Childhood Education as an Environmental Policy Alternative

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Abstract

The looming threat of climate change and its devastating repercussions have thus far been met with a patchwork of international, state-led, and grassroots mitigation efforts. (Lyon 2017) (McElwee 2019) (Ng'Wanakilala 2019). Despite these attempts to lower emissions, global emissions continued to rise in 2019. (Dennis & Mooney, 2019). This indicates that collectively, humans have been unable to mobilize on the scale necessary to halt or reverse the behaviors associated with emitting carbon dioxide and methane. Although some amount of greenhouse gas production is controlled by a handful of industry and government leaders, research suggests that the general public engages frequently and directly in emission-producing behavior through fossil fuel-powered transportation. (Environmental Protection Agency, 2020). Similarly, other individual behaviors, including conscious consumerism, can have direct environmental impacts. If individuals can directly affect their environment, whether by using public transportation or by minimizing plastic waste, then why don't they? Environmental education (EE) has emerged as a potential strategy to promote individual-level changes in attitudes and behavior. (Ardoin, Bowers, Wyman Roth & Holthuis, 2018, p.9). However, there is little existing qualitative research on long-term behavior change from EE. This study aims to understand the long-term influence of EE on environmentally-impactful behavior, and attempts to isolate the influence of EE by controlling for external factors.

This study uses surveys and interviews with past participants of EE programs from the Adventure Earth Centre, a recreational center in Nova Scotia, Canada, to measure environmental behaviors in several areas.

Overall, findings indicate that participation in AEC programs increases long-term pro-environmental behaviors. Qualitative data revealed key elements and processes associated with successful EE. Results suggest that exposure to nature fosters empathy in participants, and provides them with the impetus to make lifestyle choices which decrease individual environmental impact. Based on these findings, governments and educators may be compelled to adopt similar programs with the intention of lowering pollution and greenhouse gas emissions, and facilitating societal climate-adaptive change.

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Introduction

Today we are faced with a myriad of environmental crises: plastic garbage causes the deaths of millions of animals every year, and break down into microplastics and microfibers, which enter animal diets and even human drinking water. (Parker, 2019). Perhaps more concerning, steadily growing greenhouse gas emissions from human activities have catalyzed global climate change. (NASA, 2020). The world is experiencing hotter temperatures than ever before in human history, and greater weather volatility, including more frequent natural disasters. (Ibid). Global warming threatens human lives and entire ecosystems. There is scientific consensus on the matter (Ibid), and it seems that increasing access to technology and the internet makes information about climate change easily accessible.

The integration of fossil fuels into societies and the global economy have in many ways made civilian life intertwined with polluting and environmental degradation. For example, the adoption of suburban planning in North America during the 1950s made it difficult for suburban dwellers to live day-to-day life without using a personal vehicle that emitted greenhouse gases. (Nicolaides & Wiese, 2017). This dependency persists, as in 2018, transportation was the source of 28% of national greenhouse gas emissions in the United States, (Ibid) and a majority of passenger ground travel occurred in personal vehicles. (Bureau of Transportation Statistics, 2018).

Despite this, individuals have power to directly affect their immediate environment in a variety of ways. Conscious consumerism can change markets, leading to a reduction in the carbon footprint of goods, and a reduction in plastic waste. Additionally, efficient water and energy use can reduce emissions. Perhaps most importantly, amenability to environmental

behavior and lifestyle has the potential to alter political climates, and make sweeping institutional change more feasible.

If the threat of global climate change, scientific consensus, and available information resources are not enough to cause widespread changes in behavior, what will? Studies have suggested that environmental education programs for youth and children have an effect on the environmental attitudes of participants, and can even influence their families. However, little research has explored resulting changes in behaviors. This research aims to fill this gap by investigating the potential of environmental education during childhood and youth to influence long-term behavior that promotes environmental sustainability.

The Adventure Earth Centre[1] (AEC) is a government-funded recreational center in Halifax, Nova Scotia, that implements programming from the Institute for Earth Education (Warner 2009, p.4), which emphasizes storytelling and interactive learning in natural settings. Not only does this approach teach ecological concepts, but it fosters deep connection and appreciation for the natural environment. Though the center operates year-round, its main programming occurs during Summers, when week-long day camps and sleep-away camps place campers in natural outdoor settings. Children ages 7-12 participate in these camps, and many go on to become volunteer youth leaders at ages 12-15.

The type of education provided by this center is unlike most that is taught to students in public schools, or university. Rather than learning about the environment while sitting in a classroom, children spend time in the woods with young camp leaders, doing fun activities which

[1] Centre is spelled in Canadian English.

teach about ecological concepts interactively. This study explores whether this interactive and immersive learning experience can be a catalyst for personal behavioral change.

Many governments dedicate resources to environmental research and climate change mitigation, yet global greenhouse gas emissions continued to increase in 2019. (Dennis & Mooney, 2019). While further institutional and legislative change is necessary to create environmental parameters for industry and individuals, the willingness of individuals to adopt sustainable behaviors is crucial to the implementation and success of these policies. Therefore, research into environmentally-motivated behavior changes may yield valuable information for policymakers and environmental advocates.

Literature Review

Information-based policy aims to change behavior by instilling an internal motivation in people through education and logical reasoning. (Pal 2014, p.139). In an environmental context, it can affect attitudes and behaviors towards environmental sustainability. Changes in consumer behavior are valuable as they culminate in tangible environmental repercussions, such as pollution and emissions. Consumer behavior may also affect the political feasibility of proposed environmental policy, and market demand for sustainable products. (Unilever, 2017). While many studies have shown that participation in environmental education programs leads to changes in attitudes towards the environment, far less studies explore changes in behavior. (Ardoin, Bowers, Wyman Roth & Holthuis, 2018, p.9).

