EDUCATION AS INSTITUTIONALIZED DIFFUSION PATH:

A MECHANISM FOR THE RISE OF ENVIRONMENTAL CONCERN

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ABSTRACT

In this paper, we investigated the relationship between SES and environmental concern. We identify three shortcomings in existing empirical work: (1) inconsistent measure of environmental concern across countries; (2) miscoding/ incorrect testing of non-linear relationship, specifically cohort effect; and (3) the failure to distinguish education and income as proxies for SES. Furthermore, as an advancement of existing theory, we argue that education, as an institutionalized ideology diffusion tool, functions through an essentially distinct mechanism on environmental concern, compared to income. Treating education and income as equivalent proxy for SES oversimplifies the causal process. Moreover, whether the effect of education varies across cohorts is contingent on nation-level idiosyncratic characteristics. We test our theory in the context of United States using General Social Survey, three developed countries, Canada, Japan, and Germany, and three developing countries, India, China, and Mexico using World Value Survey.

INTRODUCTION

For decades, scholars have been debating over what might appear to be simple question: does higher socio-economic status (SES) lead to greater environmental concern? Three schools of theories exist to explain the rise of environmentalism: postmaterialist perspective, global environmentalism, and cohort diffusion theory. As articulated by Inglehart (1990, 1995), postmaterialistic values emphasize high-order, aesthetic needs, which characterize individuals socialized in times of abundance and security. This theory treats environmental quality as luxuries that high-income individuals can afford relative to low-income individuals (Franzen and Meyer, 2010). Global environmentalism, on the contrary, argues that disadvantaged individuals have greater exposure to environmental damages. Evidences have shown that low-income individuals are actively engaged in vibrant grassroots environmentalism in many less developed settings (e.g. Brechin, 1999; Dunlap and Mertig, 1995). Recently, cohort diffusion theory asserts that the effects of SES on environmental concern are non-linear across cohorts, with effects increasing for those born early in the 20^{th} century and weakening for those born later (Pampel and Hunter, 2012).

Existing theories has apparently failed to provide consistent answers to the relationship between SES and environmental concern. In this paper, we identify three shortcomings in existing empirical work: (1) inconsistent measure of environmental concern across countries; (2) miscoding/ incorrect testing of non-linear relationship, specifically cohort effect; and (3) the failure to distinguish education and income as proxies for SES. Furthermore, as an advancement of existing theory, we argue that education, as an institutionalized ideology diffusion tool, functions through an essentially

distinct mechanism on environmental concern, compared to income. Treating education and income as equivalent proxy for SES oversimplifies the causal process. Moreover, whether the effect of education varies across cohorts is contingent on nation-level idiosyncratic characteristics.

Empirically, we test our theory using General Social Survey and World Value Survey in the context of United States and six other populous countries in the world. We adopted Pampel and Hunter's methodology and applied the cross-classified hierarchical linear model (Pampel and Hunter, 2012). We found cohort diffusion theory is not fully supported by GSS data in the context of United States, as argued by Pampel and Hunter (2012). Their measurement for environmental concern is "public support for government environmental spending", which is a noisy measurement. They mis-coded and tested non-linear relationship between cohort and SES. In addition, income and education does not present same pattern: income is not proven positively or negatively associated with environmental concern. This partly confirms our theory. We then tested our theory using data from WVS conducted in Canada, Japan, Germany, India, China, and Mexico. The key advantage for WVS is that it provides a consistent proxy for environmental concern, "postmaterialistic value" measured by a Likert scale. We find education and income present different patterns of their effects on environmental concern, indicating that they may be essentially distinct proxies for SES that function through different mechanisms. Moreover, cohort effect is inconsistent across countries.

Our work contributes to existing theories of environmentalism diffusion and to social science research methodology. Theoretically, we identify education as the key mechanism for the diffusion of environmental concern that is consistent across major

populous developing and developed countries. This is largely ignored by either postmaterialism, global environmentalism, or cohort diffusion theory. Methodologically, we first challenge traditional measurement for SES that lumps education and income together and prove that these two are different mechanisms; secondly, we articulate the valid way to code, test, and interpret non-linear regression models.

Diffusion of Environmental Concern in the United States

Data

We first test existing theories in the contest of United States using General Social Survey data. GSS is a sociological survey used to collect data on demographic characteristics and attitudes of residents of the United States started in 1972. GSS provides longitudinal data with individual level information on the absolute spending on environment and their socioeconomic status; their environmental attitude data were collected from 26 surveys over 36 years (1973-2008), and for cohorts born from before 1900 through 1982.

