% of global seafood consumption (Pauly *et al.* 2003; Liu & Diamond 2005). Although China exerts a major environmental impact by virtue of being the world's most populous country, per person consumption is rising rapidly as well (Liu & Raven 2010).

The state of environmental degradation in China warrants a close look at factors affecting environmental attitude and behaviour among Chinese citizens. Previous studies in China found that Chinese people tended to have anthropocentric viewpoints (Harris 2006). People valued the environment for what it could do for them, and generally chose economic growth over environmental protection. There was also a pervasive lack of personal responsibility, as people tended to think it was the government's job to protect the environment rather than their own. Pro-environmental attitudes (such as those measured with NEP scores (Dunlap *et al.* 2000)) were more common among more educated, urbanized and affluent groups than those among more rural, less educated and less affluent groups (Hong 2005; Harris 2006; Hong & Xiao 2007), which reflected findings from western studies (Buttel 1987; Dunlap *et al.* 2000).

Less research has addressed predictors of pro-environmental behaviour than predictors of environmental attitudes in China, however, behaviour is the ultimate concern of conservationists. Recent studies found more educated people, younger people, females and those with higher NEP scores were the most likely to engage in pro-environmental behaviour (Hong 2006; Gong & Lei 2007), but most of these findings were obtained from bivariate analyses that did not control for correlations among attitudinal and sociodemographic variables. In addition, previous studies have often neglected occupational status, which is an important indicator of social class and may affect pro-environmental behaviour.

Further, little is known about the effects of urban size on pro-environmental behaviour in China, although people living in different size cities usually face different levels of environmental deterioration due to different stages in economic growth. This research gap reflects most previous studies using regional level data, without capacity for exploring effects of urban size that requires data at larger scale (such as nation level). Research in western contexts suggests urban residents exhibit greater pro-environmental attitudes and behaviour than rural residents because urban residents are often exposed to greater environmental degradation (Arcury

& Christianson 1990; Mohai & Twight 1987). Urban size may be especially important for pro-environmental behaviour in China given China's explosive urbanization and economic growth (United Nations 2004).

In this paper, we study relationships between pro-environmental behaviour and its sociodemographic predictors in urban China. In addition to the attitudinal and sociodemographic predictors that were used in previous studies in China and abroad, we also assessed the impacts of urban size and occupational status on pro-environmental behaviour. We used multivariate analysis to control for potential correlations among attitudinal and sociodemographic variables. Our findings provide important implications for managing environmental challenges in urban China, and the approaches we used may be applicable elsewhere.

## METHODS

We used a recently released national dataset from the General Social Survey of 2003 administered jointly by the Survey Research Center of the Hong Kong University of Science and Technology and the Department of Sociology at Renmin University of China. Respondents were selected using a stratified random design with five strata. The strata were designed to eliminate double sampling any group of the population and facilitate comparisons between respondents living in cities of different sizes. Sample size was chosen to ensure an absolute sampling error of  $\leq 3\%$  at the 95% confidence level ( $n = 5073$ , 98.6% compliance rate). The first stratum included the 44 urban districts in Beijing, Tianjin and Shanghai (central municipalities). The second stratum included 175 urban districts in 24 provincial capital cities and Chongqing (a central municipality). Provincial capital cities were smaller and generally had lower gross domestic product (GDP) per person and lower percentages of non-agricultural population than central municipalities. Chongqing, the newly established central municipality, was sampled together with other provincial capital cities because it was demographically (for example as measured by GDP per person and % of non-agricultural population) more similar to provincial capital cities than to the other three central municipalities. The third stratum included the 611 city districts and counties in Beijing, Tianjin and Shanghai (excluding urban districts of Beijing, Tianjin and Shanghai), and five provinces in the eastern region (excluding urban districts of their provincial capital cities). The fourth stratum included 1136 city districts and counties in ten provinces in the central region (excluding urban districts of their provincial capital cities). The fifth stratum included 835 city districts and counties in ten provinces in the western region (excluding urban districts of their provincial capital cities). Tibet, Jilin, Guangdong and Taiwan provinces, and Hong Kong and Macao Special Administrative Regions were excluded from the survey due to logistic constraints (Hong & Xiao 2007). Survey data were collected through personal interview.

