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People with Different Educational Attainment in Washington, DC, USA have Differential Knowledge and Perceptions about Environmental Issues

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Abstract: We predicted that people's knowledge and perceptions about the interconnectedness of natural resources, climate change, economics, and socio-cultural well-being would differ among demographic groups in Washington, DC, USA, so we conducted surveys to test that prediction. We collected demographic data from 455 participants and asked them 26 questions/statements related to natural resources, climate change, economics, and health. We selected education as the focal demographic category and participants were categorized based on their level of educational attainment: (1) completion of high school or less (hereafter "high school"); (2) some trade school or university education beyond high school up to and including completion of a trade school, two-, or four-year degree (hereafter "post-high school"); and (3) completion of a Master's, professional, or doctoral degree (hereafter "advanced education"). Participants with advanced education reported the highest connection with nature and were more likely to report that their personal welfare depended on the natural community. Participants with the least education were more likely to believe that humans do not have much influence on natural resources and placed more trust in technology and human achievements to control nature and ensure that earth will not become unlivable. Participants with the least education were also more likely to express an interest in local environmental concerns over global, jobs over natural resources, and effects of degraded local natural resources on income, health, and the environment instead of on cultural/social practices, neighborhood aesthetics, and recreation.

Keywords: climate change; community survey; demographics; human health; natural resources

1. Introduction

Only 14% of the world's population lived in cities in 1900, but now over 50% live in cities and this percentage is expected to reach 66% by 2050 [1]. The United States of America (USA) has an even higher urban population than the world average: over 80% live in urban areas [2]. The urbanization of the human population is happening simultaneously with worsening local and global environmental problems, such as overexploitation and degradation of natural resources [3,4], population declines and extinctions of other species [5,6], and climate change [7]. These environmental problems are interrelated in often complex ways and have the potential to influence neighborhood aesthetics and a person's economic well-being, health, cultural and social practices, and recreation [8,9]. Whereas environmental knowledge does not necessarily lead people to take pro-environmental actions [10], tackling environmental, and related economic, social, and cultural, problems may be more challenging if the general public is under- or un-educated about environmental problems [11–13].

Cities can have a profound influence on natural resources and pollution within a region as well as globally, which in turn can negatively affect human well-being [14–16]. Therefore, effective solutions for sustainably using natural resources, curtailing climate change, and improving the lives of people must consider the role that cities can play [8,17,18]. Some city governments have been more proactive than others in addressing environmental problems and the well-being of the city's inhabitants. For example, London (UK) and Beijing (China) have made efforts to electrify transportation, including public buses and taxis, in order to improve air quality [19] and Portland, Oregon is considered one of the most advanced cities in the USA for climate planning because they have been conducting work on mitigation since the 1990s [20]. Characteristics of proactive cities include a political culture that embraces mitigation, local experts that engage with government agencies, and a general public that has an awareness of environmental problems and advocates that their political leaders act [20].

Washington, DC is the capital of the USA and its District government has plans for sustainability, improving air quality, adapting to climate change, reducing the government's carbon footprint, and protecting wildlife and watersheds [21,22]. The District government also commissioned a study on the linkage between urban heat islands and poor health [23]. These plans and studies may indicate that Washington, DC has the political culture of a proactive city because District government seeks to identify and mitigate environmental problems and the associated impacts on people. The 177 km^2 of the District is headquarters for federal agencies, 19 colleges and universities, several hundred environmental nonprofit organizations and charities, and numerous for-profit organizations. As employees of the only public university in the District, we can attest to the fact that local experts from diverse organizations engage with government agencies, which is another characteristic of a proactive city. However, little is known about whether the District possesses the third characteristic of a proactive city: a general public that has awareness of environmental problems and advocates that their political leaders act. Therefore, our goal was to assess environmental knowledge and perceptions of residents in the Washington, DC area.

Globally, environmental knowledge, an individual's perception of their environmental knowledge, and environmental action are often correlated with demographic characteristics, such as education, age, gender, and place of residence [24–28], and participation in group organizations [13]. Washington, DC has an extremely diverse population, there are large disparities among the population in education, employment, income, health, and overall well-being [29], and distribution of natural, manmade, and financial resources are unequal [22,30]. Washington, DC is divided into eight Wards, and people who live in eastern and eastern-central Wards typically have fewer resources, less education, higher unemployment, lower income, and a higher rate of poor health indicators, such as obesity, diabetes, heart disease, and a shorter lifespan, than those in western and western-central Wards [29]. The population is also largely African American in the east and becomes predominantly white in the west. We predicted that people's knowledge and perceptions about the interconnectedness of natural resources, climate change, economics, and socio-cultural well-being would differ among demographic groups throughout Washington, DC so we conducted surveys over three years to test that prediction. Understanding what people know and perceive is key to designing effective educational programs, engaging in collective conversations, and building effective partnerships that find solutions for environmental problems and benefit the community.