Method

We apply cross-classified multilevel hierarchical linear model to test the relationship between environmental spending support (hereafter ESS) and the socioeconomic status (SES) measures of the respondents[2]. Here, ESS equals a ratio to the mean support for spending across all other items, with values greater than 1 indicating higher support for environmental spending than for other spending priorities, and values

[2] For detailed information of data coding and processing, please refer to Pampel and Hunter (2012). We followed the same procedure.

less than 1 indicate lower support. Table 1 presents descriptive details for every variable in our model.

---------- Insert Table 1 here ----------

To test the non-linear effect of cohort and its interaction with SES, we followed the approach by Pampel and Hunter (2012) who incorporated a quadratic term, cohort squared, and an interactive term, cohort squared* SES into the model. The equation is as shown below. As noted, "The postmaterialism and affluence arguments predict positive effects of the SES variables (b3>0), while the counterarguments predict weak or negative effects (b3<=0). Reflecting the initial strengthening of the effect of SES across older cohorts, the SES*cohort coefficients b4 should be positive. Reflecting the weakening effect of SES across new cohorts, the SES*cohort squared coefficients b5 should be negative" (Pampel and Hunter, 2012: 434).

DV= b0+ b1* cohort + b2* cohort^2 + b3* SES + b4 * SES * cohort + b5 * SES * cohort^2

Every predicting variable in the above equation is grand-mean centered. However, one key difference between our approach and theirs is how the variable *cohort square* is grand-mean centered. Pampel and Hunter first calculated the square of *cohort* to get *cohort square*, and then subtracted the grand mean from these values to get the grand-mean centered *cohort square*. This data processing approach results in highly correlation (=0.966) between grand mean centered *cohort square* and grand-mean centered *cohort*, indicating potential collinearity issue in their model. Alternatively, we first took grand-mean centered values of *cohort*, and then got the square of this centered *cohort* variable as the grand-mean centered *cohort square*. This approach results in the correlation down to -0.259.

Table 2 presents key control variables and predicting variables without interaction terms, similar with Pampel and Hunter (2012). Note that education and occupational prestige are positively associated with ESS, but family income has a negative effect. This suggests potential two different mechanisms.

---------- Insert Table 2 here ----------

Table 3 shows key the regression results from our approach. The coefficient of the interaction between cohort and education (b4) changes from significantly positive in the Pampel and Hunter's paper to negative significant at .1 in our model. This suggests that even for older cohorts born in the early 20th century, the marginal effect of education is decreasing, which contradicts Pampel and Hunter's assertion. Moreover, Table 3 presents the different effect patterns between education and family income after adding cohort interactions: family income is not shown to be positively related to ESS, but education demonstrates strong positive effect.

---------- Insert Table 3 here ----------

Robustness Check

In addition, we implemented ordered logit models as a comparison to the previous analysis using HML, because in the GSS dataset, environmental spending is categorical and take values of 0 to 3, it is reasonable to argue that the effect between different levels of spending categories may not be the same and not well captured in hierarchical linear model. The ordered logit models take the absolute spending on environment as the dependent variable, with all independent variables being the same as in the hierarchical models, including the SES measures and control variables. Comparison between the resulting coefficients of ordered logit regressions and hierarchical linear regressions show

that the effects of race being black change from negative to positive across all models, and the coefficients of both education and cohort are more than 10 times that from the original models. Other results are consistent with the previous findings in our model, indicating that hierarchical linear models fit the sample data well and the results are convincing.

We further checked the robustness of our analysis by using robust standard errors, in order to test for potential misspecification in our models. After controlling for the random effects, only slight changes in figures are found, and all signs of coefficients remain the same. Therefore, it is reasonable to believe that the models above do not have serious misspecification problems

Findings

To conclude, after correcting the coding error found in the original paper on grand-mean centering the *cohort square* variable, we found that SES has inconsistent effect patterns on individuals' environmental concern contingent on the measurement: education and occupational prestige are shown to be significantly positively associated with higher environmental concern, but family income does not have an effect. Moreover, the marginal effect of education/occupational prestige is decreasing across cohorts such that the younger the cohort is, the less the marginal effect is.

Environmental Concern in A Cross-National Context

Data

As acknowledged by Pampel and Hunter (2012), the GSS data allow only for the indirect study of diffusion. The results apply to a measure of environmental concern

based on a question about support for national spending to improve and protect the environment. The current measure does not reflect postmaterialism as the core theoretical arguments proposed by Inglehart (1990, 1995)[3]. Furthermore, the study by Pampel and Hunter is confined to the United States context. A cross-national approach is necessary to test a "global environmentalism" theory. Therefore, we extend the Pampel and Hunter approach to a cross-national context using World Value Survey (WVS) data.

