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RESEARCH ARTICLE

The Influences of Socio-demographic Factors, and Non-formal and Informal Learning Participation on Adult Environmental Behaviors

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Abstract

Multiple factors are likely to influence adult literacy regarding the natural environment and environmental issues, but very little research has been carried out in this area. The research presented in this article is intended to help address this information gap, by investigating influences on adult environmental literacy using data from a Minnesota environmental literacy survey. The article presents the research findings regarding the influence of demographic factors and of non-formal and informal learning on environmental behavior, one of the key dimensions of environmental literacy. Results from this study indicated that environmental behavior prediction was most improved by adding non-formal and informal learning participation. These results suggest that non-formal and informal learning options should be looked at more carefully for predictive possibilities.

Keywords: Environmental literacy; environmental education; environmental behavior, informal environmental learning; non-formal environmental learning.

The Impact of Non-formal and Informal Learning on Adult Environmental Behaviors

While it can be assumed that industry and other large-scale operations are a main cause of environmental degradation, individual citizens and decisions made by adults at an individual level, also have a significant impact on our natural environment. As Coyle (2005) pointed out, environmental problems caused by individuals are not only a problem but also are on the rise. This is a particular concern if individual citizens do not see that their decisions and actions are part of current and ongoing environmental degradation problems.

Research by Blake (2001) found however that "where the culprit is clear and a solution to the problem seems within the power of individuals to achieve, environmental action is more likely to occur" (p. 717). This is at least promising, but also highlights why it is imperative that environmental issues are clarified in ways that enable individuals to

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recognize that their singular impacts and actions do matter, and that their individual actions can positively influence environmental health. A key concept in this context is environmental literacy. Environmental literacy has been used to describe the confluence of an adult's knowledge about, and attitudes and behaviors toward, the environment (Coyle, 2005; Murphy, 2002, 2004, 2008). This aligns well with how the North American Association of Environmental Education (2004) has defined environmental literacy as individuals having knowledge regarding the environment and environmental issues, and having the ability and inclination to engage in independent environmental learning and action.

In addition to the formal environmental education offerings available in colleges and universities; environmental education has also been available at non-formal venues such as environmental learning centers; interpretive facilities; state, county, and city parks; national wildlife refuges; and at arboretums, botanical gardens, museums, and zoos. Beyond these possible learning settings, informal environmental education options via newspapers, magazines, television, the Internet, and even conversations with friends and family, have also been widely available for adults interested in learning about the environment and environmental issues. In spite of extensive formal, non-formal, and informal environmental education efforts, however, national and state-wide research studies in America (Coyle, 2005; Donovan, 2001; Mancl, Carr, & Marrone; 1999; Murphy, 2002, 2004; National Environmental Education & Training Foundation, 2001; Pennsylvania Center for Environmental Education, 2001; RoperASW, 2002) have indicated that adult environmental literacy is lacking, and has shown few signs of improving over the past decade. These and related studies have demonstrated that people's lack of knowledge about the environment combined with their attitudes and behaviors toward the environment are less than what is assumed to be minimally necessary for making informed decisions regarding pro-environmental behavior and actions. Directed and self-directed education are essential for addressing environmental literacy concerns.

Merriam and Caffarella (1999) highlighted that facilitating learning depends on knowing who your learners are, why they participate in learning activities, and understanding the ways in which adults learn. Understanding general adult audiences (citizens 18 years and older) is critical for education efforts regarding the environment since adults everywhere are making and acting on decisions that directly affect our air, land and water quality every day. Adults daily decide transportation options for themselves and their families, whether to use fertilizer or herbicides on their lawns or gardens, and, how disposal of their waste using trash bins, composting, or recycling will be carried out. Adults also have a significant influence on political officials' decisions regarding local, state, and national environmental use and issues. All of these individual and collective decisions and behaviors impact environmental quality, and are informed by aspects such as knowledge adults have about the environment, as well as their attitudes toward the environment (Coyle, 2005; Kollmuss & Agyeman, 2002; Koupal & Krasny, 2003; Smith, Rechenberg, Cruey, Magness, & Sandman, 1997). Having better information regarding factors influencing adult environmental literacy may help educators better understand their adult learners, enable improved tracking of trends in environmental literacy at state and national levels, and may be used in targeting environmental adult education efforts for optimum impact.

A myriad of factors influence adult literacy regarding the natural environment and environmental issues, but, research on general adult populations and environmental literacy has been sparse. The research presented in this article is intended to help address this information gap by investigating influences on adult environmental literacy using data from *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson,

2008). The article presents research findings regarding the influence of demographic factors, and non-formal and informal learning on environmental behavior, one of the key dimensions of environmental literacy.