2. Materials and Methods

The survey included five demographic questions (i.e., age, education, ethnicity, gender, and place of primary residence), and 26 open-ended, closed-ended, and Likert scale questions/statements (hereafter "questions") to assess knowledge and perceptions of the participants (Tables 1–3). Some questions were duplicated or adapted from the connectedness-to-nature-scale [31]. We also included a question about whether the District government was spending the appropriate amount on health, workforce development, education, protecting natural resources, developing natural resources, law enforcement, and drug rehabilitation to see what people thought about spending for natural resources compared to

other priority areas (Table 3). We loaded the survey into the iSurvey app (Harvest Your Data, Wellington, New Zealand) and trained undergraduate students in our classes at the University of the District of Columbia to conduct face-to-face interviews during each fall semester from 2016-2018. We canvassed 11 neighborhoods in Washington, DC's eight Wards and solicited participants largely along sidewalks, but also at transit stations, businesses, libraries, and homes. Participants were the first ones encountered in an area, were adults ($\geq$ 18 years old), and were selected because of their presence in the area only and without regard to any demographic category. In total, 455 completed surveys were collected. A survey was considered complete once a participant was read the final question, but it was not mandatory for the participants to answer every question. Of the 455 surveys, 449 were completed in their entirety and the remaining six surveys each had a single demographic (N = 1), closed-ended (N = 1), or Likert scale (N = 4) question that was unanswered. The sampled group is relatively representative of the population in DC in terms of age (88% of the DC population is $\geq$ 18 years old; participant ages align well with the overall age distribution in DC) and gender (46% of participants were women compared to 52.6% of the DC population). There is some discrepancy between the surveyed population and the actual population in terms of race (71% of survey participants were African American or Black versus 46% of the DC population). The discrepancy in race resulted from an emphasis on conducting surveys in neighborhoods with residents that are historically underrepresented, overlooked, or excluded.

Some demographic variables were potentially correlated (e.g., people in some Wards were also likely from a certain ethnic group and educational background), so they were not all independent variables. Therefore, we ran preliminary analyses using separate χ^2 contingency tests to determine whether the responses to two questions differed according to age, education, ethnicity, gender, and place of primary residence. The responses were converted into percentages before analysis to account for unbalanced sample groups. We selected education as the focal demographic category because preliminary analyses found strong differences in response to the statement that "human activities have little influence on natural resources" ($p < 0.05$), whereas no strong differences in responses were found across other demographic variables ($p > 0.05$).

Participants were categorized into one of three groups based on their level of educational attainment: 1) completion of high school or less (hereafter "high school") (n = 177); 2) some trade school or university education beyond high school up to and including completion of a trade school, two-, or four-year degree (hereafter "post-high school") (219); and 3) completion of a Master's, professional, or doctoral degree (hereafter "advanced education") (n = 59). We did not further separate the educational groups based on other demographic structure (i.e., age, ethnicity, gender, and place of residence) because the sample size prohibited meaningful analyses.

There were four open-ended questions that probed participants' knowledge and perceptions of natural resources (Table 1). We coded answers to each open-ended question in order to reduce all responses to a limited number of categories. The percentages of participants selecting each response category were analyzed using χ^2 contingency tests to determine whether the responses differed among educational groups. Answers to the question "Can you describe what natural resources are?" were coded to fit into four categories: natural resources, creation, recycling, and none (Table 1). When the participant gave an example of a natural resource, such as air, water, trees, and land, this indicated that they understood what natural resources are and their response was coded as "natural resources." Participants' answers that included terms such as God or biblical phrases were coded as "creation." Answers that indicated reuse or recycling of materials for financial gain were coded as "recycling." Finally, responses that indicated that the participants were unable to answer the question were coded as "no." Answers to the questions "What do you consider to be the most important natural resource?" and "Which natural resources have been threatened the most in your neighborhood?" were coded to fit into eight categories: air, water, soil, trees, land, energy/fossil fuels, multiple resources, and other (Table 1). Participants' answers that included oil, fossil fuel, coal, and gas were coded as "energy/fossil fuels." Participants' answers that included more than one natural resource were coded as "multiple resources." The "other" category includes natural resources that were infrequently mentioned, such as