## Measures

Respondents were asked if they engaged in one or more of six pro-environmental behaviours during the last year: classifying garbage (sort garbage), talking about environmental issues with relatives or friends (environmental-talk), recycling plastic packing bags (recycle bags), participating actively in education programmes about environmental knowledge held by the government or corporations (environmental education), participating voluntarily in environmental activities held by non-governmental organizations (environmental volunteer), and participating actively in appeal and prosecution processes about environmental issues (environmental litigation). Although participation in environmental litigation is low compared to other environmental behaviours in many countries (Blocker & Eckberg 1997; Barkan 2004), sociopolitical structures in China facilitate unusually high participation rates. Further, environmental litigation may be particularly important in many developing countries such as China, where people have been experiencing higher levels of environmental degradation than their counterparts in developed countries (Brechin & Kempton 1994; Dunlap & York 2008).

The NEP scale (Dunlap *et al.* 2000) was used to measure environmental attitudes. The NEP addresses five aspects of an environmental worldview with three statements for each: the realization of limits to growth, anti-anthropocentrism, belief in the fragility of the balance of nature, rejection of human exemptionalism, and belief in future ecocrisis. Attitudes are measured with five-point Likert type scales ranging from strongly disagree to strongly agree. Among these fifteen statements, there are eight positively (pro-environmentally) narrated statements and seven negatively narrated statements. Agreement with eight positively narrated statements results in higher measures, while measures of the seven negatively narrated statements are reversed so that disagreement with them results in higher measures. The NEP scale aggregates all fifteen statements and scores can range from 15 to 75. In this study, the scale had moderately high internal consistency (Cronbach's  $\alpha = 0.71$ ). Previous studies consistently found members of environmental organizations score higher on the NEP scale than do the general public or non-environmental interest groups (Dunlap & Van Liere 1978; Widgren 1998; Dunlap *et al.* 2000; Dunlap & Michelson 2002). The NEP has shown significant, if weak, correlations with pro-environmental behaviour and intentions in many studies (Vining & Ebreo 1992; Scott & Willits 1994; Stern *et al.* 1995; Schultz & Oskamp 1996; Tarrant & Cordell 1997; Schultz & Zelezny 1998).

We used four demographic variables traditionally studied in association with NEP and pro-environmental behaviour (Scott & Willits 1994; Tarrant & Cordell 1997; Gong & Lei 2007): gender (female = 1, male = 0), age, education (years) and income (annual income of the respondent in the previous year measured in ten-thousands of Yuan [US\$ 1 = 8.3 Yuan when the survey was conducted]). We also included two

occupational variables: employment status (employed = 1, unemployed = 0) and employment rank (leadership position = 1, and 0 for others), because people's occupational status may represent differences in social classes that may influence pro-environmental behaviour (Van Liere & Dunlap 1980; Ebreo & Vining 2001). We evaluated effect of urban administrative level (0 for towns of counties, 1 for county level cities, 2 for non-capital cities above county level, and 3 for municipalities of the nation and capital cities of provinces) the respondent lived in. The urban administrative levels represent political power, but are related to population size, environmental degradation and influence concentration of resources (for example education resources and development funds) (State Bureau of Statistics of China 2003). We also included marital status (married = 1, unmarried = 0) because family responsibilities may reduce discretionary time available for participation in pro-environmental behaviour.

## Analytical methods

We used logistic regression to estimate effects of respondents' environmental attitudes (NEP) and sociodemographic attributes on each pro-environmental behaviour. In addition to the ordinary odds ratios which represent effects of a unit change of the independent variables, we also calculated the standardized odds ratios (X standardized), which represent effects of a standard deviation change of the independent variables. Standardized odds ratios allow intuitive comparisons among the effects of continuous independent variables (Long & Freese 2006). We conducted all statistical analyses with STATA 8.0 (software, STATA Corp., College Station, Texas, USA).