Background

Kollmuss and Agyeman (2002) defined pro-environmental behavior as "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world" (p. 240). Exactly how knowledge about the environment impacts or influences a person's pro-environmental attitudes or behaviors is not fully clear based on research to date, but, basic environmental knowledge is recognized as important for informing or affecting positive environmental attitudes or behaviors (Abdul-Wahab, 2008; Fraj-Andrés & Martínez-Salinas, 2007; Frick, Kaiser, & Wilson, 2004; Maloney & Ward, 1973; McDaniel & Alley, 2005).

Several studies have investigated environmental knowledge, attitudes, and behavior relationships (Franzen, 2003; Holden, 1995; Murphy, 2002, 2004; Murphy & Olson, 2008; Environmental Education & Training Foundation, 1997; Environmental Education & Training Foundation, 1998; Environmental Education & Training Foundation, 2001; Pennsylvania Center for Environmental Education, 2001; Scott & Willits, 1994; White, 2006). In the main, a positive but weak association between increased environmental knowledge, a positive environmental attitude, and behavior changes to protect the environment has been identified (Coyle, 2005; Koupal & Krasny, 2003; Smith et al, 1997). Coyle (2005) reported evidence for instance that environmentally knowledgeable people are 10% more likely to save energy in the home; 50% more likely to recycle; 10% more likely to purchase environmentally safe products and 50% more likely to avoid using chemicals in yard care. Additionally, Hornik and Cherian's (1995) meta-analysis of recycling behavior found that the strongest predictors of recycling behavior were level of consumer knowledge of or awareness of recycling programs. Unfortunately, according to the research evidence, adults in the U.S. have relatively low levels of environmental knowledge. Coyle's (2005) research identified that "after three decades of school-based environmental education programs, only one-third of American adults can pass a simple test of environmental knowledge with a grade equivalent to A, B, or C" (9 questions or more answered correctly out of 12) (p.3).

To better understand the influences on levels of environmental literacy in order to increase knowledge and promote behavioral change, various researchers have investigated relationships between demographic variables such as age, education, income, and gender, and, environmental knowledge, environmental attitudes, and environmental behaviors. However, a review of this literature revealed that very few of these research studies have focused on general adult populations.

Research into the impact of age on environmental behavior has largely been grounded in Mannheim's (1952) theory of generations, which suggested that important historical events occurring at the adolescent and young adulthood phases of life can permanently impact a cohort throughout its existence. For example, Hallin (1995) found that participants who had been in their mid to late 20s during the Great Depression or during the Second World War were more likely to lead a frugal lifestyle and also to make significant efforts to reduce their waste (Hallin, 1995). This and other studies (e.g. Coyle, 2005) suggest that older adults, who were teenagers or older at the time of environmental catastrophes such as the Three Mile Island (1979) and Chernobyl (1986) nuclear disasters, may have higher environmental knowledge and behaviors than other adult age groups. However, Van Liere and Dunlap's (1980)

review of the aspect of environmental concern reported that "age is negatively correlated with environmental concern" (p. 183), a finding supported by results from Hsu and Roth's (1996) research in which younger community leaders in Taiwan scored higher on environmental attitudes and environmental knowledge than other adult age groups from the study. Research evidence regarding the impact of age on environmental literacy appears therefore inconclusive.

Similarly, research evidence varies regarding the relationships between gender and environmental literacy. Coyle's (2005) research found that women "typically express a more positive attitude toward the environment than men" (p. 81), a finding which supported those of Hines (1987) and Bord and O'Connor (1997). Chua and Aldrich's (2000) review of a decade of research on gender differences in environmental attitudes and behaviors found that "women report stronger environmental attitudes and behaviors than men" (p. 443), a pattern that was consistent across age and 14 countries. Other studies indicated that adult males have significantly higher environmental knowledge scores than females (Arcury & Christianson, 1993; Coyle, 2005; Kentucky Environmental Education Council, 2005, 2009; Kibert, 2000; Murphy, 2002, 2004; White, 2006).

Education and income do appear to have an impact on environmental knowledge and behaviors, at least for some groups. Research indicates that higher levels of education offer an advantage in respondent environmental knowledge scores (Hsu & Roth, 1996; Kaplowitz & Levine, 2005; Kentucky Environmental Education Council, 2005, 2009; National Environmental Education & Training Foundation, 2001; Nerbonne & Schreiber, 2005), while Arcury and Christianson's (1993) research indicated that participants' income was positively related to global environmental knowledge. In their meta-analysis of research on responsible environmental behavior, Hines, Hungerford, and Tomera (1987) found evidence of a weak positive relationship between income and environmental behavior, and between education level and environmental behavior. However, McDaniel and Alley (2005), from their study on land use practices in western Georgia, found that there was not a strong relationship between participants' education or income levels and knowledge of their local environment. Similarly, a survey considering the environmental knowledge, attitudes and behaviors of Kentucky adults, indicated that attitudes about the environment were not significantly different among the various educational levels (Kentucky Environmental Education Council, 2005).