food, and resources that were not natural, such as education and transportation. Answers to the question "Can you describe what climate change is to you?" were coded to fit into four categories: weather patterns, human cause/reaction, climate change, and no. Participants' answers that included weather change, temperature change, hotter or colder weather, or similar statements were coded as "weather patterns." Participants' answers that voiced a human cause or invoked a human emotion, such as scary or fear, were coded as "human cause/reaction." Participants' answers that included climate change causes or effects (not including weather), such as global warming, carbon emissions, greenhouse gases, and sea level rise, were coded as "climate change." Finally, responses that indicated that the participants were unable to answer the question were coded as "no."

We also used separate χ^2 contingency tests to determine whether the percentage of responses to the other 22 questions differed among educational groups. Sample size was sometimes fewer than the total number of participants (N = 455) when a participant did not answer a question.

3. Results

Participants across the three educational groups answered 14 questions dissimilarly (see Tables 1 and 2 for data supporting the results in this paragraph). Over 84% of participants in the post-high school and advanced education groups were able to describe natural resources, whereas fewer than 67% of participants in the high school group were able to do so. Participants in the high school group were more likely to discuss recycling of materials for financial gain when asked to describe natural resources. Over 60% of all participants discussed weather patterns when asked to describe climate change, but those with advanced degrees or post-high school education also discussed other causes and effects of climate change, whereas a greater percentage of those in the high school group were unable to describe climate change. Over 80% of participants with advanced education somewhat or strongly agreed that they think of the natural world as a community to which they belong, but only slightly over half of the other participants agreed with this question. Similarly, those with advanced education were less likely to feel disconnected from nature than other participants. Whereas over 70% of those with advanced education somewhat or strongly disagreed that their personal welfare is not connected to the welfare of the natural world, fewer than 60% and 42% of participants in the post-high school and high school groups, respectively, felt similarly. A relatively low percentage of participants with an advanced (15.2%) or post-high school education (20.1%) somewhat or strongly agreed that human activities have little influence on natural resources, whereas 42.6% of participants in the high school group somewhat or strongly agreed with this question. Those with the lowest educational attainment were also most likely to somewhat or strongly agree that technological advances will ensure that we do not make the earth unlivable (48.6% of the high school group versus 28.8%-31.5% of other participants). Those with a post-high school or high school education were more likely to strongly agree that humans are severely abusing the environment than those with an advanced education, but 84.8% of those with an advanced education selected that they somewhat or strongly agreed with this question compared to 72.9%-80.4% of other participants. Participants in the high school group were more likely to somewhat or strongly agree that local environmental concerns are more important than global concerns (43% versus 23.7%-28.8% of participants with post-high school and advanced education). Participants with a post-high school or high school education were more likely than those with an advanced education to strongly agree that earth has plenty of natural resources if we just learn how to develop them. Those in the high school group were also more likely than other participants to strongly agree that humans will eventually learn enough about how nature works to be able to control it and to somewhat or strongly agree that there is too much worry about natural resources and not enough about jobs. Those with an advanced education were over twice as likely to be a member of a community organization or faith-based group than all other participants.

Table 1. Open-ended questions that assessed knowledge and perceptions of people of different educational attainment in Washington, DC, USA about the interconnectedness of natural resources, climate change, economics, and socio-cultural well-being.