## RESULTS

Respondents of the survey had a mean NEP score of 51.71 (Table 1). The sample was 52% female, mean age was 44, and the mean education level of 10.44 corresponded to a level between middle school and high school (Table 1). Most respondents (89%) were married and mean annual income was about 10 000 Yuan. Most respondents were employed (76%), and 26% held jobs with leadership positions. Less than half of the respondents (44%) lived in municipalities of the nation or capital cities of provinces. Among respondents in the sample, more than half reported engaging in environmental-talk (68%) and recycling bags (71%), while less than half of them reported engaging in sorting garbage (37%), environmental education (41%), environmental volunteering (24%) and environmental litigation (17%) in the previous year (Table 1).

All independent variables were significant predictors of at least one pro-environmental behaviour (Table 2). A one standard deviation increase in NEP score increased the odds of environmental-talk 1.35 times and increased the odds of recycling bags 1.42 times (Table 2). Being female increased the odds of sorting garbage 1.26 times and recycling bags 1.51 times. Older respondents generally had lower odds

**Table 1** Summary statistics of pro-environmental behaviours, environmental attitude and sociodemographic conditions of respondents. SD = standard deviation.

<i>Variables</i>	<i>Description</i>	<i>Mean</i>	<i>SD</i>
NEP	Aggregation of responses to 15 NEP questions	51.71	7.24
Gender	Female = 1; Male = 0	0.52	0.50
Age	Years	43.51	13.18
Education	Years	10.44	3.70
Marital status	Married = 1; Unmarried = 0	0.89	0.31
Income	Ten thousands of yuan	1.00	1.21
Employment status	Employed = 1; Unemployed = 0	0.76	0.42
Employment ranking	Leadership position = 1; 0 for others	0.26	0.44
Urban administrative level	Towns = 0; county level cities = 1; non-capital cities above county level = 2; central municipalities of the nation and capital cities of provinces = 3	2.03	1.03
Sort garbage	1 if engaged in sort garbage; 0 otherwise	0.37	0.48
Env-talk	1 if engaged in environmental-talk; 0 otherwise	0.68	0.46
Recycle bags	1 if engaged in recycling bags; 0 otherwise	0.71	0.45
Env-education	1 if engaged in environmental education; 0 otherwise	0.41	0.49
Env-volunteer	1 if engaged in environmental volunteering; 0 otherwise	0.24	0.43
Env-litigation	1 if engaged in environmental litigation; 0 otherwise	0.17	0.38

of participating in pro-environmental behaviour (Table 2). A one standard deviation increase in education level increased the odds of environmental-talk, environmental volunteering and environmental litigation 1.59, 1.40 and 1.30 times, respectively (Table 2). Single respondents had higher odds of participating in sorting garbage, recycling bags, and environmental volunteering than married respondents (Table 2, Fig. 1).

In general, employed respondents had higher odds of pro-environmental behaviour than unemployed respondents (Table 2, Fig. 1). Holding a leadership position within employment generally increased the odds of participating in pro-environmental behaviour. The greatest impact was on environmental litigation, environmental-talk and participating in environmental education programmes where those in leadership positions had 1.52, 1.43 and 1.51 times higher odds of participation than those not in leadership positions, respectively (Table 2, Fig. 1). Respondents in more urban regions were significantly more likely to engage in sorting garbage, recycling bags, and environmental volunteering (Table 2, Fig. 1).