For example, a study by De Montfort University evaluated an environmental education program utilizing games, outdoor adventures, and innovative action to create environmental awareness in young people by asking participants whether the camp had changed their

environmental behavior. (McCahon et al. 2018). The result was that "85% of young people told researchers they had changed their behavior". (Ibid). The question "have you changed your behavior?" is abstract in that it does not specify which types of behaviors are environmental, or whether the change was beneficial, and does not capture the extent to which behavior is changed: making the change to sort one's garbage into recycling has very different effects than making the change to create a backyard compost and reuse materials. Yet another study asked youth in an environmental science class how likely they were to adopt different positive environmental behavior: but not whether they had actually adopted this behavior. (Boyes and Stanisstreet 2011). Another study explored students' environmental identities and how these were shaped through education in a school setting. Behavior was measured, however it was analyzed in the context of the student's environmental identity, and the study did not control for other potentially influential factors shaping this identity. (Blatt 2012). While these studies yield results of behavioral intent and perceived behavior, they do not measure the isolated influence of EE on real behaviors. Thus assessments like these yield very little insight into the quantitative behavior changes of students or youth stemming from environmental education.

Several studies focus on the impact of children's education on the environmental behavior of their parents. (Grodzinska-Jurczak et al. 2010) (Jelavic 2014) (Damerell 2013). These have suggested that parental behavior is significantly changed by children's participation in environmental programs. One survey employed questions such as 'do you recycle plastic bottles and aluminum cans?' and 'do you pick up trash on the beach and put it in a garbage?" in questionnaires administered to families before and after children's exposure to EE curriculum in school. (Jelavic 2014). Another used quantitative methods to measure environmental impact based on water use of parents and children in a household, and concluded that participation in an

educational program had significant effects on environmental impact. (Damerell 2013). The focus on adult behavior in these studies may be due to the fact that children have less action potential than adults in terms of financial efficacy. Contributions like these are valuable because they indicate that environmental education influences a wider scope of action than only that of participants. However, focus on adult efficacy by studying parents of participating children highlights a limitation of studying the effects of children's education: It is difficult to study long-term behavior change. Much research seeking to measure the effect of environmental education surveys children directly after completion of their educational program. Research into the lasting effects of educational programs would provide more reliable data by gathering adult rather than child responses, and estimating accumulated environmental impact over time. Integrating these factors would allow for a clearer understanding of the effect of environmental education programs for children and youth.

In studying the effect of EE programs on environmental behaviors, it is important to consider which external factors could influence propensity to make environmentally-friendly choices. Controlling for these potentially influential variables allows for a clearer understanding of the role of EE in shaping environmental behavior.

Income has been identified as a strong predictor of greenhouse gas emissions and energy consumption in several studies (Santillán Vera & Vega Navarro, 2018) (Kleinhückelkotten & Moser, 2017) (Oxfam, 2015). One study analyzed the carbon dioxide emissions and energy consumption of households in Mexico by household income, and found overwhelmingly that wealthier households were responsible for higher levels of carbon dioxide emissions (Santillán Vera & Vega Navarro, 2018). Another report from Oxfam in 2015 found that "the richest 10% of people in the world are responsible for around 50% of global emissions." (Oxfam, 2015 p.1).

Recent studies also suggest that parents' and children's environmental behaviors and attitudes are positively correlated (Casaló & Escario, 2016) (Grønhøj & Thøgersen, 2009). One study used survey data (n = 95,008) from 16 different countries that captured children and parents' environmental attitudes, and found that these were positively correlated. (Casaló & Escario, 2016). Interestingly, these studies posit that parents influence children's environmental attitudes, but are not able to infer causality as do Damerell or Jelavic through pre and post-testing in their experiments to test child-to-parent generational learning (Damerell, 2013) (Jelavic, 2014).

Having identified income and parental environmental attitudes as potential influencers of environmental behaviors, these variables will be used in analyzing data as is explained below.

Methodology

To what extent does childhood and youth participation in AEC programs affect the environmental behaviors of those individuals in adulthood? To answer this question, a multi-modal approach was used: Past participants of the AEC were surveyed to gather quantitative data on environmental behaviors, and qualitative interviews were conducted to contextualize and complement survey data. Eighty (80) participants with a history of AEC involvement were contacted initially, and an additional forty (40) were contacted through exponential snowball sampling (Dudovskiy, n.d.) (UCLA 2019). This was possible due to the main researcher's previous involvement with the AEC and core contacts. In total, one hundred and twenty (120) past AEC participants were contacted through direct message on social media platforms Facebook and Instagram, of which seventy (70) participated in the online survey, with a response rate of 58%. Potential bias exists in this sample as social networking implies some shared characteristics, which may include prolonged involvement with the AEC, environmental values,

or others. In order to offset this potential bias, demographic data was used in a multi-variate regression analysis to capture other influential factors impacting environmental behavior.

A control group of seventy-one (71) people who did not participate in AEC programs were surveyed through intercept surveying in Halifax, Nova Scotia. Intercept locations were chosen based on public accessibility and the potential for random sampling. These locations included a popular supermarket, a public library, and two shopping malls. Participants were offered the ability to complete the survey on an iPad or on their phones by scanning a QR code, completing the survey in the same format as the target (AEC) group.

The online survey contained non-leading questions to measure environmental choice-making, and captured demographic data. In total, thirty-two (32) environmental behaviors were measured. The behaviors in the survey were chosen by creating an index of behaviors that affect several areas of environmental sustainability: These areas were energy consumption; greenhouse gas emissions; plastic waste; and chemical pollution. Within these areas, behaviors were chosen that could be practiced at the individual level, and that ranged from high cost and low cost. For example, high cost behaviors included type of personal vehicle used for transportation, and type of energy used in the home. These behaviors or choices require long term planning and financial investment. Low cost behaviors on the other hand had the ability to be practiced with low financial cost and low time investment. Examples of this include: Length of time spent showering on average; whether the individual recycles or not; amount of meat consumption; and turning the TV off when not using it. Additionally, two measured behaviors were in the realm of environmental advocacy. All of the survey questions measuring environmental behaviors and information used in data analysis are displayed in appendix A on page 33.

Survey data measuring behaviors was aggregated to create a single points-based 'environmental choice score', or EC score, for every individual. This was done through an index which ranked every answer on a scale of 0 – 6, where zero (0) corresponded to no environmental impact (or the most eco-friendly choice), higher numbers corresponded to increasingly harmful choices, and six (6) corresponded to the most harmful choice or behavior for the environment from the available options. The EC score for each individual is the simple average of all of their behavior scores.

