



Changes in environmental worldviews among Chinese urban residents during economic growth and accelerating polluting in the 2000s

Chenyang Xiao^{a,*}, Erik Kojola^b, Yechao Fan^c

^a Department of Sociology Renmin University of China, Beijing, China American University, Washington DC, USA

^b Department of Sociology and Anthropology Texas Christian University, Fort Worth, Texas, USA

^c School of Ethnology and Sociology Minzu University of China, Beijing, China

ARTICLE INFO

Keywords:

New ecological paradigm
Socioeconomic status
Chinese General Social Survey
Structural equation modeling

ABSTRACT

During the first decade of the 2000s, China experienced tremendous growth in the economy and environmental degradation. This study examines whether there has been a subsequent increase in pro-environmental worldviews among urban Chinese people over that period since theories predict that both greater affluence and exposure to pollution can promote such views. We find that from 2003 to 2010, Chinese urban citizens' pro-environmental worldviews measured by the New Environmental/Ecological Paradigm (NEP) did not increase as would be predicted by multiple theories, indicating that environmental concern is more complex and multifaceted. Instead, we find some evidence for a diffusion process of environmental concern from more educated people to the rest of the population. We also argue that the impact of different facets of socioeconomic status on environmental concern matter as we find that education increases pro-environmental worldviews more than income.

1. Introduction

During the first decade of the 2000s, China experienced significant growth in the economy and environmental degradation. Data from the National Bureau of Statistics of China (National Bureau of Statistics of China (NBS), 2004) show that from 2003 to 2010 (the two time points of the data in this study), China's GDP and per capita disposable income more than doubled. Meanwhile, China was facing an increasingly deteriorating natural environment from air pollution to water contamination (Hong, 2012; Liu and Mu, 2016; Managi and Kaneko, 2006). The Chinese public responded to such alarming environmental degradation with environmental protests (Bradsher, 2012; Gilbert, 2012; Lang and Xu, 2013; Steinhardt and Wu, 2016). Concern for the environment among the Chinese public, unsurprisingly, has received significant scholarly attention (Hao and Song, 2020; Liu et al., 2018). While studies show a generally high level of concern for the environment (Hao et al., 2018), one question remains, however. Has there been any change in the level of environmental concern among the Chinese public over this period given growing affluence and accelerating environmental problems?

Several theoretical perspectives would predict a rising trend. Many argue that economic development can stimulate stronger public concern

for the environment (Gelissen, 2007). For instance, Franzen and Meyer (2010) argue that increased wealth makes a high-quality environment, an economic "luxury", more affordable and therefore more desired and supported. Inglehart (1990) believes that affluent living conditions can stimulate a value shift from materialist needs (e.g., economic and physical security) to postmaterialist concerns (e.g., freedom of speech, improvements in quality of life, and the environment), which in turn can boost public concern for the environment. Therefore, given the increase in personal wealth during the first decade of the 2000s, these perspectives would anticipate an increase in environmental concern among the Chinese public.

However, other theoretical approaches, namely global environmentalism and environmental justice, and empirical evidence from national and cross-national studies challenge the link between affluence and greater environmental concern (Dunlap and York, 2008; Kvaløy et al., 2012). On the other hand, both global environmentalism and environmental justice anticipate that worsening environmental conditions can heighten public environmental concern as people deal with the consequences of pollution. Therefore, these theoretical perspectives would also predict rising public environmental concern given the increasing environmental degradation in China during the 2000s.

In this study, we utilize data from two national surveys, the 2003 and

* Corresponding author.

E-mail address: xiao@american.edu (C. Xiao).

2010 Chinese General Social Surveys (CGSS) to examine if there has been an increase in public environmental concern, particularly among urban residents, between the two years and what might be driving any such change. Understanding environmental concern in China is important as the country's economy continues to expand, creating more pollution and greenhouse gas emissions, and offers a distinct social and political-economic context to refine theories and measures of environmental concern that have largely been developed based on data from industrialized Western countries. However, largely due to limited availability of suitable longitudinal data (i.e., comparable measures across surveys at different time points), there has been relatively few studies on trends in public environmental concern in China. This study seeks to contribute to this topic by making use of the New Environmental/Ecological Paradigm (NEP) Scale (Dunlap et al., 2000), included in the two CGSS mentioned above, which is a robust indicator of the multi-faceted dynamics of environmental worldviews that has been used in research across national and historical contexts.

2. China's environment and economy in the 2000s

In the past four decades, China's economy has experienced unprecedented growth. From 1978 to 2018, China's GDP has on average grown 9.4% annually, increasing from 367.9 billion RMB to 90,030.9 billion RMB; per capita gross net income increased from about 200 US dollars to 9732 US dollars (National Bureau of Statistics of China (NBS), 2004). By 2010, China's GDP has outstripped that of Japan to become the second largest in the world. Consequently, China was able to lift more than 800 million people out of poverty since 1978 (The World Bank, 2019). Meanwhile, the country has faced increasingly serious environmental degradation. Due to the large-scale consumption of fossil fuels, China became the largest CO₂ emitter in the world, surpassing the US in 2006 (Rosenthal, 2008). Water pollution is similarly alarming; continuous monitoring shows that since 2000, only 8 out of 28 major lakes in China have met the II level water quality standard (the best is the I level); 59% of all rivers could not even meet the III level (Asian Development Bank, 2007). Esty et al. (2005) ranked China's environmental sustainability as nearly the worst in the world – which also means harms to human health and the depletion of natural resources and clean water. The Chinese government estimated that in 2004 economic loss due to pollution could be as much as 511.8 billion RMB, 3.05% of the total GDP (Wang et al., 2006).