## DISCUSSION

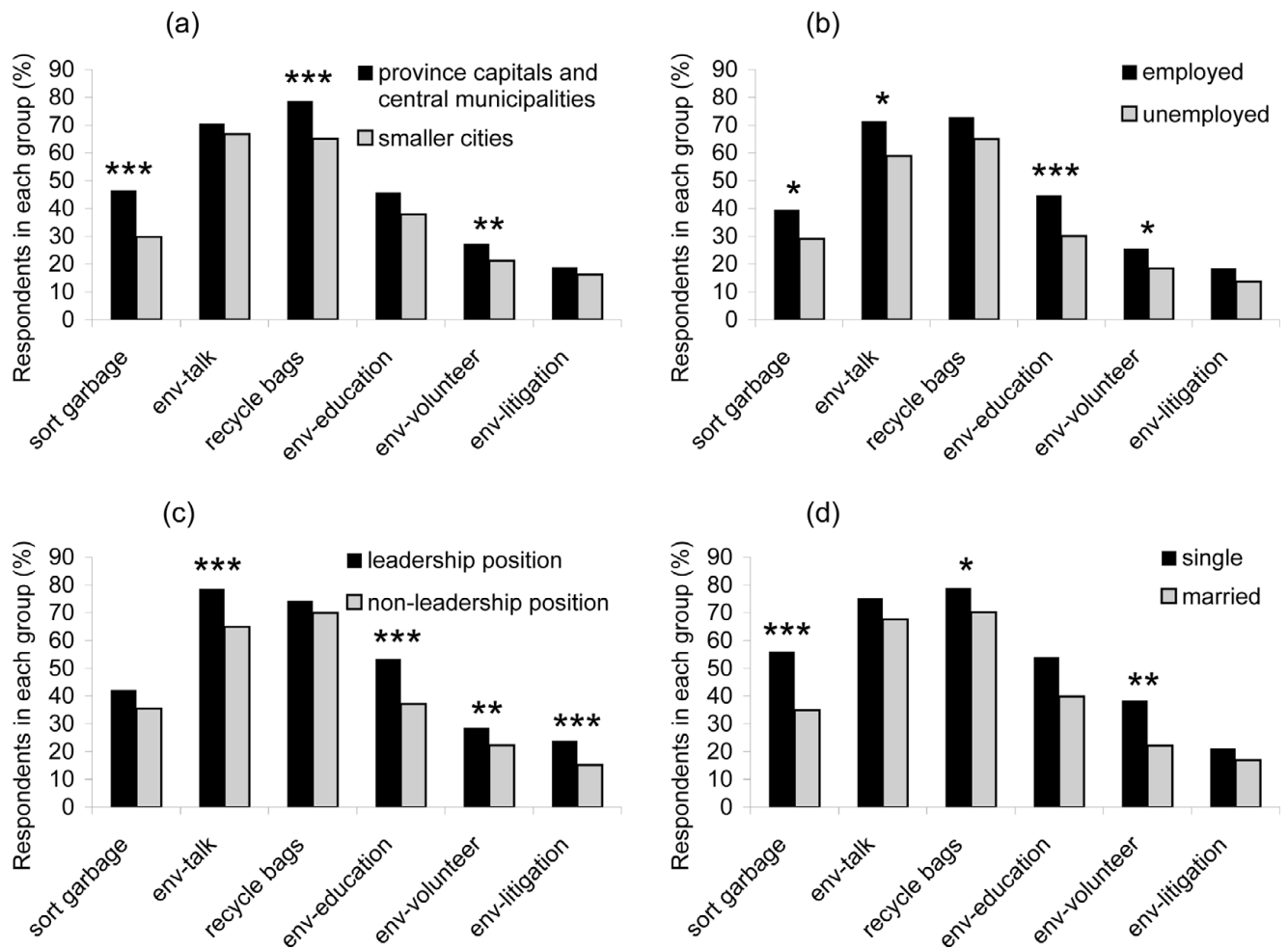
Our results identify employment status, employment rank and urban level as key variables to consider in future studies of pro-environmental behaviour. Both employed respondents and respondents holding leadership positions reported more participation in four of six pro-environmental behaviours than their counterparts (Fig. 1). Significant

employment effects suggest that people may be exposed to the diffusion of environmental values through their employment (Brechin & Kempton 1994). Further, many pro-environmental practices (such as environmental education and environmental volunteering) are organized by the employers (for example corporations) of respondents. People in non-leadership positions may engage less in pro-environmental behaviour because they perceive low levels of control over the behaviours and their outcomes (Ajzen 1991). Employment effects on pro-environmental behaviours may also reflect the fact that Chinese people tend to place the majority of the responsibility for carrying out environmental conservation on people in powerful positions who they believe can influence policy (Harris 2006). Harris (2004) noted that environmental policy making in China has been 'top down' with little involvement among the general public. In fact, the relationship between holding leadership roles in employment and participating in environmental litigation may reflect both fulfilment of a public role in society and higher levels of perceived control.