By weighting each environmental behavior equally, the EC score aims to capture the amount or number of behaviors in which an individual acts environmentally. This does not capture the magnitude of an individual's environmental impact. Thus, an individual who acts environmentally in several areas will have a lower (better) EC score than an individual who takes no flights, yet makes harmful environmental choices in every other behavior. In this context, 'acting environmentally' means engaging in behavior which promotes sustainability: this can be an act that reduces plastic pollution, energy consumption, or reduces greenhouse gas emissions e.g. buying locally-grown produce that travelled less distance than imported produce.

Face-to-face interviews were conducted with eleven (11) past AEC participants over Facebook video, and were audio recorded with informed consent. Interview questions focused on personal environmental behavior, experience with AEC program(s), its perceived effects, and other factors influencing environmental behaviors. These interviews were instrumental in contextualizing the results from survey data analysis and gathering insight on the EE experience provided by the AEC.

Finally, statistical tests were conducted with the survey data using R, including multivariate regressions, and a heteroscedasticity test. These served to isolate the treatment effect

of the AEC program on environmental behaviors, and identify demographic and behavioral trends. External influence was measured through parent's environmental attitudes and behaviors, education, income, and other factors.

Initial Data Analysis

A t-test of EC scores from the AEC group and control group revealed statistical significance between the two groups' environmental behaviors with a p-value of 5.364e-08. This means that there is a difference between the two group scores, and the p-value indicates more than 99.99% confidence that this difference exists in the population outside of this sample. With average EC scores of 2.091892 (AEC) and 2.671549 (control), AEC participant scores were 22% lower than control group scores. This means that the behaviors measured, past AEC participants made 22% more eco-friendly choices on average than non-participants.

T-tests were conducted on all of the individual behavior variables and revealed that out of 32 behaviors measured, 20 had statistically significant differences between the AEC and control group. Additionally, eight (8) of those behaviors saw a difference of 50% or more between AEC and control group scores. Table 1 shows which behaviors are statistically significant (highlighted in green), and behaviors with a difference of 50% or more between the two groups (highlighted in light blue).

Table 1: Difference in means of variables measuring environmental impact

Behavior	P-value	Lower EC score	Difference of means
1. Transportation type	0.009597	AEC	0.977629 | 24%
2. Personal vehicle fuel efficiency	0.1652	AEC	0.349635 | 13%

3. Personal vehicle fuel type	0.1357	AEC	0.565436 | 11%
4. Time in personal vehicle	0.0006973	AEC	0.960108 | 47%
5. Carpooling / Number of personal vehicle occupants	0.01343	AEC	0.899315 | 21%
6. Flights in a year	0.1334	Control	0.41405 | 22%
7. Home's energy source	0.6176	AEC	0.100114 | 2%
8. Average shower time	0.03046	AEC	0.491178 | 27%
9. Taking staggered showers	0.0005928	AEC	1.148268 | 22%
10. Baths per month	0.001627	AEC	0.0194947 | 70%
11. Hang-drying clothing	0.1905	AEC	0.483061 | 17%
12. Owning a television	0.006208	AEC	1.178531 | 23%
13. Leaving TV on	0.0007565	AEC	1.0717548 | 75%
14. Turning lights off	0.2509	AEC	0.2249715 | 41%
15. Amount of meat consumption	0.06992	AEC	0.586601 | 15%
16. Amount of beef consumption	0.04653	AEC	0.503616 | 21%
17. Effort to buy locally-grown food	0.0743	AEC	0.573667 | 20%
18. Effort to buy locally-made goods	0.08061	AEC	0.559193 | 18%
19. Using second-hand clothing	0.00001131	AEC	1.3555539 | 39%
20. Using reusable grocery bags	0.002501	AEC	0.867191 | 42%
21. Using reusable menstrual products	0.017	AEC	1.179489 | 23%
22. Shopping in bulk	0.6937	Control	0.10963 | 3%
23. Use of disposable coffee/beverage cups	0.001299	AEC	0.7985345 | 50%
24. Use of disposable plastic water bottles	0.0006478	AEC	0.6808527 | 86%
25. Use of natural or biodegradable cleaning products	0.002122	Control	1.003236 | 36%

26. Effort to buy seasonal produce	0.8671	Control	0.079939 | 4%
27. Effort to buy products with less plastic packaging	0.00003806	AEC	1.8054816 | 75%
28. Recycling paper	0.04542	AEC	0.5138941 | 76%
29. Recycling plastic and glass	0.05087	AEC	0.42596117 | 84%
30. Likelihood of supporting environmental policy	0.0007086	AEC	0.998858 | 51%
31. Do you influence others to be more eco-friendly?	0.6612	AEC	0.133232 | 5%
32. Purchasing from sustainable businesses	0.0001473	AEC	1.129806 | 45%

Referencing table 1, the behavior with the greatest difference between groups was 'use of disposable plastic water bottles', with the control group using approximately 86% more plastic water bottles than the AEC group on average. The next greatest differences were found in recycling. plastic and glass'. Past AEC participants recycled plastic and glass at a rate 84% higher than non-participants, and recycled paper at a rate 76% higher than non-participants. The AEC group was also 75% less likely to leave their TVs on while not watching it than the control group, and made 75% more effort than the control group to buy products with less plastic packaging.

Notably, in one of the statistically significant behaviors, the control group acted more environmentally than the AEC group. To measure 'use of natural or biodegradable cleaning products', the survey asked participants to indicate which, if any, of the following items in their household were natural or biodegradable: Soap, shampoo, laundry detergent, and cleaning products. The control group as a whole used 36% more natural or biodegradable products than the AEC group. Having established that the AEC group had more environmentally positive

behaviors than the control group on average, it is important to understand whether this difference in behaviors can be attributed to participation in AEC programs while considering other factors that influence environmental attitudes and behaviors.

Multivariate Regression

A multivariate regression was used to estimate the impact of AEC program participation and other factors on EC scores. The following explanatory variables were used in the regression: Parent's environmental attitudes; age; income bracket; gender; access to public transit; highest education level achieved; participation in AEC programs. Parent's environmental attitudes are expected to be correlated with EC scores, consistent with previous research (Casaló & Escario, 2016) (Grønhøj & Thøgersen, 2009). Income level is also expected to be correlated with previous research, such that having higher income will be correlated with less environmentally-friendly behaviors. (Santillán Vera & Vega Navarro, 2018) (Kleinhückelkotten & Moser, 2017) (Oxfam, 2015).