During the 2000s, the Chinese government initiated several environmental reforms claiming to address rising pollution and other environmental problems created by rapid industrialization and growth (Dou, 2013; Harris, 2006, 2008). However, the priority of the Chinese government has largely remained economic expansion. For instance, in 2006 at the end of the Tenth Five-Year Plan, reports showed that all economic goals have been achieved or exceeded, while only 12 of 20 environmental protection goals were completed; even worse, in the following five years, the total emissions of major pollutants increased by 27%, instead of a 10% reduction as planned (Guo et al., 2013).

Yet, there continues to be an active and seemingly growing environmental movement and push for environmental protection from Chinese citizens. The success of environmental governance and policy depends on widespread public support and active environmental movements. It is therefore important to examine changes in citizens' environmental beliefs and support for environmental protection.

3. Theoretical perspectives and research on environmental concern

3.1. Affluence, socioeconomic status, and pollution

How has citizens' environmental concern evolved in China over a time period of rising affluence and increasing environmental degradation? Several theoretical perspectives would predict an increase in

environmental concern in China over the initial decade of the 2000s while disagreeing on what specific factors are the driving force, whether is increased affluence, pollution, or education. What evidence does empirical research provide for these competing theories? Within the vast environmental concern literature, we focus on more recent studies (since 2000) that explicitly examine the relationship between affluence, socioeconomic status (SES), and environmental concern as well as studies using samples from China.

First, there is a school of theoretical perspectives positing that economic growth and rising personal wealth in China would promote environmental concern among the public. Among them, Inglehart's postmaterialist values theory has been widely used as an explanation for the emergence of public concern for the environment (Inglehart, 1977, 1990, 1995). As Dunlap and York (2008) point out, postmaterialist values theory draws on the scarcity hypothesis that once people have their basic material needs satisfied, they can focus on non-material concerns such as improvements in quality of life and a clean environment. It also draws on the related socialization hypothesis that argues for a widespread shift in public values towards post-materialism among generations growing up with greater affluence.

Another perspective in this school is Franzen and Meyer's (Franzen and Meyer, 2010) affluence hypothesis. Disagreeing with Inglehart on the role of postmaterialism as a medium, this hypothesis posits a direct connection between affluence and environmental concern. Increased affluence makes a quality environment – an amenity good – more affordable and hence generates more concern for it.

Empirical studies show mixed and inconsistent results. Findings about family income's impact have long been inconsistent in the literature (Greenbaum et al., 1995). From studies that include a direct measure of postmaterialism (Ahern, 2012; Echavarren, 2017; Franzen and Meyer, 2010; Nawrotzki, 2012), findings of positive associations with environmental concern are common, but effect sizes are typically small. Two studies focusing on China (Mohai et al., 2010; Zhao, 2012) find no impact of postmaterialism. At the country level, GDP – as one common measure of economic development – shows no consistent influence on environmental concern. However, other aspects of SES, beyond income, show more consistent effects. At the individual level, the influence of education is found in nearly all studies we reviewed with higher education typically associated with elevated concern for the environment.

Other theoretical approaches and empirical research challenge the association between affluence and environmentalism. Martinez-Alier (2014) describes an "environmentalism of the poor" to account for the ways in which farmers, peasants, and working-class communities struggle for clean air and clean water, and defend their rights to land and resourced-based livelihoods. The extensive research on environmental justice demonstrates how marginalized and low-income people care greatly about having a clean environment and engage in environmental movements (Bullard, 1990; Holifield et al., 2018; Mohai et al., 2009). Global environmentalism theory also points out that concern for the environment emerges in less industrialized countries (Dunlap and York, 2008; Mayer and Smith, 2017). The global emergence of environmentalism implies there are multiple sources of environmental concern beyond the narrow emphasis on affluence, such as degradation of local environmental conditions. Interestingly, proponents of postmaterialist values theory (Inglehart, 1995; Kidd and Lee, 1997) acknowledge that there may be multiple sources of environmental concern including deteriorating environmental conditions in less industrialized countries, which forms the "Objective Problems Subjective Values" (OPSV) theory (Brechin, 1999; Hao and Song, 2020).