The more pro-environmental behaviour among more urban residents may reflect an aggregate of the same phenomenon observed at the individual level in terms of employment and leadership positions. In this case, larger cities with political power and jobs can afford to promote pro-environmental behaviour, while the smaller cities lacking jobs and political power are compelled to pursue economic growth even with high environmental costs. Ironically this difference in pro-environmental behaviour would relate to past decisions of sacrificing environmental protection for economic growth. Although more pro-environmental attitudes and behaviours

**Table 2** Logistic regression of six pro-environmental behaviours on NEP, sociodemographic conditions and urban administrative levels. \*  $p \leq 0.05$ ; \*\*  $p \leq 0.01$ ; \*\*\*  $p \leq 0.001$ ;  $n = 5073$ .

<i>Independent variables</i>	<i>Coefficients (odds ratios) [standardized odds ratios]</i>					
	<i>Model 1</i> <i>Sort garbage</i>	<i>Model 2</i> <i>Env-talk</i>	<i>Model 3</i> <i>Recycle bags</i>	<i>Model 4</i> <i>Env-education</i>	<i>Model 5</i> <i>Env-volunteer</i>	<i>Model 6</i> <i>Env-litigation</i>
NEP	0.009* (1.009) [1.067]	0.042*** (1.042) [1.353]	0.049*** (1.050) [1.422]	0.007 (1.007) [1.055]	0.000 (1.000) [0.999]	-0.003 (0.997) [0.981]
Gender	0.232*** (1.261) [1.123]	0.093 (1.097) [1.047]	0.410*** (1.506) [1.227]	0.072 (1.075) [1.037]	0.066 (1.069) [1.034]	-0.066 (0.936) [0.967]
Age	-0.010*** (0.990) [0.873]	-0.010** (0.990) [0.881]	0.008** (1.008) [1.116]	-0.007* (0.993) [0.914]	-0.012*** (0.989) [0.859]	-0.003 (0.997) [0.966]
Education	0.088*** (1.092) [1.385]	0.126*** (1.134) [1.591]	0.068*** (1.070) [1.285]	0.132*** (1.142) [1.632]	0.0900*** (1.094) [1.395]	0.071*** (1.074) [1.301]
Marital status	-0.378*** (0.685) [0.890]	0.224 (1.251) [1.072]	-0.312* (0.732) [0.908]	-0.134 (0.875) [0.960]	-0.312** (0.731) [0.908]	-0.090 (0.914) [0.973]
Income	0.055* (1.056) [1.069]	0.002 (1.002) [1.003]	0.011 (1.011) [1.014]	-0.037 (0.964) [0.956]	-0.044 (0.957) [0.948]	-0.027 (0.973) [0.968]
Employment status	0.184* (1.201) [1.081]	0.184* (1.202) [1.081]	0.110 (1.116) [1.048]	0.297*** (1.346) [1.135]	0.204* (1.227) [1.091]	0.102 (1.108) [1.045]
Employment rank	0.124 (1.132) [1.056]	0.357*** (1.429) [1.169]	-0.016 (0.984) [0.993]	0.410*** (1.505) [1.196]	0.225** (1.252) [1.103]	0.421*** (1.523) [1.202]
Urban administrative level	0.262*** (1.300) [1.310]	0.012 (1.012) [1.013]	0.255*** (1.290) [1.300]	0.029 (1.030) [1.031]	0.107** (1.113) [1.117]	0.032 (1.033) [1.034]
Constant	-2.048***	-2.697***	-3.156***	-2.131***	-1.793***	-2.204***
Likelihood ratio	403.91***	519.03***	354.85***	452.82***	220.01***	102.84***



**Figure 1** Frequency of participation in pro-environmental behaviour among respondents with different (a) urban levels, (b) employment status, (c) employment ranking and (d) marital status. Significant differences indicated by regression analysis: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

may emerge as China and many other parts of the world continue to urbanize, urbanization may produce substantial environmental threats (Vitousek *et al.* 1997; Kalnay & Cai 2003). In fact, the threats associated with urbanization in China (for example air and water pollution) may explain the link between pro-environmental behaviour and urban level found in this study.