Table 2 illustrates the summary of this multivariate regression. The estimated coefficient displays the difference in EC score attributable to a specific variable. For example, the coefficient for 'Low Income' shows that having a low household income of $30,000 or less is associated with a 0.437 decrease in EC score compared to people with a household income of $100,000 or more.

Table 2. Regression 1 of EC Scores on Explanatory Variables

Explanatory Variable	Estimated Coefficient	Standard Error	T-Statistic	P-Value	
Intercept	3.465710	0.356619	9.718	1.1e-15	***
Community College	0.417693	0.262848	1.589	0.115544	
Certificate Program	0.541910	0.459922	1.178	0.241797	
Some High School	0.766585	0.426786	1.796	0.075821	.
High School	0.098473	0.173562	0.567	0.571879	
Master's Degree	-0.358044	0.256636	-1.395	0.166406	
PhD Degree	1.141488	0.448174	2.547	0.012564	*
Some Bachelor's Degree	0.103492	0.142085	0.728	0.468271	
Low Access to Public Transportation	0.234508	0.174550	1.344	0.182487	
Moderate Access to Public Transportation	0.049342	0.165210	0.299	0.765885	
High Access to Public Transportation	0.016246	0.175872	0.092	0.926607	
Low Income ($30k or less)	-0.437021	0.185041	-2.362	0.020345	*
Moderate Low Income ($31k - $70k)	-0.156267	0.175033	-0.893	0.374352	
Moderate High Income ($71k - $100k)	0.194825	0.203348	0.958	0.340586	
Age	-0.009551	0.005491	-1.739	0.085382	.
Male	-0.085583	0.126615	-0.676	0.500818	
Parental Attitudes: Low Environmental Concern	-0.442965	0.240890	-1.839	0.069232	.
Parental Attitudes: Moderate Environmental Concern	-0.552798	0.249394	-2.217	0.029173	*
Parental Attitudes: High Environmental Concern	-0.984397	0.268636	-3.664	0.000419	***
AEC Program Participation	-0.343972	0.132235	-2.601	0.010860	*

Notes: '.'p<0.1 '*'p<0.05 '**'p<0.01 '***'p<0.001. Results without marker are not statistically significant.

With reference to table 2, only one level of education was found to be statistically significant compared to a Bachelor's degree: A PhD degree. The coefficient indicates that having a doctorate degree is associated with a predicted increase in EC score, which means less eco-friendly behavior. An issue with this result is that only two survey participants indicated having a PhD degree, which explains why the coefficient is not significant. In order to better understand the role of education in determining EC scores, a second multivariate regression was created with education variables condensed into two groups: Higher education and lower education. The variable 'lower education' captures those who indicated having completed 'some high school' or 'high school diploma' as their highest level of education. Table 3 illustrates the results of a multivariate regression using this variable. As can be seen in table 3, grouping education did not

change the significance of education overall, and it remains not statistically insignificant in determining EC scores.

Table 3. Regression 2 of EC Scores on Explanatory Variables

Explanatory Variable	Estimated Coefficient	Standard Error	T-Statistic	P-Value	
Intercept	3.478000	0.345792	10.058	<2e-16	***
Lower Education	0.095555	0.151819	0.629	0.530581	
Low Access to Public Transportation	0.241948	0.171788	1.408	0.162241	
Moderate Access to Public Transportation	0.013516	0.169358	0.080	0.936558	
High Access to Public Transportation	-0.015014	0.172185	-0.087	0.930696	
Low Income ($30k or less)	-0.472539	0.180889	-2.612	0.010438	*
Moderate Low Income ($31k - $70k)	-0.277210	0.174605	-1.588	0.115655	
Moderate High Income ($71k - $100k)	0.062348	0.202910	0.307	0.759306	
Age	-0.005272	0.005203	-1.013	0.313489	
Male	-0.071055	0.125487	-0.566	0.572558	
Parental Attitudes: Low Environmental Concern	-0.380756	0.237873	-1.601	0.112737	
Parental Attitudes: Moderate Environmental Concern	-0.550414	0.250658	-2.196	0.030509	*
Parental Attitudes: High Environmental Concern	-0.987165	0.269948	-3.657	0.000417	***
AEC Program Participation	-0.327189	0.136261	-2.401	0.018268	*

Notes: '.'p<0.1 '*'p<0.05 '**'p<0.01 '***'p<0.001. Results without marker are not statistically significant.

The variables beneath 'lower education' indicate a person's access to public transportation. Survey respondents rated the accessibility to public transportation in their area from 0 – 3: Zero (0) indicated 'no access or convenience', one (1) 'low access & convenience', two (2) 'moderate access & convenience', and three (3) 'high access & convenience'. Table 2 shows that none of these variables are statistically significant.

The next indicator appearing in table 2 is income. Participants could indicate their estimated annual income with the following options: $30,000 or less; $31,000 to $70,000; $71,000 to $100,000; $101,000 or more. Out of these income brackets, only one proved statistically significant. According to figure 2, having an annual household income of $30,000 or

less is associated with a decrease of 0.473 in EC score compared to having an annual household income of $101,000 or more. Neither age nor gender appeared to have a statistically significant impact on environmental behaviors.

The independent variable 'parental attitudes' indicates the extent to which parents of survey respondents are concerned about environmental sustainability. Survey respondents rated their parents' environmental attitudes on a scale of 0 – 3, where 0 indicated 'parents have no concern for the environment' and 3 indicated 'parents have high concern for the environment'. Two levels of parental environmental attitudes were statistically significant. Having parents with moderate concern for the environment (a rating of '2') is associated with a decrease of 0.550 in EC score compared to having parents with no concern for the environment. Furthermore, having parents with high concern for the environment attitudes (a rating of '3'), is associated with a decrease of 0.987 in EC score compared to having parents with no concern for the environment.