Borrowing insights from the diffusion of innovation theory, Pampel and Hunter (2012) argue that environmentalism could first originate among people with higher socioeconomic status (SES) and then gradually diffuse into segments with lower SES. Thus, Pampel and Hunter suggest that postmaterialist values theory and affluence hypothesis can explain early adoption of environmentalism among those with higher

SES while diffusion and objective problems may explain wider adoption later. In other words, SES would have stronger positive effects at first, then such effects would diminish over time. Pampel and Hunter's (Pampel and Hunter, 2012) argument therefore extends research attention to other SES factors beyond income such as education, social status, and occupational prestige while also predicting an increase in public concern for the environment as it spreads across the general population.

3.2. Environmental concern in China

There are recent studies focusing on factors that influence environmental concern in China specifically. Hao and colleagues in a series of studies (Hao, 2014; Hao and Song, 2020; Hao et al., 2019) examine various such factors, and most relevant to the current study are measures of affluence and environmental conditions at both the individual and provincial levels. While one earlier study (Hao, 2014) found supporting evidence for both the affluence and degradation hypothesis, results from more recent studies (Hao and Song, 2020) call both hypotheses into question as there is no consistent empirical support for either. Notably, in a study comparing levels of environmental concern between the United States and Chinese public, Hao et al. (2018) found that the level of concern for the environment among the Chinese public is relatively high, at least comparable to the US public.

Liu and Mu (2016) examined a set of potential determinants of individual environmental concern in China. Their results show that higher education, ethnic Han majority (vs. minority), higher household income, urban (vs. rural) residence, and female (vs. male) gender are correlated with higher levels of concern for the environment; at the macro level, pollution measures also have positive influences on individual environmental concern. However, Liu and Mu did not find supporting evidence for any effect of economic conditions or affluence at the macro level. Liu, Wang, and Wang (Liu et al., 2018) found similarly in this regard. In addition, Liu, Wang, and Wang found no supporting evidence for any effect of environmental conditions. Thus, more recent studies do not support either the affluence or degradation hypothesis. On the other hand, education is found to be a robust predictor of individual environmental concern in all studies.

These studies mentioned above, while insightful, are all cross-sectional and therefore provide no direct evidence regarding changes over time in levels of individual environmental concern in China. Based on the theories and studies reviewed above, it seems logical to predict a rising trend in public environmental concern in China during the 2000s. Many studies speculate that the Chinese public has been increasingly concerned with environmental issues (Liu and Mu, 2016; Liu et al., 2018) while providing little direct empirical test.

4. Data and methods

4.1. Hypotheses

The main objective of our study is to examine whether there has been a rising trend in levels of environmental concern among the Chinese public in the first decade of the 2000s. We acquire data from two surveys, the 2003 and 2010 CGSS. Studies on environmental concern use various measures, but we use the New Ecological/Environmental Paradigm (NEP) Scale as our primary measure, which is one of the longest and most consistently used measures in the literature that captures the multi-faceted aspects of people's pro-environmental worldviews (Dunlap, 2008). This measure allows for comparisons to research in other national contexts and time periods. Our main hypothesis, based on the review of the literature above, is that there is a higher level of endorsement of the NEP among Chinese people in 2010 than in 2003.

Our secondary objective is to examine the effects of socioeconomic status (SES) factors and people's experience of negative environmental conditions on the NEP with a focus on cross-survey differences. SES

factors such as personal affluence and education are consistently present in theoretical arguments and empirical studies. Pampel and Hunter (2012) find evidence that effects of education (but not income) on environmental concern has diminished over time in the US, suggesting a diffusion process of environmentalism. We therefore put forth the following hypotheses, that SES factors have positive effects on the NEP and that the effects of SES on the NEP are stronger in 2003 than in 2010. Finally, we follow the literature to hypothesize that having experienced environmental problems increases the level of the NEP. However, we do not have a specific expectation on the over-time trend of this relationship.

4.2. Data, samples, and measures

The 2003 and 2010 CGSS are the first and second nationwide general social survey in China conducted through in-person interviews (response rate 77% in 2003 and 71% in 2010., see cgss.ruc.edu.cn for more details) that contained the full 15-item NEP Scale (Dunlap et al., 2000). The NEP Scale was not featured in any other CGSS. The 2003 CGSS was administered only to urban areas (defined as townships and cities of more than 2,500 residents) due to a funding shortage issue. Because CGSS used a multistage stratified random sampling design and the sampling was independently carried out in rural and urban areas of China, the final sample surveyed was a random sample of the urban population of China, 40.5% of the entire nation in 2003 (National Bureau of Statistics of China (NBS), 2004). The 2010 CGSS has separate urban and rural samples, but the environment module was only administered to one third of the overall sample, randomly selected. After deleting cases with excessive missing data in key survey questions (completely missing all NEP items, for instance), final sample size for CGSS 2003 is 5,073 (1% deleted cases) and 3,409 for CGSS 2010 (8.3% deleted cases), in which the urban sample has 2,262 cases and the rural sample 1,147 cases. To maintain comparability across surveys, we only include urban samples in most analyses while keeping the rural sample as a reference in some analyses. See Table 1 for descriptive statistics on demographic variables.