While findings on effects of income on pro-environmental behaviour have been mixed (Scott & Willits 1994; Chung & Poon 2001), we found that in urban China income was a relatively unimportant predictor of pro-environmental behaviour. This difference may be explained in part by the inability of previous studies, using bivariate methods, to differentiate between correlated variables including education level, employment rank, employment status, urban administrative level and income. Weak correlation between income and environmental behaviour may also reflect the fact that respondents, regardless of their income levels, have been experiencing the effects of environmental degradation in China, hence may not consider environmental quality as

a luxury good that otherwise may be correlated to income (Brechin & Kempton 1994; Dunlap & York 2008).

Our results reflect the findings of previous studies addressing pro-environmental behaviour in China by finding that highly educated, more urbanized, young, female and environmentally oriented Chinese demonstrated more pro-environmental behaviours than their counterparts (Harris 2006; Hong 2006; Gong & Lei 2007). These findings largely match those from pro-environmental behaviour studies in Western countries (Howell & Laska 1992; Scott & Willits 1994; Tindall *et al.* 2003; Hunter *et al.* 2004). Education plays a key role because it may not only facilitate people's understanding of environmental issues, hence improving people's environmental knowledge, but also promote individuals' realization of their own responsibility for the environment.

The age related impact of pro-environmental behaviour may be explained by the cohort effect (Buttel 1979), where younger Chinese have come of age during a period of intense environmental degradation. Our findings also indicate marital

status should be considered in future environmental behaviour studies since single respondents generally demonstrated more pro-environmental behaviours than married respondents. The additional predictive power of marital status (single respondents were younger than married respondents) over age may relate to time constraints on pro-environmental behaviour imposed by family responsibilities. Environmental-talk (an easily multi-tasked behaviour) was the behaviour with smallest participation differences between single and married respondents (Fig. 1). Gender effects on pro-environmental behaviour may be explained by traditional gender roles in China, where women perform more domestic tasks than men, for example sorting garbage and recycling (Li 2003).

The positive relationship between NEP score and pro-environmental behaviour is not surprising since NEP reflects, in part, belief in future ecocrisis. The finding, however, has major implications in China where land erosion, flooding, drought and other natural disasters have boomed (Liu & Diamond 2005). In these contexts, perspectives reflecting the NEP may become more prevalent (Lo & Leung 1998; Harris 2006). Our findings suggest pervasive views reflecting the NEP would correlate with more pro-environmental behaviour.

Efforts to promote pro-environmental behaviour in urban China could well target less educated people, those with low employment status (unemployed or low employment rank), and inhabitants of smaller cities, at least for the six behaviours analysed in this study. However, our study excluded some rural regions of China due to lack of data, thus these findings cannot be assumed to extend to those regions and a few provinces where the survey was not conducted. Although we identified potential mechanisms for explaining predictors of pro-environmental behaviour in urban China, future studies should test those mechanisms.