It can be assumed that in terms of education, citizens who are interested in the environment or environmental issues will seek out choices beyond formal education venues. Non-formal and informal environmental education are options for citizens to gain more information, but, there is not much research on these for general adult populations. Non-formal education can be considered "organized activities outside educational institutions, such as those found in learning networks, churches, and voluntary associations," and, informal education as "the experiences of everyday living from which we learn something" (Merriam & Caffarella, 1999, p. 25). Informal learning options like television and newspapers have been identified as leading sources of information on environmental issues (Yavetz, Goldman & Pe'er, 2005), and, Mancl, Carr and Marrone (2003) found that their lowest literacy respondents were most likely to use informal learning options, or television, to gain their environmental information. Non-formal and informal environmental learning venues will be considered an important part of this research study to try to better gauge whether involvement in these self-directed education venues positively relate to pro-environmental behaviors.

Purpose of Study

The purpose of this study is to investigate the environmental behaviors of adults in Minnesota and possible factors that influence this, using data from the *Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008). Heimlich and Ardoin's (2008) literature review identified that there are many ways that behavior is discussed in the literature. For the Minnesota Report Card survey, adult citizens were asked to self-report the frequency of their recycling and food purchase behaviors, and their energy behaviors. While the Murphy and Olson (2008) report provided information on the basic knowledge, awareness and behavior of Minnesota adults regarding the environment, the researchers did not specifically address the role of age, gender, education and income along with non-formal or informal learning variables as possible predictors of environmental behaviors.

In order to address this information gap, the present study was designed to (1) measure the environmental literacy of Minnesota adults, in terms of knowledge, attitudes, and behavior scores (KABs); (2) explore possible relationships between Minnesota adults' KABs and their socio-demographic characteristics as well as their participation in non-formal learning and informal learning; and (3) determine the relative contribution of environmental literacy variables for predicting environmental behavior. The study used a conceptual framework shown in Figure 1.

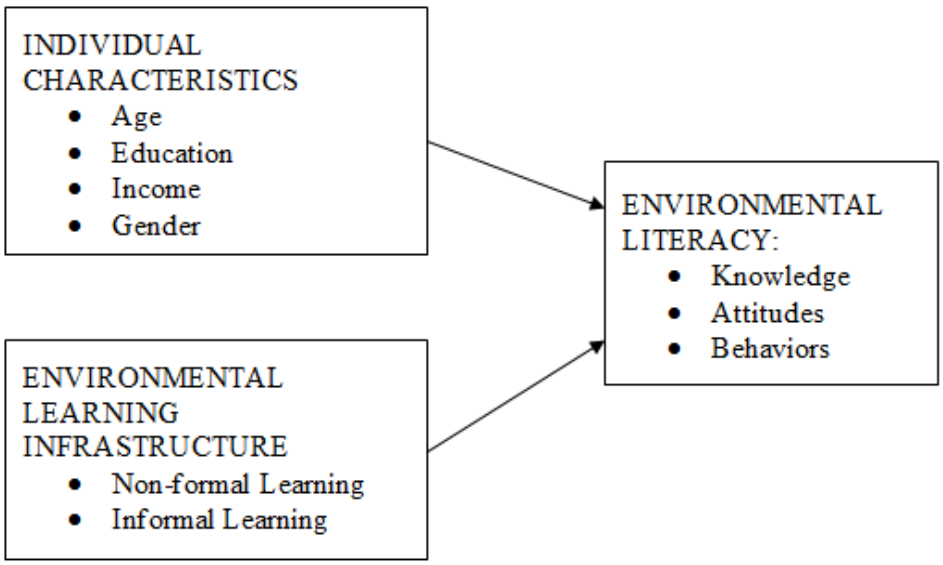

Figure 1. Influences on Environmental Literacy

This article focuses on the findings of the study relating to the influences of socio-demographic factors and participation in EE non-formal and informal learning on the behavioral dimension of environmental literacy. This is arguably the most important aspect of the study, since positive behavioral change is a key objective of environmental education efforts. Both non-formal and informal learning and a better understanding of other influences on behavior can help improve the effectiveness of pro-environmental education efforts.

The specific research questions addressing demographics and environmental behavior scores focused on the relationships between generation (age), level of education, income level, and gender, and, environmental behavior scores. Also analyzed were the relationships between non-formal and informal learning participation and environmental behavior scores.

Method

The research consisted of secondary analysis of survey and demographic data from *The Third Minnesota report card on environmental literacy: A survey of adult environmental knowledge, attitudes and behavior* (Murphy & Olson, 2008). The original survey data were collected by MarketLine Research using random digit dialing and computer aided telephone interviewing between August 24, 2007 and November 6, 2007 (Murphy & Olson, 2008) with an achieved sample of 1,000 adult residents of Minnesota, aged 18 or older.