A potential problem with using parental attitudes as an independent variable is that some research shows that children's exposure to environmental education results in changes in parental attitudes through generational learning. (Grodzinska-Jurczak et al. 2010) (Jelavic 2014) (Damerell 2013). If this were the case, positive parental attitudes towards the environment could be partially due to their child's participation in AEC programs, and not an independent predictor of environmental behaviors. Family influence on environmental behaviors is discussed further in the 'interviews' section on page 17.

Finally, participation in AEC programs (denoted by AEC) was statistically significant, and associated with a decrease of 0.327 in EC score. This means that when controlling for all of

the independent variables in regression 2, participation in AEC programs alone was associated with an increase in positive environmental behaviors.

One limitation of regression 2 was that 31 observations were omitted from the regression due to missing entries. Some data analysis revealed that the majority of the missing entries were in relation to one variable. Twenty-two participants had chosen the option 'prefer not to say' when indicating household income. A sensitivity test was conducted, consisting of a regression omitting the income variable. This regression captured the majority of the missing observations and showed results consistent with findings from regression 2, specifically statistical significance in AEC participation and high parental concern for the environment. The summary of this regression can be seen in table 4.

Table 4. Sensitivity Test Regression Omitting Income Variable

Explanatory Variable	Estimated Coefficient	Standard Error	T-Statistic	P-Value	
Intercept	3.098245	0.301499	10.276	<2e-16	***
Lower Education	0.033392	0.141357	0.236	0.81366	
Low Access to Public Transportation	0.177383	0.164057	1.081	0.28175	
Moderate Access to Public Transportation	-0.112411	0.157934	-0.712	0.47798	
High Access to Public Transportation	-0.094265	0.159661	-0.590	0.55602	
Age	-0.004151	0.004912	-0.845	0.39981	
Male	-0.056968	0.110647	-0.515	0.60759	
Parental Attitudes: Low Environmental Concern	-0.166960	0.204497	-0.816	0.41585	
Parental Attitudes: Moderate Environmental Concern	-0.303135	0.215357	-1.408	0.16182	
Parental Attitudes: High Environmental Concern	-0.633087	0.229295	-2.761	0.00666	**
AEC Program Participation	-0.484170	0.118727	-4.078	8.17e-05	***

Notes: '.'p<0.1 '*'p<0.05 '**'p<0.01 '***'p<0.001. Results without marker are not statistically significant.

The most important finding from this quantitative data and statistical analysis is that when accounting for various external factors, participation in EE programs has lasting and

tangible effects: it increases individuals' propensity to practice environmentally friendly behaviors in adulthood.

Interviews

When past AEC participants were initially contacted, they were provided the option to participate in a video interview to discuss their participation in AEC programs and their environmental behaviors. Eleven (11) interviews with different people were conducted. These lasted approximately 30-40 minutes, and were semi-structured. A list of guiding interview questions can be found in appendix B. All interviewees had participated in AEC programs: seven participated as children, youth, and senior leaders; two participated as children and youth; one participated only as a youth; and one participated only as a senior leader. This variety of involvement enabled the identification of learning patterns during different ages.

Childhood Involvement

When asked about childhood memories of participation in AEC programs, most people did not recall specific activities. Rather, they recalled being in nature, and the social aspect of camp participation, simply put, 'having fun'. Others described their childhood experiences at the AEC as 'fun', 'magical', 'running outdoors with friends', and 'having fun in the woods'. Most associated their positive experiences at camp with spending time in nature, and one person mentioned understanding a 'larger goal' of appreciating nature at a young age. One person discussed direct changes she experienced from childhood participation at the AEC. She recalled that upon going home from a week-long overnight camp she refused to kill mosquitoes, and completed all the environmental activities suggested in a booklet she brought home. This

suggests a gained appreciation for other organisms, and an increased interest in the natural environment. Other childhood memories of the AEC included climbing up a rock, being in a giant 'leaf' (under a tarp) and learning about photosynthesis, a pond study with buckets and magnifying glass, and stargazing. The memories recalled were overwhelmingly of learning in nature. It seemed that the memorable moments were not so much of understanding, but of awe and positive experiences in the natural environment.

Youth Involvement

Youth experiences in AEC programs yielded different types of learning. Mostly, interviewees recalled gaining a deeper understanding environmental concepts. One person recalled being a youth leader and playing 'bioaccumulation tag', an activity that illustrates mercury bioaccumulation in fish. He described it as a memorable learning moment where he understood the threat of bioaccumulation, and the mechanism by which it occurred. Another person recalled leading an activity called 'web of life', which interactively illustrates food chain fragility in ecosystems. He said that as a youth leader, the lesson 'clicked' in a way it had not when he was a camper. This same interviewee identified the moment in which he understood the threat of climate change: he watched 'Mindshift', a skit performed by other youth at the AEC. The skit depicts a team of scientists monitoring the rise of carbon dioxide levels in the earth's atmosphere and simultaneously witnessing the effects of climate change in a compressed timeframe. The interviewee said it was 'shocking' for a 14-year old and made him more passionate about environmental issues. Several other interviewees recalled specific activities that they led as youth leaders which caused them to understand environmental concepts at a deeper level than they did as children.

Although deeper learning occurred for most at the youth level of involvement, social interaction remained a key element in their involvement with the AEC. One participant said, "I went for friendship, stayed for nature, and continued because I actually started to care." For many, the social environment at the AEC provided a reprieve from stressful social situations they encountered in middle school, including bullying, and frequent use of cell phones and social media. One participant commented that "being in nature takes you out of some of the social constructs that we have to deal with in school, or in life." This idea that outdoor programming leads to a change in social expectations mirrors findings from other research in environmental education. (Ardoin, Bowers, Wyman Roth & Holthuis, 2018).

Youth participation in AEC programs may have a more direct influence on environmental behavior than childhood involvement, as several people discussed feeling empowered through leadership opportunities to make active changes in their lives. Eight out of the eleven interview participants said that they had felt empowered to take greater environmental action from leadership positions they had held at the AEC. One participant added that "It's not until you teach that you understand a lesson, and have the agency to change behavior in your own life." Another participant said that when acting in a leadership position at the AEC, there was a 'constant incentive to act sustainably' by role modeling sustainable behaviors. Opportunities for leadership at the AEC exist in the form of volunteering as a youth leader beginning at age 14, as well as membership in HEAT (Helping the Earth by Acting Together), a youth group that conducts clean-ups and other environmental activities. Other programs such as Mindshift and Cycle Savers allow youth to take on the role of educators. Not only were participants empowered to take environmental action, but several reported becoming more confident when it came to discussing sustainability with others. Youth involvement may also directly affect environmental

behaviors, as youth have more purchasing power and independence than children do. Interviewees said that when they became adults they were able to make more choices affecting the environment, and felt they had more power.