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## References

- Ajzen, I. (1991) The theory of planned behavior. *Organizational Behavior and Human Decision Processes* 50(2): 179–211.
- Arcury, T.A. & Christianson, E.H. (1990). Environmental worldview in response to environmental problems: Kentucky 1984 and 1988 compared. *Environment and Behavior* 22(3): 387–407.
- Barkan, S.E. (2004) Explaining public support for the environmental movement: a civic voluntarism model. *Social Science Quarterly* 85(4): 913–937.
- Blocker, T.J. & Eckberg, D.L. (1997) Gender and environmentalism: results from the 1993 General Social Survey. *Social Science Quarterly* 78(4): 841–858.
- Brechin, S.R. (1999) Objective problems, subjective values, and global environmentalism: evaluating the postmaterialist argument and challenging a new explanation. *Social Science Quarterly* 80(4): 793–809.
- Brechin, S.R. & Kempton, W. (1994) Global environmentalism: a challenge to the postmaterialism thesis. *Social Science Quarterly* 75(2): 245–269.
- Buttel, F.H. (1979) Age and environmental concern: multivariate analysis. *Youth and Society* 10(3): 237–256.
- Buttel, F.H. (1987) New directions in environmental sociology. *Annual Review of Sociology* 13: 465–488.
- Buttel, F.H. (2002) Environmental sociology and the sociology of natural resources: institutional histories and intellectual legacies. *Society and Natural Resources* 15(3): 205–211.
- Catton, W.R. & Dunlap, R.E. (1978a) Environmental sociology: new paradigm. *American Sociologist* 13(1): 41–49.
- Catton, W.R. & Dunlap, R.E. (1978b) Paradigms, theories, and primacy of Hep-Nep distinction. *American Sociologist* 13(4): 256–259.
- Chung, S.S. & Poon, C.S. (2001) A comparison of waste-reduction practices and new environmental paradigm of rural and urban Chinese citizens. *Journal of Environmental Management* 62(1): 3–19.
- Dunlap, R.E. & Mertig, A.G. (1995) Global concern for the environment: is affluence a prerequisite? *Journal of Social Issues* 51(4): 121–137.
- Dunlap, R.E. & Michelson, W., eds (2002) *Handbook of Environmental Sociology*. Westport, CT, USA: Greenwood.
- Dunlap, R.E. & Van Liere, K.D. (1978) The ‘new environmental paradigm’: a proposed measuring instrument and preliminary results. *Journal of Environmental Education* 9(4): 10–19.
- Dunlap, R.E. & York, R. (2008) The globalization of environmental concern and the limits of the postmaterialist values explanation: Evidence from four multinational surveys. *Sociological Quarterly* 49(3): 529–563.
- Dunlap, R.E., Van Liere, K.D., Mertig, A.G. & Jones, R.E. (2000) Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues* 56(3): 425–442.
- Ebreo, A. & Vining, J. (2001) How similar are recycling and waste reduction? Future orientation and reasons for reducing waste as predictors of self-reported behavior. *Environment and Behavior* 33(3): 424–448.
- Feng, Z.W., Miao, H., Zhang, F.Z. & Huang, Y.Z. (2002) Effects of acid deposition on terrestrial ecosystems and their rehabilitation strategies in China. *Journal of Environmental Sciences-China* 14(2): 227–233.
- Gong, W. & Lei, J. (2007) An analysis of gender difference in the environmental concern and environmentally friendly behaviors of Chinese urban residents. *Humanities and Social Sciences Journal of Hainan University* 25(3): 340–345 (in Chinese).
- Harris, P.G. (2006) Environmental perspectives and behavior in China: synopsis and bibliography. *Environment and Behavior* 38(1): 5–21.
- Harris, P.G. (2004) ‘Getting rich is glorious’: environmental values in the People’s Republic of China. *Environmental Values* 13: 145–165.
- Hong, D. (2005) Environmental concern of the Chinese urban residents. *Jiangsu Social Sciences* 1: 127–132 (in Chinese).
- Hong, D. (2006) Measurement of environmental concern: application of the NEP scale in China. *Society* 26: 71–92 (in Chinese).