The Third Minnesota report card on adult environmental literacy was based on the National Environmental Education & Training Foundation (2001) national report. Some questions, relating to popular environmental topics and issues that average citizens were expected to be familiar with, are identical between the two surveys. The latest Minnesota study (Murphy & Olson, 2008) also included additional questions relating to Minnesota adults' knowledge of global warming, and their attitudes toward environmental protection and responsibility. For the purpose of the analysis reported in this article, the independent variables from the Minnesota study are demographics and self-reported learning, and the dependent variable is environmental behavior.

Non-formal and informal learning participation variables from the Minnesota questionnaire contained seven items in total, including the following information used for the present study: gender; age (recorded as year of birth); highest level of education completed, and income before taxes.

The knowledge section of the Minnesota survey included two questions, with multiple possible answers, on self-reported environmental learning. First, using a five-point scale (where 1 = *use a lot* and 5 = *do not use at all*), respondents are asked how much "you use each of the following to get environmental information": the Internet; newspapers – hard copy or online; magazines – hard copy or online; television; radio; conversations with friends or neighbors; and conversations with children about their environmental learning experiences. For the purpose of the present study, the aggregate scores for this question were used as the informal environmental learning scores. Second, using the same five-point scale, respondents are asked "how much environmental information you get" from: government agencies (state or Federal); conservation or environmental groups; environmental learning centers including nature centers, parks, science museums, and zoos; and scientific experts. Aggregate scores from this question were used in the current study as non-formal environmental learning score. Responses for the non-formal and informal learning questions were reversed for the purpose of analysis so that a higher aggregate score on non-formal and informal learning corresponded with active engagement in participating in self-directed environmental learning. These aggregate scores ranged from 7 - 37 for informal learning, and from 4 - 22 for non-formal learning.

In the behavior section of the Minnesota survey, participants were asked to rate the frequency with which they perform each of twelve environmentally-friendly acts on a scale of 1 to 5, where 1 = *almost always do it* and 5 = *never do it*. The 11 specified acts were: recycle things such as newspapers, cans and glass; turn off lights and electrical appliances when not in use or when you leave the room; bike or walk to work; use the bus; carpool with others; purchase lamps, light bulbs, and appliances

that are energy efficient; run air conditioner less often in the summer; lower the thermostat in the winter; accelerate slowly when driving; donate money annually to an environmental group or organization; buy organic foods on a regular basis, and buy locally-grown foods on a regular basis. After recoding, the aggregate scores for these questions ranged from 15 - 56. The higher the aggregate score on the behavior questions, the more active the participant is assumed to be in environmentally friendly behaviors.

Data from the survey were analyzed using analysis of variance (ANOVA), *t*-tests and multiple regression. All statistical procedures were conducted using SPSS (version 17). To investigate the relationship of age, education, and income on environmental behavior (Questions 1, 2, and 3), one-way ANOVA was first used to analyze the extent to which the groups vary from one another with respect to the question's dependent variable (environmental behavior). Normality was assumed for each of the variables. In addition, the Levene's test of homogeneity was examined for significance. If the difference in means was significant ($p < .05$) for ANOVA, a post hoc Bonferroni test was conducted to show which group means were statistically different from one another. T-tests were used to compare mean environmental behavior scores for females and males (Question 4).

To address Questions 5 and 6, multiple regressions were conducted to consider whether any statistically significant correlations exist between the dependent measures, a set of predictor variables, and non-formal and informal learning participation. Specifically, multiple regression was conducted to investigate whether adding informal and non-formal learning participation to the other independent variables of age, education levels, gender, and income, further contributed to the predictive ability for environmental behavior score.

Results

Profile of Respondents

Fifty-eight percent of the sample was female, and the age range of respondents was 18 to 97, with an average age of 54 years. The full distribution of respondents by gender and age group is shown in Table 1.

Table 1
Frequencies and Percentages for Gender and Age of Respondents

Demographic	Category	*f*	%
Gender	Females	577	57.7
	Males	423	42.3
Age			
	28 or less	59	6.0
	29-42	207	20.9
	43-61	408	41.3
	62 or over	315	31.9
	Missing	11	1.1

The distribution of respondents by highest level of education and income is shown in Table 2. There was a fairly even split between respondents who had at least a two-year college degree (54%), and those who reported having only some college or less (46%). The largest proportion of respondents (22.8%) reported an income of greater than $50,000 to $75,000; followed closely by 21.7% reporting an income of greater

than $30,000 to $50,000. An income of $15,000 or less was reported by 6.9% of the sample.