The AEC and Other Influences

When asked about factors influencing their views on sustainability, all remarked that the AEC had played a central role in their awareness and action towards the environment. Most interviewees also said their family played a part by fostering a connection to the outdoors through frequent hiking, biking, or walks in nature. Only two participants said that family had not been an influential factor, and spent little time outdoors. One participant cited media influence, saying that childhood TV shows showcasing nature influenced him to care about wildlife. All of these influences are rooted in exposure to nature. It follows that the AEC is a successful environmental education center, as its impact on children is mostly creating positive memories and experiences in nature from what is observed in these interviews. Furthermore, the attribution of influence to family reflects the findings from the statistical analysis that parental environmental attitudes are highly significant in predicting environmental behavior.

Personal Environmental Behavior

When discussing environmental action, most interviewees discussed the need for systemic change, and several mentioned the importance of electing government representatives who champion climate action. One person saw systemic change as the only attainable solution: "Ultimately, there's not going to be a whole lot I can do to change it unless there's somebody elected that does a little bit more." However, others said that personal action was also important

to promote sustainability. One said, “Every person’s actions matter. We are all just a collection of people,” and another remarked that “Work won’t happen if we collectively shrug responsibility.” Overall, most felt they had the ability to create environmental change through personal behaviors.

All of the interview participants reported taking personal action for the environment. Some actions named were: buying from local sources, buying products with less plastic packaging, planting trees, using reusable shopping bags, taking shorter showers, recycling, and lessening meat intake. Some people educated others to promote sustainability. All participants said they wished to do more for the environment.

When asked the question “do you find there are barriers to acting environmentally?” all interviewees replied affirmatively. The most common barriers mentioned were inconvenience and cost. Five people said that more harmful options were often more convenient. This is manifested through lack of accessible environmental options. One simple example mentioned was that when shopping for food at the grocery store, one person had to decide between produce with excessive plastic packaging, or imported produce with a high carbon footprint. He knew he could find a more eco-friendly option at the farmer’s market, however it would require a separate trip, and more time spent shopping. Three people mentioned a lack of public transportation, and choose to drive, which is more convenient than taking the bus due to time savings.

Five people said that cost was often prohibitive when attempting to engage in environmental behavior. This contrasts findings in regression 2, which show that having an income of $30,000 or less is associated with a decrease in EC score compared to having an income of $100,000 or more. This conflict in quantitative and qualitative data prompted an analysis of the individual behaviors in which people with an income of $30,000 or less had lower

environmental impact than people in all other income brackets. In the following section, 'group A' refers to people in households making $30,000 or less, and 'group B' refers to people who indicated a higher income bracket. Survey data analysis revealed that group A and group B had the greatest difference in behaviors the following behaviors contained the greatest difference between groups A and B:

1. Types of transportation used: The possible answers for this question were active transportation, public transportation, or personal vehicle e.g. car. The EC index shows that group A uses on average 39% more eco-friendly transportation options than group B. In this case, it costs less to choose the most environmental option, however it is likely that group A has less ability to pollute due to the lack of resources needed to purchase and maintain a personal vehicle, and not due to environmental concern. This group does not have the option to choose a more convenient mode of transportation.

2. Owning a television: On average, group A owned 27% less televisions than group B. This is another instance in which a positive environmental behavior (not owning a television) is not cost prohibitive. However, it is likely that group A makes this eco-friendly choice unwillingly due to lack of resources.

3. Fuel type of personal vehicle: Possible answers for this question included: no vehicle; gas; hybrid; diesel; electric. On average, group A used 26% more eco-friendly options than group B. This was not because group A used more hybrid or electric vehicles, rather they indicated 'no vehicle' more frequently than group B.

4. Time spend in a personal vehicle per day: An EC value was calculated for this behavior based on minutes spent in a personal vehicle per day. On average, group A spent 24% less time in a

personal vehicle than group B. Once again, this is likely because group A is spending less time in personal vehicles than group B, as previously indicated.

5. Amount of meat in diet: Participants were asked to rank their level of meat consumption on a scale of 0-3, with 0 indicating no meat consumption, and 3 indicating daily meat consumption. On average, group A reported 22% less meat consumption than group B. As with the behaviors above, it is unlikely this choice is fueled by environmental concern, and more likely that group A lacks the resources to buy as much meat as they might like to consume.

The cost barrier discussed by interviewees referred to not being able to buy an electric vehicle, or acquire other new technology that uses renewable energy. In contrast, the behaviors delineated above show that some environmental choices actually cost less money than environmentally harmful alternatives. Importantly however, it is not desirable to produce environmental behaviors through a lack of choice and limited resources. Others identified lack of power as a barrier to environmental decision-making, for example not being able to change the energy source of a rental space. Interestingly, some cited the behaviors of others around them as a barrier to acting environmentally. One person remarked that in social situations, she feels compelled to partake in unsustainable behavior, be that eating meat or not using sustainable transportation options. Another complained that his workplace has an unsustainable culture, in which disposable items are used and workers idle in their vehicles. In these two instances, individuals are making unsustainable choices when they have the option of making eco-friendly choices, and compel others around them to act similarly. These two examples provide a compelling argument for the importance of personal environmental action, by showing that personal behaviors can facilitate or discourage collective behaviors.

Influencing Others

If past AEC participants are able to influence the environmental attitudes of others, the impact of participation in childhood environmental education programs may be greater than previously thought. When asked, 'do you think you influence others to act sustainably?' some people answered confidently that they do influence others. One such participant noticed that his friends stopped littering around him after he voiced his opinion on the matter. Another participant said that he makes an effort to promote sustainability to friends by taking them to his favorite tree near his house. This participant is implementing a key tool used by the AEC: immersing others in nature to foster a connection.