- Hong, D. & Xiao, C. (2007) Sociological analysis on gender difference of environmental concern. *Sociological Studies* 2007 2: 1–19 (in Chinese).
- Howell, S.E. & Laska, S.B. (1992) The changing face of the environmental coalition: a research note. *Environment and Behavior* 24(1): 134–144.
- Hunter, L.M., Hatch, A. & Johnson, A. (2004) Cross-national gender variation in environmental behaviors. *Social Science Quarterly* 85(3): 677–694.
- ITTO (2006) International Tropical Timber Organization annual review and assessment of the world timber situation [www document]. URL [http://www.itto.or.jp/live/Live\\_Server/377/E-AR06-Text.pdf](http://www.itto.or.jp/live/Live_Server/377/E-AR06-Text.pdf)
- Kalnay, E. & Cai, M. (2003) Impact of urbanization and land-use change on climate. *Nature* 423(6939): 528–531.
- Leung, C. & Rice, J. (2002) Comparison of Chinese-Australian and Anglo-Australian environmental attitudes and behavior. *Social Behavior and Personality* 30(3): 251–262.
- Li, S.C. (2003) Recycling behavior under China's social and economic transition: the case of metropolitan Wuhan. *Environment and Behavior* 35(6): 784–801.
- Liu, J. G. (2010) China's road to sustainability. *Science* 328(5974): 50.
- Liu, J. & Diamond, J. (2005) China's environment in a globalizing world. *Nature* 435: 1179–1186.
- Liu, J.G. & Diamond, J. (2008) Science and government: revolutionizing China's environmental protection. *Science* 319(5859): 37–38.
- Liu, J. G. & Raven, P. H. (2010) China's environmental challenges and implications for the world. *Critical Reviews in Environmental Science and Technology* 40(9–10): 823–851.
- Lo, C.W.-H. & Leung, S.-W. (1998) Environmental protection and popular environmental consciousness in China. In: *China Review*, ed. J.Y.S. Cheng, pp. 501–541. Hong Kong: The Chinese University Press.
- Long, J.S. & Freese, J. (2006) *Regression Models for Categorical Dependent Variables Using Stata*. College Station, Texas, USA: Stata Press.
- Maloney, M.P., Ward, M.P. & Braucht, G.N. (1975) Psychology in action: revised scale for measurement of ecological attitudes and knowledge. *American Psychologist* 30(7): 787–790.
- Mertig, A.G., Dunlap, R.E. & Morrison, D.E. (2002) The environmental movement in the United States. In: *Handbook of Environmental Sociology*, ed. R.E. Dunlap & W. Michelson, pp. 448–481. Westport, CT, USA: Greenwood.
- Mohai, P. & Twight, B.W. (1987) Age and environmentalism: an elaboration of the Buttel model using national survey evidence. *Social Science Quarterly* 68(4): 798–815.
- Pauly, D., Alder, J., Bennett, E., Christensen, V., Tyedmers, P. & Watson, R. (2003) The future for fisheries. *Science* 302(5649): 1359–1361.
- Schultz, P.W. & Oskamp, S. (1996) Effort as a moderator of the attitude-behavior relationship: general environmental concern and recycling. *Social Psychology Quarterly* 59(4): 375–383.
- Schultz, P.W. & Zelezny, L.C. (1998) Values and proenvironmental behavior: a five-country survey. *Journal of Cross-Cultural Psychology* 29(4): 540–558.
- Schultz, P.W., Zelezny, L. & Dalrymple, N.J. (2000) A multinational perspective on the relationship between Judeo-Christian religious beliefs and attitudes of environmental concern. *Environment and Behavior* 32(4): 576–591.
- Scott, D. & Willits, F.K. (1994) Environmental attitudes and behavior: a Pennsylvania survey. *Environment and Behavior* 26(2): 239–260.
- State Bureau of Statistics of China (2003) *China City Statistical Yearbook*. Beijing, China: China Statistics Press.
- Stern, P.C., Dietz, T. & Kalof, L. (1993) Value orientations, gender, and environmental concern. *Environment and Behavior* 25(5): 322–348.
- Stern, P.C., Dietz, T. & Guagnano, G.A. (1995) The new ecological paradigm in social-psychological context. *Environment and Behavior* 27(6): 723–743.
- Tarrant, M.A. & Cordell, H.K. (1997) The effect of respondent characteristics on general attitude-behavior correspondence. *Environment and Behavior* 29(5): 618–637.
- Tindall, D.B., Davies, S. & Mauboules, C. (2003) Activism and conservation behavior in an environmental movement: the contradictory effects of gender. *Society and Natural Resources* 16(10): 909–932.
- United Nations (2004) *World Urbanization Prospects: The 2003 Revision*. New York, NY, USA: The United Nations: 336 pp.
- Van Liere, K.D. & Dunlap, R.E. (1980) The social bases of environmental concern: a review of hypotheses, explanations and empirical evidence. *Public Opinion Quarterly* 44(2): 181–197.
- Vining, J. & Ebreo, A. (1992) Predicting recycling behavior from global and specific environmental attitudes and changes in recycling opportunities. *Journal of Applied Social Psychology* 22(20): 1580–1607.
- Vitousek, P.M., Mooney, H.A., Lubchenco, J. & Melillo, J.M. (1997) Human domination of Earth's ecosystems. *Science* 277(5325): 494–499.
- Widegren, O. (1998) The new environmental paradigm and personal norms. *Environment and Behavior* 30(1): 75–100.
- World Bank (2001) *China: Air, Land, and Water: Environmental Priorities for a New Millennium*. Washington, DC, USA: World Bank.