The primary dependent variable is the NEP Scale. As mentioned above, lack of comparable measures over time is the main reason for relatively limited trend studies in the current literature on environmental concern. Therefore, it was fortunate that both surveys in this study included the full NEP Scale, providing identical measures across time. This scale has been thoroughly tested by several scholars who have found that 10 of these 15 items can form an internally consistent and conceptually viable measure of the NEP in China with satisfactory measurement quality in both surveys, indicating robust reliability regarding the scale structure (Hong et al., 2014; Xiao et al., 2013). We therefore use these 10 items to measure endorsement of the NEP (NEP1-10). These NEP items are the No. 1, 3, 5, 7, 8, 9, 10, 11, 13, and 15 of the 2000 NEP Scale, coded as "Strongly Agree" = 1, "Somewhat Agree" = 2, "Unsure" = 3, "Somewhat Disagree" = 4, "Strongly

Table 1
Descriptive statistics for social demographic factors and independent variables.

Variables	2003	2010	
	(N = 5,073)	Urban (N = 2,262)	Rural (N = 1,147)
Age (mean and SD)	43.51 (13.18)	46.11 (15.94)	47.67 (14.85)
Percent female	51.84%	52.92%	50.57%
Education (mean years and SD)	10.44 (3.70)	10.61 (4.28)	6.70 (4.00)
Family Annual Income (mean RMB and SD)	24,390 (41,983)	54,349 (123,545)	23,816 (38,318)
Having Encountered Environmental Problems	76.62%	92.08%	83.63%

Disagree” = 5. Environmental concern is commonly conceptualized as having multiple dimensions, besides environmental worldview, however, the NEP was the only comparable item available across the two surveys.

Both surveys have the same set of SES factors. Education is reported as the highest educational degree attained, ranging from “no formal education” to “graduate degree.” We recoded the answers into typical years of schooling required to finish each degree. The second SES factor is annual family income in Chinese yuan (RMB), and we used natural log transformation to correct for its positive skewness. Full-time employment (working at least 40 hours per week or not), gender (“female” = 1, “male” = 0), and age (in years) are control variables.

Ideally, we should also include measures of postmaterialism. Unfortunately, while both surveys did include relevant survey items, they are not comparable across surveys. For environmental experiences, we make use of one item in each survey asking whether respondents have encountered any environmental problems that call for action in the past year (see Mobley (2016) for a similar operationalization). An answer of “yes” is coded as 1 and “no” as 0.

4.3. Analysis strategy

To test our primary hypothesis, we pool relevant data from the two surveys to form a single dataset and conduct multigroup confirmatory factor analysis (CFA) and structural equation modeling (SEM) to facilitate comparisons across survey years (Bollen, 1989). We first use a multigroup CFA to check factor loadings of all NEP items in order to establish measurement invariance, which is necessary for cross-survey comparisons but seldom carefully examined in the current literature. Our results (see Table 2) of the multigroup CFA show that (1) in each year the ten NEP items indeed load on one single latent factor as specified, and (2) there is little to no difference between the pairs of factor loadings across surveys. It is thus reasonable to conclude we have measurement invariance regarding the NEP between the two years.

Then, we proceed to examine the difference between two latent means of the NEP, one for each survey year, for its statistical significance as a direct test of the primary hypothesis. Next, we conduct a multigroup SEM to estimate and compare the influences of various SES factors on the NEP between the two urban samples to test the rest of our hypotheses. Mplus 7.11 was used to run CFA and SEM. Mplus is well known for its ability to utilize a robust weighted least square (WLSMV) estimator that can account for the categorical nature of many variables we have (Brown, 2006). Missing data were imputed using the full information maximum likelihood imputation tool in Mplus.

5. Results

Table 2 reports results of our multigroup CFA and SEM, through which we tested all our hypotheses. Table 3 highlights results of comparisons across the two survey years. The primary hypothesis predicts that there will be higher levels of environmental concern among the public in 2010 than in 2003. As Table 3 shows, with the latent mean of the NEP in 2003 set to zero as the reference point, the estimated latent mean of the NEP in 2010 (urban sample only) is -0.025, which is not statistically significantly different from zero. Thus, we find no evidence to support our primary hypothesis. It is important to note that the level of endorsement of the NEP is not low in China. In 2003, on average 68% of respondents agree or strongly agree with the 10 NEP statements, which shows a high level of endorsement. The averages for 2010 rural and urban respondents are 55% and 70%, respectively (see Table 4).

Regarding the effects of SES factors, results show that indeed both education and household income have statistically significant positive coefficients in both years. This finding is more or less consistent with previous studies mentioned above. We also note that the effects of education are much larger than those of household income in both years.

To examine whether the influences of SES on environmental concern

Table 2
Factor Loading of the NEP Items and Effects of SES factors on the NEP, 2003 and 2010 Urban.