WVS is the largest cross-national, time series investigation. Starting in 1981, WVS consists of nationally representative surveys conducted in almost 100 countries. The first six waves were carried out respectively in 1981-1982, 1990-1991, 1995-1997, 1999-2001, 2005-2007, 2011-2012. In particular, WVS includes one direct measure of postmaterialism, which provides a golden opportunity to test the cohort diffusion of environmental concern.

Method

As noted by Pampel and Hunter, high-income countries might differ from low- and middle-income countries not only in the levels of environmental concerns but also in the size of the relationships of environmental concern with SES. For sample representativeness, we chose three developed countries, Japan, Canada, and Germany, and three developing countries, China, India, and Mexico. Each country provides over 3,000 respondents across at least four waves. We adopted Cross-classified hierarchical models following Pampel and Hunter (2012). Because occupational prestige is largely heterogeneous across counties, due to limited time, we decided not to include this variable at current stage of analysis.

[3] Articulated by Inglehart (1990,1995), environmental concerns manifest themselves primarily through "postmaterial values" that emphasize higher-order, aesthetic needs.

Findings

As shown in Table 4, among developed countries, Canada presents the exact same pattern with United States: education and family income are positively associated with postmaterialism. The coefficients of SES*cohort (beta4) and SES*cohort^2 (beta5) are both smaller than zero, indicating a decreasing marginal effect of SES (education/ family income) on postmaterialism across cohorts. Japan exhibits a different pattern such that income does not have significant effect on postmaterialism, neither does such effect vary across cohorts. Education as a proxy for SES has significant impact on postmaterialism and such impact decreases for younger cohorts. Data from the third developed country, Germany, show least support for the cohort diffusion theory as shown in Table 4. Education is positively related to postmaterialism, but there is no sufficient evidence suggesting the varying marginal effect. Income and its interaction with cohort or cohort^2 do not confirm the cohort diffusion theory neither. In conclusion, among three populous developed countries in North America, East Asia, and West Europe, only data from Canada support the cohort diffusion theory.

---------- Insert Table 4 here ----------

Across three developing countries, China, India, and Mexico, education has significant positive effect on postmaterialism. However, there is no sufficient evidence supporting the marginal effect variance across cohorts except for India. Income shows puzzling patterns: for India, higher income is associated with higher inclination towards postmaterialism; but in China, the relationship is opposite such that people with higher income are more materialists. Furthermore, there is no consistent pattern of the marginal effect of income across cohorts. In China and Mexico, income* cohort is negative,

indicating a decreasing marginal effect among older cohorts; but income* cohort^2 is not significant so no statistical support for a decreasing marginal effect among younger cohorts. In conclusion, none of the three developing countries confirm the cohort diffusion theory.

Note that education and income show different patterns, indicating that they may be essentially distinct proxies for SES that function through different mechanisms. Family income is a direct measure for economic status and is valid to test if richer people have higher inclination for higher-order, aesthetic needs. Contrary to Inglehart's theory, higher income is not consistently associated with postmaterialistic across countries. Data from Germany, Japan, and Mexico do not provide statistically significant evidence. Data from China suggest the opposite relationship such that higher income is associated with higher materialistic value inclination.

In contrast, education presents consistent relationship patterns across six countries: better-educated individuals are more postmaterialistic. We speculate that education serve more as an ideology diffusion tool instead of a proxy for SES. Educational institutes as one of the key places to socialize social members convey the ideology of environmentalism across cohorts. Distinct from "global environmentalism", "postmaterialism", or "cohort diffusion" theory, we propose that education as an ideology broadcaster facilitates the diffusion of environmental concern. The pattern of cohort variance of education effect remains inconsistent: for Canada, India, and Japan, there exists a decreasing marginal effect across cohorts; but for China, Germany, and Mexico, there is no sufficient evidence to confirm such pattern. We speculate that such cross-national variance is contingent on each country's idiosyncratic educational system and

economic developmental stage. We are constrained by limited information provided by WVS and limited time to further explore why the interactions education and cohort vary across countries. It is conservative to conclude that the underlying mechanisms of education and family income on environmentalism differ across countries, and that it is imprudent to use education and family income as unified proxies for SES.