Survey Question	Education (Sample Size)	Responses (%)								Statistics
Can you describe what natural resources are?		Natural resources	Creation	Recycling	No					$\chi^2 = 15.4$ df = 6 $p = 0.018$
	Advanced degree (59)	84.7	1.7	11.9	1.7					
	College/trade (219)	85.4	0.9	12.8	0.9					
	High school (177)	66.7	1.1	30.5	1.7					
What do you consider to be the most important natural resource?		Air	Water	Soil	Trees	Land	Energy /fossil fuels	Multiple resources	Other	$\chi^2 = 18.8$ df = 14 $p = 0.17$
	Advanced degree (59)	11.9	47.5	0	3.4	0	11.9	10.2	15.2	
	College/trade (219)	22.4	44.1	1.4	1.4	1.8	10.5	6.4	15.1	
	High school (177)	18.6	37.9	2.3	8.5	0	7.9	6.2	18.6	
Which natural resource has been threatened the most in your neighborhood?		Air	Water	Soil	Trees	Land	Energy /fossil fuels	Multiple resources	Other	$\chi^2 = 15.6$ df = 14 $p = 0.34$
	Advanced degree (59)	23.7	25.4	0	6.8	1.7	3.4	3.4	35.6	
	College/trade (219)	21.5	27.9	0	8.7	1.8	10.0	3.2	26.9	
	High school (177)	14.1	23.2	2.8	11.3	0.6	6.8	3.4	37.9	
Can you describe what climate change is to you?		Weather patterns	Human cause/ reaction	Climate change	No					$\chi^2 = 12.8$ df = 6 $p = 0.046$
	Advanced degree (59)	66.1	15.3	11.9	6.8					
	College/trade (219)	61.6	12.3	18.3	7.8					
	High school (177)	64.4	9.0	8.5	18.1					

Table 2. Closed-ended and Likert scale questions/statements that assessed knowledge and perceptions of people of different educational attainment in Washington, DC, USA about the interconnectedness of natural resources, climate change, economics, and socio-cultural well-being.

Survey Question/Statement	Education (Sample Size)	Responses (%)					Statistics
I have a strong knowledge of natural resources.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 11.2$ df = 8 $p = 0.19$
	Advanced degree (59)	1.7	16.9	30.5	28.8	22.0	
	College/trade (219)	2.3	14.2	37.9	26.0	19.6	
	High school (177)	9.6	16.9	34.5	22.0	16.9	
I think of the natural world as a community to which I belong.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 20.4$ df = 8 $p = 0.009$
	Advanced degree (59)	1.7	3.4	11.9	35.6	47.5	
	College/trade (219)	2.7	9.1	25.6	22.4	36.5	
	High school (177)	6.2	11.3	26.0	26.0	30.5	
I often feel disconnected from nature.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 25.7$ df = 8 $p = 0.001$
	Advanced degree (59)	35.6	32.2	10.2	22.0	0	
	College/trade (219)	25.1	26.9	23.3	14.6	10.0	
	High school (177)	26.6	24.9	15.8	16.4	16.4	
My personal welfare is not connected to the welfare of the natural world.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 30.0$ df = 8 $p < 0.001$
	Advanced degree (59)	52.5	18.6	16.9	6.8	5.1	
	College/trade (219)	32.4	27.4	21.5	12.3	6.4	
	High school (177)	23.2	18.6	22.0	21.5	14.7	
Human activities have little influence on natural resources.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 54.0$ df = 8 $p < 0.001$
	Advanced degree (59)	64.4	13.6	6.8	8.4	6.8	
	College/trade (219)	47.9	22.4	9.6	5.9	14.2	
	High school (176)	19.9	15.3	22.2	17.0	25.6	

Table 2. *Cont.*

Survey Question/Statement	Education (Sample Size)	Responses (%)					Statistics
Technological advances will ensure that we do not make the earth unlivable.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 19.8$ df = 8 $p = 0.01$
	Advanced degree (59)	15.3	27.1	28.8	25.4	3.4	
	College/trade (219)	17.4	20.5	30.6	17.8	13.7	
	High school (177)	15.8	11.9	23.7	31.1	17.5	
Humans are severely abusing the environment.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 17.0$ df = 8 $p = 0.03$
	Advanced degree (59)	6.8	1.7	6.8	40.7	44.1	
	College/trade (219)	2.3	6.8	10.5	25.1	55.3	
	High school (177)	6.8	7.3	13.0	20.9	52.0	
Local environmental concerns are more important than global environmental concerns.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 18.3$ df = 8 $p = 0.02$
	Advanced degree (59)	10.2	23.7	37.3	23.7	5.1	
	College/trade (219)	20.5	22.8	32.9	14.6	9.1	
	High school (177)	13.6	15.3	28.2	24.9	18.1	
The natural resources in your neighborhood cannot support more people.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 14.6$ df = 8 $p = 0.07$
	Advanced degree (59)	8.5	35.6	32.2	16.9	6.8	
	College/trade (219)	12.8	19.2	33.8	24.2	10.0	
	High school (177)	9.0	20.3	30.5	22.6	17.5	
The earth has plenty of natural resources if we just learn how to develop them.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 18.4$ df = 8 $p = 0.02$
	Advanced degree (58)	1.7	10.3	17.2	46.6	24.1	
	College/trade (218)	8.3	8.7	13.8	31.2	38.1	
	High school (176)	3.4	7.4	19.9	26.7	42.6	