Table 2
Frequencies and Percents for Highest level of education and Income levels

Demographic	Category	f	%
Highest level of Education completed*	High school graduate/GED or less	252	25.2
	Some college	207	20.7
	2 year degree	129	12.9
	4 year degree	245	24.5
	Graduate degree	166	16.6
Income levels*	$15,000 or less	62	6.9
	Greater than $15,000 to $30,000	141	15.7
	Greater than $30,000 to $50,000	195	21.7
	Greater than $50,000 to $75,000	205	22.8
	Greater than $75,000 to $100,000	128	14.2
	Over $100,000	169	16.6

*Missing cases were excluded

For the self-reported informal and non-formal environmental learning participation questions respondents were asked to gauge their use of a variety of sources. These sources: internet; newspapers; magazines; television; radio; conversations with friends or neighbors; and conversations with children about their environmental learning experiences, are referred to as informal environmental learning for this study. Aggregate scores for informal learning participation ranged from 7 to 37 (*M*=19.55, *SD*=4.71). These sources: government agencies; conservation or environmental groups; environmental learning centers including nature centers, parks, science museums, and zoos; and scientific experts, are referred to as non-formal environmental learning for this study. Aggregate scores for non-formal learning participation ranged from 4 to 22 (*M*=10.34, *SD*=3.82).

Table 3
Correlation of Study Variables to Adult Environmental KABs

	M	*SD*	1	2	3	4	5	6	7	8
1. Gender										
2. Education Level			-.090**							
3. Generation from year born			.020	-.161**						
4. Income Level			-.191**	.461**	-.206**					
5. Informal learning	19.55	4.71	-.043	.109**	-.099**	.125**				
6. Non-formal learning	10.34	3.82	-.108**	.286**	-.070*	.243**	.476**			
7. Knowledge	6.18	2.56	-.328**	.291**	.049	.287**	.242**	.325**		
8. Attitude	14.54	2.89	.103**	.088**	.020	.002	.185**	.145**	.145**	
9. Behavior	36.10	6.45	.086**	.164**	-.013	.144**	.396**	.348**	.178**	.267**

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed)

Correlation Scores

Table 3 shows the correlation scores for all study variables, including the environmental knowledge and attitude variables that are not explored in detail in the current article. Environmental knowledge scores were weakly positively correlated, and statistically significant, with education, income, and informal and non-formal environmental learning participation. Environmental attitude scores were weakly positively correlated, and statistically significant, with education, and informal and non-formal environmental learning participation. Environmental behavior scores (*M*=36.1, *SD*=6.45) were found to be weakly positively correlated, and statistically significant, with education, income, and informal environmental learning participation and non-formal environmental learning participation.

Assuming a positive relationship between each of the dependent variables (environmental knowledge, attitude, and behavior scores), and the independent variables of age, education levels, and income levels, the statistics do indicate a weak positive relationship. In other words, as age, education and income levels increase, so do knowledge, attitude and behavior scores.

Impact of Age

One-way between-groups ANOVA was conducted to explore the impact of age on environmental behavior scores. Subjects were divided into four groups according to their age (Group 1/Generation Y: 28 years or less; Group 2/Generation X: 29 to 42 years; Group 3/Baby Boomers: 43-61 years; Group 4/Silent Generation: 62yrs or older) (age groups based on Smith & Clurman, 1997 & 2007). There was found to be a statistically significant difference at the $p < .05$ level between the age groups for the environmental behavior scores (Table 4).

Table 4
Summary of Age Groups and KAB's Analysis of Variance (ANOVA) Results

Variable	*Sum of Squares*	*df*	*Mean Square*	*F*	*p*
Behaviors					
Between Groups	1,681.84	3	560.61	14.10	.00**
Within Groups	39,174.52	985	39.77		
Total	40,856.37	988			

**$p < 0.01$

Post-hoc comparisons using the Bonferonni test indicated that for environmental behaviors and ages, only the Baby Boomer generation's mean behavior score (*M*=37.51, *SD*=6.29) was significantly different (higher) from each of the other three generations' mean behavior scores (Table 5). Generation Y (*M*=33.69, *SD*=6.01) had the lowest mean behavior score of the age groups. Generation X (*M*=35.87, *SD*=5.98), Generation Y, and Silent Generation's mean behavior scores (*M*=34.82, *SD*=6.59) did not differ significantly from each other.

Impact of Education

One-way between groups ANOVA was conducted to explore the impact of education on behavior scores. Subjects were divided into five groups according to their education levels (Group 1: High school grad, GED or less; Group 2: Some College; Group 3: Two-year degree; Group 4: Four-year degree; Group 5: Graduate degree).

There was found to be a statistically significant difference at the $p < .05$ level between these groups for their KAB scores (see Table 6).