Many said they attempt to influence others by initiating conversations about sustainability, as one person put it, "in a respectful way when the opportunity presents itself." One initiated conversation simply asking his friends if they had a separate trash receptacle for compost and recycling when visiting their house. Two people admitted they are wary of seeming obnoxious or judgmental, and stick to 'leading by example', and role modeling positive behavior rather than talking about sustainability. Five out of the eleven interviewees worked or volunteered in sustainability-related positions at the time of this interview, and have direct influence on the environment and environmental education in this way.

Based on these answers, it seems likely that past AEC participants have some degree of influence on others and non-participants, whether through direct work or volunteering, or by role-modeling positive environmental behavior.

Expanding Environmental Education

If environmental education is expanded and adopted in the future, appropriate venues and forms of learning must be identified to guide this development. As schools are the primary source of government-funded education for children and youth, they present a strategic and efficient location for EE implementation. When prompted to contemplate EE taking place in a school setting, four interviewees actually remembered experiencing some form of EE in grade school. One recalled a limited EE curriculum being taught in elementary school, and expressed the wish that the board of education would dedicate funding and integration to EE in the same way they are enjoyed by visual arts and music programs. Two interviewees partook in environmental leadership in their high schools, one saying the experience significantly contributed to their environmental attitudes and behaviors.

Another person experienced the integration of AEC programs into her high school experience. Her teacher provided the option that instead of writing an essay, students could volunteer to lead an AEC program, 'Mysterious Encounters', teaching fifth graders ecological concepts in nature. This is one template for how public schools can integrate EE into their curriculum, however it requires the support of an EE center (like the AEC) to provide programming and training for students.

I asked interviewees whether they thought EE as conducted by the AEC could be replicated in a school setting. Answers varied, but most concluded that it could be successful under some conditions. Two argued the 'right people' were needed to lead the program and act as sustainability role models. Four people said that the 'right space' was necessary: what does this entail? One explained that the AEC provided more figurative 'space' for his personal development than school did. This may be because the AEC uses different learning outcomes, as one person suggested, creating more opportunities for children and youth to 'succeed'. Another

person said that the AEC took them away from pressures in junior high school, and a similar education program could succeed if social pressures were somehow mitigated. Another interviewee posed a potential solution, saying EE should happen outside the physical classroom to prevent its implementation as 'just another class'.

The qualitative data obtained in these interviews served to identify key elements in the success of the AEC's EE model as experienced by interviewees. These included exposure to nature, a positive and inclusive social environment, and opportunities for youth leadership. Furthermore, interview findings aligned with quantitative data, suggesting that parents are an influential source of environmental attitudes and behaviors, and that participation in AEC programs was influential in determining participants' environmental behaviors.

Findings

With survey data, this study found that past AEC participants made more environmentally-friendly choices in twenty (20) out of thirty-two (32) individual behaviors compared to people who did not participate in AEC programs. These behaviors spanned from high-cost to low-cost, and affected various areas of sustainability including plastic pollution, energy consumption, and global warming. A multivariate regression analysis found that participation in AEC programs during childhood and youth was associated with an overall increase in environmentally-friendly behaviors in adulthood, when controlling for other influential factors, including income, education, age, and parent's environmental attitudes.

Quantitative findings also established a positive correlation between parents' environmental attitudes and children's environmental behaviors in adulthood, which contributes to and supports existing research on the positive correlation between parents' environmental

attitudes and children's environmental attitudes (Casaló & Escario, 2016) (Grønhøj & Thøgersen, 2009).

Furthermore, regression results align with existing research on the correlation between individual environmental behaviors and income level. This study found that having a household income of $30,000 or less is associated with an increase in positive environmental behaviors, a finding in line with research indicating that wealthier people are responsible for more carbon dioxide emissions (Santillán Vera & Vega Navarro, 2018) (Kleinhückelkotten & Moser, 2017) (Oxfam, 2015). This finding was particularly interesting, as interview data revealed that some people find cost a barrier to adopting sustainable behaviors.

Qualitative interview data generally supported quantitative findings, particularly the influence of parental and family environmental attitudes in determining environmental behavior, and the positive influence of AEC participation on environmental behaviors. Interviews also enabled the identification of key components in the AEC's learning model which encouraged the adoption of environmental behaviors for interviewees. These key components were: Exposure to nature, a positive social environment, and opportunities for youth leadership.

Limitations

One limitation of this research is that the sample of past AEC participants was not random. Due to lack of access to records, social networking and the snowball method were employed to contact past participants. This method of contacting participants carries potential bias as pre-existing contacts and snowball references likely had continued involvement in AEC programs, meaning the sample may over represent participants with prolonged exposure to AEC

programs. Data analysis attempted to compensate for this bias by using multivariate regression analysis with several demographic variables to capture and isolate the effect of possible shared characteristics.

Another limitation in this research was the lack of discernment in the survey between past AEC participation and past AEC leadership, or employment. Many AEC participants remained involved with the center throughout their lives, whereas some only participated in one program, rendering it difficult to assess simply the effect of participation. In the future, it would be advantageous to assess the effect of a variety of participatory experiences, measuring length of involvement, and involvement during childhood, youth, or adulthood.

Implications

The finding that exposure to an environmental education program in childhood is associated with environmentally sustainable behavior in adulthood has wide-ranging implications. Not only does this indicate that environmental education programs can change behavior, it reveals that these behavior changes persist long after exposure to the program. Furthermore, these changes in behavior are wide in scope, suggesting that the approach taken by the AEC towards environmental education encourages a holistic and applied sustainability approach. One of the most important implications of this research is that other EE programs have the potential to create similar change.

The environmentally sustainable choice-making identified in this study indicates willingness to adopt lifestyle changes in pursuit of a greater goal, signaling high adaptability and resilience. This willingness to adapt in pursuit of sustainability could translate to higher support

for government policies, and greater response to educational campaigns urging communities to undertake different climate change-mitigation strategies.