Table 2. *Cont.*

Survey Question/Statement	Education (Sample Size)	Responses (%)					Statistics
Humans will eventually learn enough about how nature works to be able to control it.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 19.4$ df = 8 $p = 0.01$
	Advanced degree (59)	15.3	30.5	22.0	25.4	6.8	
	College/trade (219)	19.2	19.2	21.9	27.4	12.3	
	High school (177)	12.4	15.8	20.9	25.4	25.4	
If things continue on their present course, we will soon experience an environmental catastrophe.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 9.9$ df = 8 $p = 0.27$
	Advanced degree (59)	5.1	6.8	15.3	40.7	32.2	
	College/trade (219)	3.2	4.6	20.0	26.9	45.2	
	High school (177)	4.5	10.2	18.6	26.0	40.7	
There is too much worry about natural resources and not enough about jobs.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 49.4$ df = 8 $p < 0.001$
	Advanced degree (59)	18.6	47.5	23.7	6.8	3.4	
	College/trade (219)	17.8	20.5	35.2	11.9	14.6	
	High school (177)	14.7	16.9	21.5	20.9	26.0	
Natural resources in my neighborhood are plentiful.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	$\chi^2 = 14.3$ df = 8 $p = 0.07$
	Advanced degree (59)	10.2	28.8	35.6	22.0	3.4	
	College/trade (219)	16.0	30.6	33.3	14.6	5.5	
	High school (177)	15.3	22.0	27.1	21.5	14.1	

Table 2. *Cont.*

Survey Question/Statement	Education (Sample Size)	Responses (%)						Statistics
Climate change has a negative impact on natural resources in my neighborhood.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree		$\chi^2 = 4.7$ df = 8 $p = 0.79$
	Advanced degree (59)	3.4	13.6	23.7	35.6	23.7		
	College/trade (219)	4.6	9.1	31.5	27.9	26.9		
	High school (177)	4.5	15.3	24.9	28.2	27.1		
I understand that the natural environment impacts my individual health.		Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree		$\chi^2 = 8.5$ df = 8 $p = 0.38$
	Advanced degree (59)	3.4	6.8	13.6	25.4	50.8		
	College/trade (219)	1.8	1.8	10.5	28.8	57.1		
	High school (177)	4	8.5	17.5	23.2	46.9		
Degraded natural resources in my neighborhood have a negative impact on (select all that apply):		you or your family's income	you or your family's health	other parts of the local environment	your cultural or social practices	the aesthetics of the neighborhood	your recreation	$\chi^2 = 22.5$ df = 10 $p = 0.01$
	Advanced degree (59)	32.2	81.4	69.5	67.8	66.1	76.3	
	College/trade (219)	35.6	76.3	66.2	42.0	53.9	52.1	
	High school (177)	53.7	65.5	56.5	37.3	40.1	44.6	
Which people or groups do you think have the most responsibility for improving natural resources in your neighborhood?		Individuals	Community organizations	Businesses	Environmental groups	District government	Federal government	$\chi^2 = 17.3$ df = 10 $p = 0.07$
	Advanced degree (59)	35.6	5.1	16.9	15.3	13.6	13.6	
	College/trade (219)	36.1	5.0	9.1	7.3	15.5	26.9	
	High school (177)	35.6	6.2	5.1	9.0	13.6	30.5	

Table 2. *Cont.*

Survey Question/Statement	Education (Sample Size)	Responses (%)					Statistics
How often do you spend time doing outdoor activities?		Never	Very infrequently (once a week)	Occasionally (3 days a week)	Frequently (5 days a week)	Almost daily (>5 days a week)	$\chi^2 = 6.7$ df = 8 p = 0.57
	Advanced degree (59)	1.7	13.6	30.5	27.1	27.1	
	College/trade (219)	7.3	11.0	31.1	22.4	28.3	
	High school (177)	5.6	15.3	29.4	17.5	32.2	
Are you a member of a community or faith-based organizations in your neighborhood?		No	Yes				$\chi^2 = 35.6$ df = 2 p < 0.001
	Advanced degree (59)	33.9	66.1				
	College/trade (219)	67.1	32.9				
	High school (177)	72.3	27.7				
How often does your community or faith-based organization spend time doing outdoor activities?		Never	Very infrequently (once a week)	Occasionally (3 days a week)	Frequently (5 days a week)	Almost daily (>5 days a week)	$\chi^2 = 11.5$ df = 8 p = 0.17
	Advanced degree (38)	15.8	34.2	26.3	10.5	13.2	
	College/trade (72)	9.7	47.2	20.8	16.7	5.6	
	High school (49)	8.2	36.7	24.5	18.4	12.2	