Table 5
Bonferroni Comparison for Age Groups and Environmental Behaviors

Variable	Mean Behavior Score Difference	Std. Error	*p*	95% CI Lower Bound	95% CI Upper Bound
Baby Boomers vs.					
Generation Y	3.81*	.88	.00	1.49	6.14
Generation X	1.64*	.54	.02	.21	3.06
Silent Generation	2.69*	.47	.00	1.44	3.94
Generation X vs.					
Generation Y	2.18	.93	.12	-.28	4.64
Silent Generation	1.06	.56	.37	-.43	2.55
Silent Generation vs.					
Generation Y	1.12	.89	1.0	-1.24	3.49

*$p < 0.05$

Table 6
Summary of Education and KABs Analysis of Variance (ANOVA) Results

Variable	*Sum of Squares*	*df*	*Mean Square*	*F*	*p*
Behaviors					
Between Groups	1,364.13	4	341.0340.30	8.46	.00**
Within Groups	40,060.25	994			
Total	41,424.38	998			

*$p < 0.05$, **$p < 0.01$

Post-hoc comparisons using the Bonferonni test indicated that for environmental behaviors and education, Group 1 (High school grad, GED or less), and the Group 4 (Four-year degree) and Group 5's (Graduate degree) mean behavior scores (see Table 7) were significantly different from each other. Group 1's mean behavior scores (*M*=34.85, *SD*=6.74) were lower than both Group 4 (*M*=36.72, *SD*=6.32) and Group 5's mean behavior scores (*M*=38.20, *SD*=6.59). Group 5's mean behavior scores were also significantly different (higher) from all groups except Group 4. Group 4 and Group 5's mean behavior scores however did not differ significantly from each other nor did Group 2 (*M*=35.85, *SD*=5.60) or Group 3's (*M*=35.08, *SD*=6.44) mean environmental behavior scores significantly differ.

Table 7
Bonferroni Comparison for Education Levels and Environmental Behaviors

Variable	Mean Behavior Score Difference	Std. Error	*p*	95% CI Lower Bound	95% CI Upper Bound
Group 5 vs.					
Group 4	1.48	.64	.21	-.32	3.27
Group 3	3.11*	.75	.00	1.02	5.21
Group 2	2.35*	.66	.00	.49	4.21
Group 1	3.35*	.63	.00	1.56	5.13
Group 4 vs.					
Group 3	1.64	.69	.18	-.31	3.58
Group 2	.88	.60	1.0	-.81	2.56
Group 1	1.87*	.57	.01	.27	3.47
Group 3 vs.					

(Cont.)

Table 7 (Cont.)

Group 2	-.76	.71	1.0	-2.76	1.24
Group 1	.23	.69	1.0	-1.70	2.17
Group 2 vs.					
Group 1	.99	.60	.96	-.68	2.67

*$p < 0.05$

Impact of Income

One-way between groups analysis was conducted to explore the impact of income on behavior scores. Participants were divided into six groups according to their income levels (Group 1: $15,000 or less; Group 2: Greater than $15,000 to $30,000; Group 3: Greater than $30,000 to $50,000; Group 4: Greater than $50,000 to $75,000; Group 5: Greater than $75,000 to $100,000; Group 6: Over $100,000). There was a statistically significant difference at the $p < .05$ level between these groups for behavior scores (Table 8).

Table 8
Summary of Income Levels and KAB's Analysis of Variance (ANOVA) Results

Variable	*Sum of Squares*	*df*	*Mean Square*	*F*	*p*
Behaviors					
Between Groups	957.20	5	191.44	4.74	.00**
Within Groups	36,135.79	894	40.42		
Total	37,093.00	899			

**$p < 0.01$

Table 9
Bonferroni Comparison for Income Levels and Environmental Behavior

				95% CI	
Variable	Mean Behavior Score Difference	Std. Error	*p*	Lower Bound	Upper Bound
Group 6 vs.					
Group 5	2.12	.75	.07	-.07	4.31
Group 4	1.44	.66	.44	-.51	3.38
Group 3	2.33*	.67	.00	.36	4.29
Group 2	2.94*	.73	.00	.81	5.07
Group 1	3.26*	.94	.01	.48	6.04
Group 5 vs.					
Group 4	.10	.28	1.0	-.71	.92
Group 3	.75	.28	.11	-.07	1.58
Group 2	1.16*	.30	.00	.27	2.04
Group 1	2.64*	.38	.00	1.52	3.75

(Cont.)

Table 9 (Cont.)

Group 4 vs.					
Group 3	.65	.25	.13	-.08	1.37
Group 2	1.05*	.27	.00	.26	1.84
Group 1	2.53*	.36	.00	1.49	3.58
Group 3 vs.					
Group 2	.40	.27	1.0	-.40	1.20
Group 1	1.88*	.36	.00	.83	2.94
Group 2 vs.					
Group 1	1.48*	.37	.00	.38	2.58

*$p < 0.05$

Post-hoc comparisons using the Bonferonni test indicated that for environmental behaviors and income, only Group 6's mean (*M*=37.87, *SD*=6.42) was significantly different (higher) from the Group 1 (*M*=34.61, *SD*=7.65), Group 2 (*M*=34.94, *SD*=6.69), and Group 3 (*M*=35.55, *SD*=6.63) behavior score means (see Table 15). Group 4 (*M*=36.44, *SD*=5.60), Group 5 (*M*=35.76, *SD*=5.89) and Group 6's s mean environmental behavior scores did not differ significantly from each other (Table 9).