Items	2003 (N = 5,073)		2010 Urban (N = 2,262)	
	Factor loading (Standard error)	Standardized Factor loading	Factor loading (Standard error)	Standardized Factor loading
NEP1 ^a	1.00 (.00)	.40	1.00 (.00)	.42
NEP2 ^b	1.70 (.06)	.69	1.35 (.08)	.66
NEP3 ^b	1.50 (.05)	.61	1.18 (.07)	.64
NEP4	1.38 (.05)	.56	1.43 (.09)	.66
NEP5	.74 (.04)	.30	.89 (.06)	.41
NEP6	1.32 (.05)	.53	1.32 (.09)	.61
NEP7	.89 (.04)	.36	.85 (.06)	.42
NEP8	1.48 (.05)	.60	1.46 (.09)	.65
NEP9	1.64 (.06)	.66	1.46 (.09)	.66
NEP10	1.67 (.06)	.67	1.58 (.10)	.68

Predictors	2003		2010	
	Coefficients (Standard Error)	Standardized Coefficients	Coefficients (Standard Error)	Standardized Coefficients
Encountered problems	.086 (.015)*	.088	.067 (.041)	.036
Education	.035 (.002)*	.316	.024 (.004)*	.21
Household Income (Log)	.027 (.01)*	.032	.023 (.011)*	.032
Gender (Female = 1)	-.078 (.013)	-.095	-.008 (.024)	-.008
Age	.001 (.001)*	.042	.000 (.001)	.005
R ²	.133		.057	

Model Fit	
Chi-square	813.626
Degree of Freedom	197
Root Mean Squared Error of Approximation (RMSEA)	.027
Comparative Fit Index (CFI)	.983
Tucker Lewis Index (TLI)	.981

Note.
^a Unstandardized factor loading for NEP 1 is fixed at 1.00 in order to identify the model.
^b Tests for differences between 2003 and 2010 are statistically significant (p < .05) regarding unstandardized factor loadings for NEP 2 and NEP 3. *p < .05.

Table 3
Results of comparing latent means of the NEP, and coefficients of SES across two surveys.

Latent Mean	2003	2010	Two-Tailed t-test p-value
	Estimate	Estimate	
	.00	-.023	.082
Coefficients	Estimate	Estimate	Wald test p-value
Encountered problems	.086	.067	.184
Education	.035	.024	.011
Household Income (Log)	.027	.013	.701
Gender	-.078	-.008	.002
Age	.001	.000	.099

Note.
a. Latent mean of 2003 is set at zero to identify the model, enabling the comparison between years.
b. Coefficients are unstandardized.

would be stronger in 2003 than in 2010, we compare the influences of education and household income on the NEP between the two urban samples. As Table 3 shows, we find a statistically significant difference between the two effects of education. The effect in 2010 is much lower than that in 2003, judging by the magnitudes of the standardized effects (0.21 vs. 0.32). We find no statistically significant results regarding

Table 4
Percentage distribution of the NEP items in 2003 and 2010.

Items	2003 urban (N = 5,073)			2010 urban (N = 2,262)			2010 rural (N = 1,147)		
	Strongly Agree	Agree	Sum	Strongly Agree	Agree	Sum	Strongly Agree	Agree	Sum
NEP1	29%	35%	64%	18%	46%	64%	13%	39%	52%
NEP2	50%	31%	82%	31%	51%	82%	19%	51%	70%
NEP3	40%	34%	74%	27%	52%	79%	21%	45%	66%
NEP4	51%	32%	83%	37%	48%	85%	31%	41%	72%
NEP5	28%	17%	45%	35%	19%	54%	24%	10%	34%
NEP6	35%	40%	75%	31%	47%	78%	23%	40%	63%
NEP7	36%	22%	58%	40%	17%	57%	28%	9%	37%
NEP8	32%	33%	65%	28%	41%	69%	17%	35%	52%
NEP9	30%	37%	67%	26%	45%	71%	16%	37%	53%
NEP10	39%	33%	72%	29%	38%	67%	17%	32%	49%

Detailed Item Wording in English	
NEP1	We are approaching the limit or the number of people the earth can support
NEP2	When humans interfere with nature it often produces disastrous consequences
NEP3	Humans are severely abusing the environment
NEP4	Plants and animals have as much right as humans to exist
NEP5	The balance of nature is strong enough to cope with the impact of modern industrial nations
NEP6	Despite our special abilities humans are still subject to the law of nature
NEP7	The so-called "ecological crisis" facing humankind has been greatly exaggerated
NEP8	The earth is like a spaceship with very limited room and resources
NEP9	The balance of nature is very delicate and easily upset
NEP10	If things continue on their present course, we will soon experience a major ecological catastrophe

Note: Two-sample proportion tests show that on all items, the 2010 rural sample has significantly ($p < .05$) lower proportions than the two urban samples.

effects of household income. This finding is consistent with Pampel and Hunter's study (Pampel and Hunter, 2012). Another factor, gender, also has significantly different effects on the NEP between the two years; gender difference in the NEP disappears in 2010; while in 2003, females have significantly lower levels of endorsement of the NEP than do males.

Finally, as Table 2 shows, we find that having experienced environmental problems indeed increases levels of the NEP as predicted, but the effect is only statistically significant in 2003, not in 2010. Table 3 shows that there is no statistically significant difference between the two coefficients, even though one is statistically significant, the other is not. This is likely because the magnitude of the effects are small to begin with and that the statistical significance in 2003 is largely due to the very large sample size.