Participants were asked whether degraded natural resources in their neighborhood had a negative impact on income, health, environment, cultural/social practices, neighborhood aesthetics, and recreation (see Table 2 for data supporting the results in this paragraph). More than two-thirds of participants with an advanced education selected that local degraded natural resources negatively impacted all of these except income. Income was selected by less than a third of participants with an advanced education. Those in the post-high school group felt less strongly than those in the advanced education group that degraded natural resources had an impact on these categories; however, more than half still thought that local degraded natural resources negatively impacted health, environment, neighborhood aesthetics, and recreation. Participants in the high school group felt less strongly than all other participants that local degraded natural resources impact these categories, except for income. More than half of these participants said that degraded natural resources negatively impacted income. Health and the environment were the other two categories where more than half of those in the high school group said that local degraded natural resources had a negative impact.

Participants across all educational groups answered 12 questions similarly (see Tables 1 and 2 for data supporting the results in this paragraph). All participants most frequently mentioned water as the most important natural resource and the one most threatened in their neighborhood, followed by air. Participants were more likely to agree that they had a strong knowledge of natural resources than disagree, but the most common answer was "neutral." Participants frequently selected "neutral" to the statement that natural resources in their neighborhood cannot support more people, with participants with advanced education somewhat disagreeing with this statement and all others somewhat agreeing. Participants also selected "neutral" most frequently to the statement that natural resources in their neighborhood are plentiful. Over 66% of participants somewhat or strongly agreed that if things continue on their present course, we will soon experience an environmental catastrophe, over 55% somewhat or strongly agreed that climate change negatively impacts natural resources in their neighborhood, and over 70% somewhat or strongly agreed that they understand that the natural environment impacts their health. Over one-third of participants thought individuals had the most responsibility to improve natural resources, followed by government entities (federal or district government). Businesses, environmental groups, and community organizations were less frequently selected. Approximately half the participants reported spending time outdoors frequently (5 days per week) or almost daily, although those that belong to a faith-based or community organization said their organization was outdoors infrequently (once per week).

Participants were also in agreement about spending by Washington, DC's government and most frequently thought the government was spending "too little" on each of the seven priority areas (Table 3). All participants were especially likely to say that District government spends too little on education (>60% of participants). Those in the high school group were also especially likely to say that too little was spent on health (62.1% of participants). Over 54% of all participants thought District government spent too little on protecting natural resources and over 46% thought too little was spent on developing natural resources. Law enforcement was the priority area for which participants were least likely to say that spending was too little.

Table 3. Responses of people of different educational attainment in Washington, DC, USA when asked "For each of the following categories, answer whether you think the District government is spending too little, about the right amount, too much, undecided.".

Category	Education (Sample Size)	Responses (%)				
		Too Little	About the Right Amount	Too much	Undecided	Statistics
Health	Advanced degree (59)	54.2	30.5	5.1	10.2	$\chi^2 = 2.6$
	College/trade (219)	58.9	26.5	2.7	11.9	df = 6
	High school (177)	62.1	26.5	2.7	11.9	$p = 0.85$
Workforce development	Advanced degree (59)	49.2	33.9	5.1	11.9	$\chi^2 = 1.7$
	College/trade (219)	52.5	34.2	3.7	9.6	df = 6
	High school (177)	54.2	28.8	6.2	10.7	$p = 0.95$
Education	Advanced degree (59)	69.5	22.0	1.7	6.8	$\chi^2 = 3.3$
	College/trade (219)	64.4	26.0	1.8	7.8	df = 6
	High school (177)	61.6	27.7	4.5	6.2	$p = 0.78$
Protecting natural resources	Advanced degree (59)	57.6	25.4	0	16.9	$\chi^2 = 6.5$
	College/trade (219)	58.4	23.3	4.1	14.2	df = 6
	High school (177)	54.2	26.0	6.2	13.6	$p = 0.37$
Developing natural resources	Advanced degree (59)	57.6	27.1	1.7	13.6	$\chi^2 = 9.3$
	College/trade (219)	55.7	22.4	5.0	16.9	df = 6
	High school (177)	46.9	26.6	10.7	15.8	$p = 0.16$
Law enforcement	Advanced degree (59)	28.8	30.5	23.7	16.9	$\chi^2 = 6.7$
	College/trade (219)	30.6	26.5	32.9	10.0	df = 6
	High school (177)	32.8	25.4	33.9	7.9	$p = 0.35$
Drug rehabilitation	Advanced degree (59)	52.5	25.4	5.1	16.9	$\chi^2 = 3.1$
	College/trade (219)	55.7	20.1	6.8	17.4	df = 6
	High school (177)	55.4	22.6	9.6	12.4	$p = 0.79$