Impact of Gender

Independent samples *t*-tests were used to compare mean scores for females and males, and there was found to be a significant effect for gender and environmental behavior scores $t(998) = -2.72$, $p = .01$, with females having higher environmental behavior scores than males. The magnitude of the differences in these means was very small (eta squared = .007) (Table 10).

Table 10
Behavior means and standard deviations for females and males

Variable	*Females*	*Males*
Behaviors	*M*=36.57, *SD*=6.42	*M*=35.45, *SD*=6.42

Table 11
Results of Hierarchical Regression Analysis for Variables Predicting Adult Environmental Behavior

	Step 1			Step 2		
Predictor Variables	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Intercept	33.16		.84	29.14		.90
Individual Characteristics						
Education	.58	.16	.13**	.27	.16	.06
Gender	1.50	.42	.12**	1.81	.40	.14**
Income	.31	.16	.07	.16	.15	.04
Belong to Gen Y or not	-3.66	.88	-.14**	-3.40	.84	-.13**
Belong to Gen X or not	-2.22	.55	-.14**	-2.13	.52	-.14**
Generation Silent or not	-2.27	.51	-.16**	-2.04	.49	-.14**
Environmental Learning						
Non-formal				.53	.06	.31**

Note. $R^2 = .08$ for Step 1; $\Delta R^2 = .17$

*$p<.05$, **$p < 0.01$

Impact of Participation in Non-Formal Learning

Hierarchical multiple regression was conducted to assess the impacts of participation in non–formal environmental learning on environmental behavior scores in addition to age, education, gender, and income (see Table 11). Age (categorized into Generation Y, Generation X, Baby Boomers, and Silent Generation), education, gender, and income variables were entered at Step 1, this accounted for 8% of the variance in environmental behaviors. After entry of non-formal learning participation at Step 2, the total variance explained by the model as a whole was 17%, $F(7, 892) = 26.33$, $p<.0005$. In other words, participation in non-formal environmental learning can explain at least nine percent of the variation of adult's environmental behaviors.

Impact of Participation in Informal Learning

A hierarchical multiple regression was conducted to assess the impacts of participation in informal environmental learning on environmental behavior scores in addition to the influence of age, education, gender, income (see Table 12). Age, education, gender, and income variables were entered at Step 1, this accounted for 8% of the variance in environmental behavior. After entry of informal learning participation at Step 2, the total variance explained by the model as a whole was 21%, $F(7, 892) = 34.27$, $p<.0005$. In other words, participation in informal environmental learning can explain at least 13% of the variation of adults' environmental behaviors.

Table 12
Results of Hierarchical Regression Analysis for Variables Predicting Adult Environmental Behavior

Predictor Variables	Step 1			Step 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Intercept	33.16		.84	23.76		1.09
Individual Characteristics						
Education	.58	.16	.13**	.48	.15	.11**
Gender	1.50	.42	.12**	1.64	.39	.13**
Income	.31	.16	.07	.24	.15	.06
Belong to Gen Y or not	-3.66	.88	-.14**	-3.19	.82	.12**
Belong to Gen X or not	-2.27	.51	-.14**	-1.50	.48	-.14**
Generation Silent or not			-.16**	.49	.04	.37**
Environmental Learning Informal						

Note. $R^2 = .08$ for Step 1; $\Delta R^2 = .17$

*$p<.05$, **$p < 0.01$

Discussion

Only the Baby Boomers' mean score for environmental behavior was significantly different (higher) than the other age groups, with Baby Boomers scoring on average about two points higher than the other age groups. Returning to Van Liere and Dunlap's (1980) application of Mannheim's theory (1952) regarding significant events and possible generational impacts, it could be assumed that people who were teenagers and older during significant environmental events could have formed "an ecology-minded generation whose commitment to environmental reform should not

disappear as they move into adulthood" (Dunlap & Van Liere, 1980, p. 183). Many Baby Boomers were at least teenagers or older during many significant environmental events in the United States (Rachel Carson's book; Cuyahoga River catching on fire; Love Canal, Three Mile Island, and Chernobyl).

With regard to education levels and environmental behavior, participants with at least a four-year college degree (education groups four and five) had mean behavior scores that were significantly different from Group 1 (high school graduate, GED or less). Group 1's environmental behaviors scores averaged almost two points less than college graduates, and almost three points less than participants with a graduate degree. These findings align with the weak positive relationship between level of education and environmental behaviors found in Hines, Hungerford and Tomera (1987) meta-analysis on responsible environmental behavior research.