Another implication of this study is the potential for widespread behavior changes in societies, not only through individual advocacy and role modeling of sustainable behavior, but through generational learning. Previous research has shown that changes in children's environmental attitudes influence their parents, and that parents' environmental attitudes are strongly correlated with their children's environmental attitudes. Additionally, as demonstrated in this study, parents' environmental attitudes are significant predictors of children's environmental behaviors. Based on this evidence, the involvement of just one child in environmental education could cause the adoption of positive environmental attitudes, and perhaps even behaviors, in multiple generations. Furthermore, interview data suggested that EE may empower participants to advocate for sustainability, and that participants may even be able to influence the behavior of their social acquaintances. This widespread and multi-generational change in environmental consciousness is needed in order to create a cultural shift towards local, regional, and global environmental sustainability. Lastly, the collective pro-environmental behavior inspired by environmental education has the potential to generate cumulative environmental benefit, contributing to healthy communities, prosperous wildlife, and climate change mitigation.

Conclusion

If the Adventure Earth Centre can influence the adoption of long-term environmentally sustainable behaviors, other environmental education has the potential to do the same. Local governments should follow the example set by the city of Halifax by providing funding and

support to existing environmental education centers, integrating EE in public schools, and encouraging recreational centers to adopt EE programs and strategies such as those outlined in this study. Governments may even consider adopting environmental education as environmental policy, making it eligible for environmental policy funding. Not only will they produce empowered children and youth, but they will create adults who act to protect the environment, globally and in their community.

Appendix A

Survey Questions	
Question	Answer options
What types of transportation do you use in an average week?	Personal vehicle; Public transportation; Active transportation; Other
Which type of personal vehicle do you use most often?	Car; Truck; SUV; Minivan; Motorbike; Other; Not Applicable
What type of energy source does this personal vehicle use?	Gas; Electricity; Hybrid; Not Applicable
Estimate how much time you spend in a personal vehicle per day	Fill in
On average, how many occupants are in your personal vehicle	Fill in
What is your home's energy source?	Check all that apply: Grid/city; Renewable; Other
How long is your average shower?	Fill in
Do you turn the water off when applying shampoo/soap/conditioner?	Yes; No; Sometimes
How often do you take a bath?	Fill in
Do you hang-dry clothing?	Yes; No; Sometimes
Do you have a television?	Yes; No
Do you leave your TV on when not watching it?	Yes; No; Sometimes; Not applicable
Do you turn off lights when leaving a room?	Yes; No; Sometimes
How much meat do you eat on a scale of 0-3? (0 meaning no meat at all, 3 meaning meat every day or more than once a day)	Select a number from 0-3
How much beef/cow meat do you eat? (0 meaning no beef at all, 3 meaning beef every day or more than once a day)	Select a number from 0-3
Do you make an effort to buy locally grown food? (0 meaning no effort, 3 meaning high effort)	Select a number from 0-3
Do you make an effort to buy locally-made goods? (0 meaning no effort, 3 meaning high effort)	Select a number from 0-3
How much of your clothing and other goods are acquired second-hand? (E.g. Thrift shopping, upcycling, hand-me-down. 0 meaning none, 3 meaning almost all)	Select a number from 0-3
How often do you use reusable grocery bags instead of disposable plastic bags? (0 meaning never, 3 meaning always)	Select a number from 0-3
If you use menstrual products, how often do you use reusable products such as a menstrual cup, or reusable pads? (0 meaning never, 3 meaning always)	Select a number from 0-3
How often do you shop in bulk? (0 meaning never, 3 meaning always)	Select a number from 0-3
How many disposable coffee cups/beverage cups do you use in an average week?	Fill in
How many disposable plastic water bottles do you use in an average week?	Fill in

Which of the following products in your household are natural or biodegradable?	Check all that apply: Shampoo; Soap; Laundry detergent; Cleaning products.
Do you consciously try to buy produce that is locally in season?	Yes; No
Do you consciously try to buy products with less plastic packaging?	Yes; No
Do you recycle paper?	Yes; No
Do you recycle plastic/glass?	Yes; No
How likely is it that you will voice support for an environmental policy? (0 meaning not at all likely, 3 meaning extremely likely)	Select a number from 0-3
Do you think that your actions influence people around you to adopt more environmentally friendly behaviors? (0 meaning not at all, 3 meaning you are very influential)	Select a number from 0-3
How much does it influence your choice if a business uses sustainable practices? (E.g. Using local materials, biodegradable, using renewable energy, etc. 0 meaning no influence, 3 meaning high influence)	Select a number from 0-3
Have you ever been a participant in a program run by the Adventure Earth Centre in Halifax, N.S.? (This excludes being a leader)	Yes; No
What level of education have you completed?	Some high school; High school/GED; Certificate program; Community college; Some bachelor's degree; Bachelor's degree; Master's degree; PhD degree
How accessible and convenient is the public transportation in your area? (0 meaning not present, 3 meaning highly accessible/convenient)	Select a number from 0-3
What is your estimated household income?	$30,000 or less; $31,000-$70,000; $71,000-$100,000; $100,000 +; Not sure; Prefer not to say
How old are you?	Fill in
What is your gender?	Female; Male; Non-binary; Other; Prefer not to say
What are the environmental attitudes of your parents or older family members? (0 meaning no concern for the environment, and 3 meaning high concern for the environment)	Select a number from 0-3

Appendix B

Interview Questions
At what age(s) were you involved with camps run by the AEC? What type of camp was this?
Describe your memory of this program, and any particular program activities that stood out for you.
Do you recall any specific moment or experience within the program that affected how you thought of the environment and sustainability?
What significance does environmentalism and sustainability hold for you?
Do you incorporate environmentalism or sustainable practices into your everyday life?
If sustainability and the environment are important to you, do you feel optimistic that you can affect these in a positive way?
How would you describe the relation between your environmental attitudes and your actions?
Do you find there are barriers to acting environmentally? Would you wish to act more environmentally?
Do you have an emotional connection or response to environmental issues? Do these feel personal to you?
What factors do you think have contributed to your environmental awareness and behaviors?
Can you describe the environmental attitudes of the people you interact with the most?
Do you think the AEC had an impact on the way you interact with the environment? If so, what parts of the program do you think had the greatest impact on you?
If you find that you act environmentally, do you think you influence the behaviors of others around you in a positive way?
Do you think that participation in an AEC program caused you to pursue further environmental education?

Do you think programs such as those offered by the AEC could be implemented in a school setting?

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