4. Discussion

People in Washington, DC had some similar knowledge and perceptions about the interconnectedness of natural resources, climate change, economics, and socio-cultural well-being. Whereas survey participants did not report having a strong knowledge about natural resources, most were able to define natural resources, listed water and air as the natural resources that they were most concerned about, indicated that the natural environment affects health, and reported that climate change negatively impacts natural resources. What created similar knowledge and perceptions among participants is unknown, but could be due to shared experiences, such as lived experiences and exposure to these issues through education and the media, and/or shared values. In fact, nationally in the USA there has been an increased awareness and concern about at least one major environmental issue: climate change [32]. A national survey about climate change found that people are increasingly discussing it with family and friends, regularly exposed to it in the media, and reporting that they feel the effects of climate change and are harmed by them [32]. The participants in the national survey also expressed worry about extreme weather events, especially those pertaining to water, such as flooding, drought, and shortages [32]. Some of the similarities among participants in our survey in Washington, DC may be part of the shifting attitudes and knowledge happening on a national scale. Additionally, the "biospheric (concern for environment)" and "altruistic (concern for others and intrinsic value)" value orientations influence responses to environmental issues and climate change [33], so the people in Washington, DC may have similar values.

Despite some similarities among survey participants, people's knowledge and perceptions about the interconnectedness of natural resources, climate change, economics, and socio-cultural well-being largely differed among groups of people with different educational attainment. Whereas most participants could describe natural resources, a large percentage of those in the high school group could not. People with an advanced education showed a greater understanding of climate change and its impacts, which is consistent with a global survey that found that educational attainment was the strongest predictor of awareness about climate change [34] and regional studies that found that educational attainment was a strong predictor of pro-environmental attitudes [35], environmental worldview, and global environmental knowledge [36]. Those with an advanced degree were also most likely to report that their personal welfare depends on the natural community and reported the highest connection with the natural community. Connection to nature is often correlated with time spent outdoors [37], but we found that time spent outdoors was similar across educational groups. We speculate that the type of activities engaged in outdoors or the type of outdoor environment [38,39] are more likely to result in a greater feeling of connectedness-to-nature than the amount of time. We base this speculation on the fact that those with an advanced degree were most likely to report that degraded natural resources impacted their recreation, which may indicate that outdoor activities are more commonly recreational with this educational group compared to other groups. In fact, previous research has shown that people from households with higher educational attainment visited aquatic ecosystems and valued the diversity of ecosystem services, such as recreational and aesthetic, provided by these ecosystems more than people from households with lower educational attainment [40,41]. Furthermore, wealthier neighborhoods, in which residents are also likely to have higher educational attainment on average, are more likely to have fewer environmental hazards [38] and higher levels of green infrastructure such as tree canopy [42], which may lead to residents more frequently using their local environment for recreation than those that are subjected to degraded environments [39].

People in the high school group were most likely to believe that humans do not have much influence on natural resources and placed more trust in technology and human achievements to control nature and ensure that earth will not become unlivable; beliefs that are not uncommon [43], but likely incorrect without concurrent changes to population growth and resource exploitation [44]. Compared to those with education beyond high school, those with a high school education were also most likely to express an interest in local environmental concerns over global, jobs over natural resources, and effects of degraded local natural resources on income, health, and the environment

instead of on cultural/social practices, neighborhood aesthetics, and recreation. Education is correlated with employment and income, with unemployment declining and income increasing with educational attainment [45], which may explain why those with no education beyond high school are more concerned about the local environment and its impact on jobs, income, and health. Vulnerable and marginalized people, such as those who are undereducated, poor, in a minority racial or ethnic group, and/or an immigrant are also disproportionately afflicted by climate change, a degraded environment, and environmental hazards [46–49], so they may be more acutely aware of the local environment and its effects on prosperity and well-being. Prior research also demonstrated that people with lower educational attainment and socio-economic status may simply be less aware or appreciative of the diversity of ecosystem services, with awareness primarily centered on economic and provisioning services [40,50] and less so on regulating and cultural services [50,51].