6. Discussion and conclusion

In this study we seek to answer, how does public concern for the environment change in China during an era of tremendous economic growth, urbanization, and increasing environmental degradation? Proponents of the affluence hypothesis and postmaterialist values theory would predict an increase in public environmental concern given the growth in China's economy and increased affluence among a growing middle-class. Scholars of global environmentalism theory would predict similarly but would emphasize the effects of worsening environmental degradation in China. However, we find that from 2003 to 2010 in China, despite growing affluence and alarming environmental degradation, Chinese citizens' pro-environmental worldviews (as measured by the NEP Scale) have not increased, particularly in urban places where much of the pollution is concentrated and residents experience deteriorating air quality. Yet, there is also fairly high concern for the environment across people of different SES positions. Thus, our study does not support the claim that affluence or postmaterialist values are critical driving forces of people's environmentalism.

Why, against all predictions, has the endorsement of a pro-environmental worldview in urban China not increased from 2003 to 2010? Results in Tables 2 and 3 provide some clues to this question. In our study, education tends to have the strongest positive influence on the NEP, which is consistent with other studies in China as reviewed above. Household income also has positive influences, but effect sizes are small. Table 1 shows that from 2003 to 2010, the average family

income among urban residents doubled, while the average education did not change. We also examined the differences in the NEP between the rural sample of 2010 and both the 2003 and 2010 urban samples, and found that the 2010 rural sample has significantly lower percentages of support for the NEP when compared to the two urban samples (see Table 4). Table 1 shows that the 2010 rural sample has an average education much lower than those of the two urban samples. The 2010 rural sample also has a much lower average family income when compared to the 2010 urban sample, but largely the same as the 2003 urban sample. Therefore, we see a consistent parallel between environmental concern and education differences, but not family income differences. We believe that stagnating educational attainment in urban China may be a partial reason why endorsement of the NEP has changed little from 2003 to 2010. Another possibility is that the NEP changes in a non-linear form and the time of significant change has not come yet.

Our results offer some limited support for the affluence hypothesis since household income indeed has positive effects on the NEP in both years. However, it is worth noting that such effects are very small across the years. Therefore, it is fair to conclude that having an ecologically conscious worldview does not depend on personal affluence and should not be conceptualized as a purely "luxury" good that people prioritize after meeting their basic necessities. Indeed, in both years, there are relatively high levels of pro-environmental worldviews, and such concern is not limited to the privileged since SES factors can account for only 5–13% of the total variations in the NEP.

Similarly, this study finds some supporting evidence for the objective problem hypothesis. Having encountered environmental problems can increase levels of the NEP. However, the effect is also very small, only becoming statistically significant in 2003 due to its much larger sample size. Thus, we argue that environmental worldviews in China are not primarily driven by experiencing objective environmental problems.

More complex and multi-faceted conceptualizations of SES, rather than just income, were more helpful in explaining differences in environmental worldviews. We find evidence that education has a stronger effect on environmental attitudes than income. Education may generate more awareness and knowledge about scientific and environmental issues, and also shift people's cultural milieus and broader worldviews. Unfortunately, we have no direct measures of these mechanisms and therefore call for more research on this topic.

We also find some evidence for global environmentalism theory and

a diffusion process of environmental concern from the more educated to the rest of people as SES measures explained less of the variation in people's environmental worldviews in 2010 compared to 2003. Moreover, the effects of education on the NEP are smaller in 2010 than in 2003. Such results are consistent with Pampel and Hunter's (2012) argument for a diffusion process of environmental concern across socioeconomic groups. This is a remarkable finding considering how different China and the US are and that we measure environmental concern with much greater detail than the single-item measure used in Pampel and Hunter's study. However, one question remains. The diffusion of environmental concern should arguably increase the overall level of concern in the general public, which was not observed in China from 2003 to 2010. In fact, Pampel and Hunter (2012) did not find much evidence for an increase of support for environmental protection in their study either. We do not have direct empirical observations regarding this diffusion process given that we only have two time points. Therefore, our interpretation is only tentative. We believe this topic is worth further study when more data become available.

Lastly, our finding of measurement invariance across the two surveys for the NEP Scale suggests that it is a valid and reliable indicator of environmental worldviews across different national contexts and within China. In previous studies as mentioned above, the NEP Scale has been carefully tested regarding its scale structure (i.e., internal consistency and factor loading pattern) and there is supporting evidence for its robustness when applied in China with certain modifications. Our finding adds to this effort by showing that the modified, 10-item Chinese version of the NEP Scale has remarkable measurement reliability over time, which further testifies to its robustness. We recommend using this scale in all applicable surveys and studies, which will be a useful indicator of how public environmental views continue to change in China and compare to people in other countries.