CONCLUSION

In this paper, we investigated the relationship between SES and environmental concern. We identify three shortcomings in existing empirical work: (1) inconsistent measure of environmental concern across countries; (2) miscoding/ incorrect testing of non-linear relationship, specifically cohort effect; and (3) the failure to distinguish education and income as proxies for SES. Furthermore, as an advancement of existing theory, we argue that education, as an institutionalized ideology diffusion tool, functions through an essentially distinct mechanism on environmental concern, compared to income. Treating education and income as equivalent proxy for SES oversimplifies the causal process. Moreover, whether the effect of education varies across cohorts is contingent on nation-level idiosyncratic characteristics.

Empirically, we test our theory using General Social Survey and World Value Survey in the context of United States and six other populous countries in the world. We adopted Pampel and Hunter's methodology and applied the cross-classified hierarchical linear model (Pampel and Hunter, 2012). We found cohort diffusion theory is not fully supported by GSS data in the context of United States, as argued by Pampel and Hunter. In fact, we find income and education does not present same pattern: income is not

proven positively or negatively associated with environmental concern. We then tested our theory using data from WVS conducted in Canada, Japan, Germany, India, China, and Mexico. As predicted, education and income present different patterns of their effects on environmental concern, indicating that they may be essentially distinct proxies for SES that function through different mechanisms. Moreover, cohort effect is inconsistent across countries.

Our work contributes to existing theories of the rise of environmentalism. Postmaterialism and affluence perspective, global environmentalism, and cohort diffusion all have a focus on socioeconomic status. We identify education as the key mechanism for the rise of environmental concern. Methodologically, we challenge traditional measurement for SES that lumps education and income together and prove that these two are different mechanisms. Moreover, we articulate the valid way to code, test, and interpret non-linear regression models.

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APPENDIX

TABLE 1 VARIABLE DESCRIPTIVE STATISTICS

ENVIRONMENTAL SPENDING VARIABLES	All COHORTS					MEANS BY COHORT GROUPS			
	N	Mean	SD	Min	Max	1900-29	1930-49	1950-69	1970-88
Relative support	26.238	1.14	0.28	0.36	2.65	1.09	1.15	1.16	1.16
Absolute support	26.238	2.50	0.66	1	3	2.32	2.52	2.63	2.66
All spending	43.739	2.25	0.33	1	3	2.16	2.25	2.31	2.32
Predictor variables									
Cohort	47. 259	1,943	19	1,900	1,982	1,917	1,941	1,958	1,974
Age	47. 260	48.30	16.30	25	89	67.43	48.07	37.29	29.57
Gender male	47. 260	0.44	0.50	0	1	0.41	0.45	0.45	0.45
Race black[a]	47. 260	0.13	0.34	0	1	0.11	0.13	0.15	0.16
Race other[a]	47. 260	0.04	0.20	0	1	0.01	0.03	0.06	0.14
Education years/10	47. 131	1.27	0.33	0	2	1.10	1.30	1.36	1.38
Married	47. 247	0.58	0.49	0	1	0.55	0.66	0.56	0.44
No. of children	47.125	2.14	1.80	0	8	2.67	2.47	1.59	1.23
Region	47. 259	4.86	2.45	1	9	4.68	4.82	5	5.14
City size	47. 259	6.53	2.93	1	10	6.18	6.47	6.78	6.96
Employed/in school	47. 253	0.61	0.49	0	1	0.28	0.65	0.79	0.81
Occupation prestige/10	44. 893	4.24	1.41	1.20	8.60	3.93	4.30	4.37	4.44
Reports occupation	47. 259	0.95	0.21	0	1	0.92	0.96	0.97	0.96
Family income ($1.000)	42.612	48.41	43.36	0	228.02	35.26	54.46	53.23	44.44

[a] Reference group race = white.

TABLE 2 ADDITIVIE MULTILEVEL MODELS OF SUPPOT FOR ENVIRONMENTAL SPENDING

	RELATIVE SUPPORT FOR ENVIRONMENTAL SPENDING			
PREDICTORS[a]	b	z	b	z
Gender male	-0.015	-3.86***	-0.0145	-3.87***
Race black	-0.037	-6.16***	-0.0366	-6.16***
Race other	-0.015	-1.48	-0.0158	-1.49
Cohort[b]	0.022	14.34***	0.0236	15.05***
Cohort^2	-0.00087	-1.7+	-0.0011	-2.17
Education years/10	0.0237	3.08***		
Education (cohort centered)			0.0410	4.23**
Married	-0.0087	-2.04*	-0.0088	-2.06*
No. of children	-0.003	-2.97**	-0.0035	-3.03***
City size	0.003	-4.44***	-0.003	-4.46***
Employed/in school	0.0046	1.02	0.0046	1.04
Occupational prestige/10	0.0037	2.27*	0.004	2.43**
Reports occupation				
Family income ($1,000)	-0.00017	-2.88***	-0.00017	-2.81***
Constant	1.150	128.04***	1.1251	128.16***
Variance component				
Age	0.00002		0.00002	
Year	0.00056		0.00056	
N	22744		22744	