There were statistically significant differences at the $p < .05$ level between the income groups and behavior scores. Group 6's average mean environmental behavior score was significantly different (higher) from Groups 1, 2, and 3. Participants who reported a total household income of $100,000 or more (Group 6) then reported slightly higher environmental behaviors (average environmental behavior scores were 2 to 3 points higher) than Groups 1, 2, and 3. These findings support the weak positive relationship between pro-environmental behavior and income indicated in Mancl et al.'s (2003) and Hines et al.'s (1987) studies.

This study found a significant effect of gender on environmental behavior scores. These findings aligned with Coyle (2005), Hines et al. (1987), and Bord and O'Connor (1997) that females report more pro-environmental behaviors than males.

Results from the hierarchical regression analysis were aligned with the findings from the correlation analysis but revealed other noteworthy results. The multiple regression analysis revealed that the predictor variables of age, education, income, and gender accounted for approximately 8% of environmental behaviors. When non-formal environmental learning was added to these models, it contributed significantly to predicting environmental behavior scores. These prediction models increased 17% for environmental behaviors after non-formal environmental learning participation was added. After controlling for the effects of demographic variables, non-formal learning participation appears to be a moderate contributor to environmental behaviors. This finding is consistent with the meta-analysis on environmental literacy in the United States conducted by Volk & McBeth (1996, 1998).

When informal environmental learning was added to the first stage model, this variable was found to contribute significantly to predicting environmental behavior scores as well. The prediction models increased from 8% to 21% for environmental behaviors after informal environmental learning participation was added. After controlling for the effects of demographic variables on environmental behaviors, informal learning participation appears therefore to be a moderate contributor to environmental behaviors.

The multiple regression results therefore indicated that both non-formal and informal learning participation, when added to age, education, income, and gender, have a significant impact on environmental behavior. There was also evidence (not reported in detail here) that participation in non-formal and informal education improved environmental knowledge and attitudes, as well as behavior models, providing evidence for the value and need for non-formal and informal environmental adult education venues.

This has significant implications for the future use of non-formal and informal learning venues as a means of influencing environmental behavior among adults. While the

potential for using non-formal and informal education venues to improve and support environmental KABs has long been recognized, researchers and practitioners have raised concerns regarding the possible quality and effectiveness of these venues (Clover, 2002; Coyle, 2005; Filho & Bandeira, 1995; Nyirenda, 1995). The results of this study, in which the environmental behavior prediction was most improved by adding non-formal and informal learning participation, suggests that these learning options should be looked at more carefully for predictive possibilities.

However, since at least 75% of the model remains unaccounted for, more work needs to be done to achieve a clearer understanding of the factors influencing environmental behavior, so that formal, non-formal, and informal education can be appropriately designed and targeted for maximum positive impact on environmental behavior.

It is promising that one of the five main themes identified for increased education research by the Office of Educational Research and Improvement of the U.S. Department of Education is that of adult learning and environmental education (Smith-Sebastio, 1998). Researchers have also called for an increase in focused efforts at teaching environmental education to adults, due to their apparent lack of environmental knowledge and pro-environmental behavior (Clover, 2002; Environmental Education Training Partnership, 2004; Whelan, Flowers & Guevara, 2004). However, there has been a significant gap in the research and evidence base needed to inform the design of effective adult environmental education (Whelan et al., 2004). The findings of this study, particularly with regard to the predictive role of non-formal and informal education, help to address this gap.

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Biographical statement

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RESEARCH ARTICLE

Sosyo-Demografik Faktörlerin, Örgün ve Yaygın Öğrenmeye Katılımın Yetişkinlerin Çevre Davranışları Üzerinde Etkileri

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Özet

Yetişkinlerin çevre okuryazarlığını ve çevresel konulara bakış açılarını birçok factor etkileyebileceğine rağmen, bu alanda çok az araştırma yürütülmüştür. Bu makalede sunulan araştırma, Minnesota çevre okuryazarlığı anketinden elde edilen verileri kullanılarak yeişkinlerin çevre okuryazarlığını etkileyen faktörleri belirleyerek, bu bilgi boşluğunun giderilmesine yardımcı olmak amacıyla tasarlanmıştır. Makal,e demografik faktörler ve, çevre okuryazarlığının temel yaklaşımlardan biri olan çevresel davranış üzerine örgün ve yaygın öğrenmenin etkileri ile ilgili araştırma bulgularını sunmaktadır. Araştırmanın sonuçları, çevresel davranışın geliştirlmesinde genel olarak yaygın ve informal öğrenmenin birbiriyle ilişkilendirilmesinin etkili olduğunu göstermiştir. Bu sonuca göre örgün ve yaygın öğrenme seçeneklerinin öngörülen imkanlara göre daha ayrıntılı ele alınması önerilmektedir.

Anahtar Kelimeler: Çevre okur-yazarlığı, çevre eğitimi, çevreye yönelik davranışlar, yaygın çevre öğrenimi, örgün çevre öğrenimi.

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