There are a few limitations of the current study that call for caution. First, we only have two time points in this study. More time points are needed to better understand longitudinal change as well as to allow any potential changes in environmental worldviews in response to changing social and environmental conditions to manifest. Second, also due to lack of data, our study only examines changes in the NEP, just one measure of environmental concern which are quite complex and not captured fully by a single indicator. With analysis of other measures of environmental concern, such as specific issues and policy support, and pro-environmental behaviors, we may find different results and achieve a better understanding of how socioeconomic and environmental factors shape environmental attitudes. Both of these limitations call for more use of standard measures across surveys in order to facilitate comparison.

In sum, our findings have several implications. We see no empirical base for the hope that a growing economy or worsening environment problems alone will bring out stronger concern for the environment among the public. How people construct pro-environmental worldviews is a complex and multi-faceted process that is not determined by material factors alone. It is also overly optimistic for environmental activists to believe that environmental degradation will necessarily increase environmental concern. Without strengthening pro-environmental worldviews, Chinese citizens' environmental activism might continue to be more reactive and sporadic than proactive and persistent. Indeed, recent case studies of several environmental protests seem to suggest the same. For instance, Zhou (2011) finds that residents of Xiamen, a city in Fujian Province of China, protested strongly against construction plans for a paraxylene chemical factory in the neighborhood, but showed no objection to plans to move the factory to a nearby city. To have more sustained long-term support for environmental policy and action, it is necessary for both policymakers and environmental activists to enhance pro-environmental worldviews among the public.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- Ahern, L., 2012. The role of media system development in the emergence of postmaterialist values and environmental concern: a cross-national analysis. *Soc. Sci. Q.* 93, 538–557.
- Asian Development Bank, 2007. Country environmental analysis for the people's Republic of China. <http://www.adb.org/sites/default/files/project-document/65809/39079-prc-dpta.pdf>. (Accessed January 2020).
- Bollen, K.A., 1989. *Structural Equations with Latent Variables*. Wiley, New York.
- Bradsher, K., Nov. 7, 2012. Facing protests, China's business investment slows, *the New York times*. <https://www.nytimes.com/2012/11/07/business/global/facing-protests-chinas-business-investment-may-be-cooling.html>. (Accessed January 2020).
- Brechin, S.R., 1999. Objective problems, subjective values, and global environmentalism: evaluating the postmaterialist argument and challenging a new explanation. *Soc. Sci. Q.* 80, 793–809.
- Brown, T.A., 2006. *Confirmatory Factor Analysis for Applied Research*. Guilford, New York.
- Bullard, R.D., 1990. *Dumping in Dixie: Race, Class, and Environmental Quality*. Westview Press, Boulder.
- Dou, X., 2013. Low carbon-economy development: China's pattern and policy selection. *Energy Pol.* 63, 1013–1020.
- Dunlap, R.E., 2008. The New Environmental Paradigm scale: from marginality to worldwide use. *J. Environ. Educ.* 40 (1), 3–10.
- Dunlap, R.E., York, R., 2008. The globalization of environmental concern and the limits of the postmaterialist values explanation: evidence from four multinational surveys. *Socio. Q.* 49, 529–563.
- Dunlap, R.E., Liere, K.D.V., Mertig, A., Jones, R.E., 2000. Measuring endorsement of the New Ecological Paradigm: a revised NEP scale. *J. Soc. Issues* 56, 425–442.
- Echavarren, J.M., 2017. From objective environmental problems to subjective environmental concern: a multilevel analysis using 30 indicators of environmental quality. *Soc. Nat. Resour.* 30, 145–159.
- Esty, D., Levy, M., Srebotnjak, T., Sherbinin, A.D., 2005. *Environmental Sustainability Index: Benchmarking National Environmental Stewardship*. Yale Center for Environmental Law and Policy, New Haven.
- Franzen, A., Meyer, R., 2010. Environmental attitudes in cross-national perspective: a multilevel analysis of the ISSP 1993 and 2000. *Eur. Socio Rev.* 26, 219–234.
- Gelissen, J., 2007. Explaining popular support for environmental protection: a multilevel analysis of 50 nations. *Environ. Behav.* 39, 392–415.
- Gilbert, N., 2012. Green protests on the rise in China. *Nature* 488, 261–262.
- Greenbaum, A., 1995. Taking stock of two decades of research on the social bases of environmental concern. In: Mehta, M.D., Ouellet, E. (Eds.), *Environmental Sociology: Theory and Practice*. Captus Press, Concord, pp. 125–152.
- Guo, X., Marinova, D., Hong, J., 2013. China's shifting policies towards sustainability: a low-carbon economy and environmental protection. *J. Contemp. China* 22, 428–445.
- Hao, F., 2014. The effect of economic affluence and ecological degradation on Chinese environmental concern: a multilevel analysis. *J. Environ. Stud. Sci.* 4, 123–131.
- Hao, F., Song, L., 2020. Environmental concern in China: a multilevel analysis. *Chin. Sociol. Rev.* 52 (1), 1–26.
- Hao, F., Huang, W., Sloan, M.M., 2018. Environmental concern in the United States and China: the influence of measurement in national context. *Soc. Curr.* 5 (5), 479–493.
- Hao, F., Michaels, J.L., Bell, S.E., 2019. Social capital's influence on environmental concern in China: an analysis of the 2010 Chinese general social survey. *Sociol. Perspect.* 62 (6), 844–864.
- Harris, P., 2006. Environmental perspectives and behavior in China: synopsis and bibliography. *Environ. Behav.* 38, 5–21.
- Harris, P., 2008. Green or Brown? Environmental attitudes and governance in greater China. *Nat. Cult.* 3, 151–182.
- Holifield, R.B., Chakraborty, J., Walker, G.P., 2018. *The Routledge Handbook of Environmental Justice*. Routledge, London; New York.
- Hong, D., 2012. Economic growth, environmental protection, and ecological modernization: the perspective of environmental sociology. *Chinese Social Science* 9, 82–99.
- Hong, D., Fan, Y., Xiao, C., 2014. Examining the application of Chinese version of NEP (CNEP): a study based on 2010 Chinese general social survey. *Sociological Studies* 172, 49–72.
- Inglehart, R., 1977. *The Silent Revolution: Changing Values and Political Styles Among Western Publics*. Princeton University Press, Princeton.
- Inglehart, R., 1990. *Culture Shift in Advanced Industrial Society*. Princeton University Press, Princeton.
- Inglehart, R., 1995. Public support for environmental protection: objective problems and subjective values in 43 societies. *PS Polit. Sci. Polit.* 28, 57–72.