[a] All predictors are grand-mean centered; region coefficients not listed.
[b] Transformed to equal decades since 1900 (birth year minus 1900 and divided by 10)
+ P<. 1
* P< .05
** P< .01
*** P< .001

TABLE 3 INTERACTION VARIABLES IN MULTILEVEL MODELS OF RELATIVE SUPPORT FOR ENVIRONMENTAL SPENDING

(N=22,744)

	EDUCATION YEARS		EDUCATION (COHORT CENTERED)		OCCUPATIONAL PRESTIGE		INCOME	
PREDICTORS	B	z	b	z	b	z	b	z
Cohort[a]	0.0234	14.90***	0.0237	15.19***	0.0228	14.78***	0.0231	14.59***
Cohort^2	-0.0009	-1.73+	-0.0010	-2.04*	-0.0008	-1.49	-0.0013	-2.48*
SES measure	0.0409	4.37***	0.0331	3.45***	0.0063	3.23***	-0.0001	-1.02
×Cohort	-0.0062	-1.77+	-0.0059	-1.68+	-0.0019	-2.50*	0.00001	0.67
×Cohort^2	-0.0048	-3.52***	-0.0035	-2.41*	-0.00079	-2.42*	-0.0000	-2.57**

NOTE. Controlling for gender, race, married, children, city size, employed, and region.
a Transformed to equal decades since 1900 (birth year minus 1900 and divided by 10)
+ P<. 1
* P< .05
** P< .01
*** P< .001

TABLE 4 INTERACTION VARIABLES IN MULTILEVEL MODELS OF POSTMATERIALISM

	CANADA		JAPAN		GERMANY		INDIA		CHINA		MEXICO	
PREDICTORS	Education	Income	Education	Income	Education	Income	Education	Income	Education	Income	Education	Income
Cohort[a]	0.0122	0.0082	0.034***	0.034***	0.0979***	0.092***	0.007	0.0088	0.0115	0.008	0.0325**	0.031***
	(1.25)	(0.87)	(5.24)	(5.37)	(6.71)	(6.28)	(1.07)	(1.34)	(1.38)	(1.12)	(2.96)	(3.07)
Cohort^2	-0.0085*	-0.0083*	0.0025	0.000	-0.044***	-0.045***	-0.0025	-0019	0.005	0.0069**	0.0057	0.0039
	(-1.84)	(-1.78)	1.08	(0.04)	(-6.79)	(-7.00)	(-0.94)	(-0.71)	(1.38)	(2.13)	(1.47)	(1.06)
SES measure	0.042***	0.0122**	0.018**	-0.0004	0.114***	-0.015	0.0055+	0.0165***	0.0199***	-0.011**	0.0417***	0.0406***
	(5.85)	(1.99)	(2.92)	(-0.09)	(12.07)	(-1.30)	(1.59)	(3.65)	(4.19)	(-2.06)	(7.34)	(8.03)
×Cohort	-0.0065*	-0.0052*	-0.0056*	-0.001	-0.002	-0.0095*	-0.0025	-0.0036+	0.003	0.0054*	-0.0024	-0.0066**
	(-1.81)	(-1.82)	(-1.72)	(-0.74)	(-0.36)	(-1.82)	(-1.34)	(-1.60)	(1.15)	(1.96)	-0.92	(-2.99)
×Cohort^2	-0.0035**	-0.0018	-0.0043**	-0.0006	-0.0038	-0.0023	-0.0018**	-0.002+	-0.002	0.00078	0.0002	-0.0007
	(-1.98)	(-1.18)	(-2.16)	(-0.67)	(-1.61)	(-0.77)	(-1.95)	(-1.58)	(-1.16)	(0.50)	0.12	(-0.56)
N	3523	3523	6373	6373	5461	5461	7573	7573	6247	6247	6329	6329

NOTE. Controlling for gender, race, married, children, city size, employed, and region.
a Transformed to equal decades since 1900 (birth year minus 1900 and divided by 10)
+ P<. 1
* P< .05
** P< .01
*** P< .001