- Kidd, Q., Lee, A., 1997. Postmaterialist values and the environment: a critique and reappraisal. *Soc. Sci. Q.* 78, 1–15.
- Kvaløy, B., Finseraas, H., Listhaug, O., 2012. The publics' concern for global warming: a cross-national study of 47 countries. *J. Peace Res.* 49, 11–22.
- Lang, G., Xu, Y., 2013. Anti-incinerator campaigns and the evolution of protest politics in China. *Environ. Polit.* 22 (5), 832–848. <https://doi.org/10.1080/09644016.2013.765684>.
- Liu, X., Mu, R., 2016. Public environmental concern in China: determinants and variations. *Global Environ. Change* 37, 116–127.
- Liu, Z., Wang, J., Wang, Y., 2018. Understanding individual environmental concern in the context of local environmental governance in China: a multi-level analysis. *Soc. Nat. Resour.* 31 (11), 1283–1301.
- Managi, S., Kaneko, S., 2006. Economic growth and the environment in China: an empirical analysis of productivity. *Int. J. Global Environ. Issues* 6, 89–133.
- Martinez-Alier, J., 2014. The environmentalism of the poor. *Geoforum* 54, 239–241. <https://doi.org/10.1016/j.geoforum.2013.04.019>.
- Mayer, A., Smith, K.E., 2017. Rethinking economic conditions and environmental attitudes: macroeconomic effects, individual experiences, and subjectivity. *Soc. Curr.* 4, 342–359.
- Mobley, C., 2016. What matters when explaining environmentalism at the watershed level: who you are, where you live, what you see, or what you perceive? *Environ. Behav.* 48 (9), 1148–1174. <https://doi.org/10.1177/0013916515586058>.
- Mohai, P., Pellow, D.N., Roberts, J.T., 2009. Environmental Justice, *Annual Review of Environment and Resources* 34, 405–430. <https://doi.org/10.1146/annurev-environ-082508-094348>.
- Mohai, P., Simões, S., Brechin, S.R., 2010. Environmental concerns, values and meanings in the Beijing and Detroit metropolitan areas. *Int. Sociol.* 25, 778–817.
- National Bureau of Statistics of China (NBS), 2004. China Statistical Yearbook. China Statistics Press, Beijing, 2014, 2015, 2018.
- Nawrotzki, R.J., 2012. The politics of environmental concern: a cross-national analysis. *Organ. Environ.* 25, 286–307.
- Pampel, F.C., Hunter, L.M., 2012. Cohort change, diffusion, and support for environmental spending in the United States. *Am. J. Sociol.* 118, 420–448.
- Rosenthal, E., June 14, 2008. China Increases Lead as Biggest Carbon Dioxide Emitter. *The New York Times*. <https://www.nytimes.com/2008/06/14/world/asia/14china.html>. (Accessed January 2020).
- Steinhardt, H.C., Wu, F., 2016. In the name of the public: environmental protest and the changing landscape of popular contention in China. *China J.* 75 (1), 61–82. <https://doi.org/10.1086/684010>.
- The World Bank, 2019. The World Bank in China: overview. <https://www.worldbank.org/en/country/china/overview>. (Accessed January 2020).
- Wang, J., Yu, F., Cao, D., 2006. Study report 2004 for green national economic accounting. *China Population Resources and Environment* 16, 11–17.
- Xiao, C., Dunlap, R.E., Hong, D., 2013. The nature and bases of environmental concern among Chinese citizens. *Soc. Sci. Q.* 94, 672–690.
- Zhao, X., 2012. Personal values and environmental concern in China and the US: the mediating role of informational media use. *Commun. Monogr.* 79, 137–159.
- Zhou, Z., 2011. Environmental protection, group pressure or interests relatedness? *Chin. J. Sociol.* 31, 1–34.