People afflicted by poor ecosystem health and degradation of natural resources need educational opportunities, tools of empowerment to change their circumstances, and employment that affords them to the choice to relocate or adapt. Results from the survey suggest topics that could be emphasized through formal educational classes, cooperative extension programs, traditional media, social media, and other platforms to increase knowledge about environmental issues and their interrelationship with economics and socio-cultural well-being. For example, understanding of natural resources is lower than climate change among all survey participants and fewer than half the participants reported having a strong knowledge of natural resources, so natural resources could be emphasized. Understanding of environmental issues, the influence of people on natural resources, and the connection between the natural world and their personal welfare is lower in people who have not had schooling beyond high school. Since as many as one-quarter of students graduating from high school in the USA are completing a science curriculum that is below standard [52], the deficiencies in knowledge may stem, in part, from lack of exposure in primary and secondary school. The deficiencies could be addressed by providing opportunities for education. However, we found that some environmental knowledge was relatively high even among the less educated group, which is consistent with previous studies that show high awareness of environmental risks and support for environmental protections regardless of education and across racial groups [53–56].

Beyond education that creates awareness of environmental issues, people from diverse groups must be given tools of empowerment that enable them to change their circumstances and demonstrate pro-environmental actions, such as advocating for environmental policies. One way in which to empower people is to recruit them into active roles in group organizations. Globally, environmental knowledge and action are often correlated with participation in group organizations [13] and participants in our study with an advanced degree generally had high environmental knowledge and reported higher involvement in community or faith-based organizations. Ensuring that people with lower educational attainment have equal opportunities to participate in group organizations may help close the gap in environmental knowledge, provide a tool of empowerment to change their circumstances and take pro-environmental actions. Mainstream environmental organizations have a low percentage of non-white minorities on their staff [57] and the term "environmentalist" is associated with well-educated and white people by minorities and whites alike [56], so structural and psychological barriers currently prevent diverse participation and representation. For example, marginalization of African American environmental thought during enslavement, sharecropping, and the Civil Rights era makes the provision of tools and inclusion of these voices critical to empowerment [58–61].

Our results suggest that those wishing to lead collective conversations and build effective partnerships that find solutions for environmental problems need to take the demographics of their stakeholders into account. Stakeholders with advanced degrees may be likely to think and act more globally and show more of an interest in curtailing environmental problems that have a negative impact on their recreation, neighborhood aesthetics, and cultural/social practices. However, engaging stakeholders with a high school education means focusing on local concerns and issues that have a more immediate impact on their jobs and income. People with lower incomes will more likely want to

discuss mitigation and adaptation measures in their neighborhoods, such as improved emergency alerts, access to government subsidies for air conditioners and energy-efficient appliances, stronger buildings that withstand extreme weather, and more local agriculture and community gardens [62]. Building a coalition to address environmental problems at the local level can have positive results, even with problems considered more global in scope, such as climate change [63]. This is especially true if educational programs focus on the most effective individual actions [64] and change attitudes so the participants become more pro-environment [65]. The negative impacts of a degraded environment on health and the environment, especially air and water, are common concerns that would likely be of interest to most of the population in Washington, DC, regardless of their educational attainment. So, for example, increasing awareness among the population in Washington, DC that environmental degradation promotes poor air quality, which exacerbates chronic illnesses, may prompt people to want to more thoroughly understand natural resources and climate change. The survey participants indicated that individuals, followed by government entities, have the greatest responsibility to improve local natural resources. Therefore, people should be empowered to engage in the process of improving a degraded environment and taught how to advocate for changes within the government.

This study does suffer from some limitations, namely that it focuses on a relatively small sample of people from one geographic area and African Americans or Blacks are overrepresented when compared with the total population in the District. However, we chose this population, in part, because it is in the capital city of the United States, has not been surveyed previously, and can strongly influence District and national politics and environmental initiatives. Over half the population of the District until very recently identified as African American or Black and this racial group is still the largest within the District. As we previously discussed, people from minority groups have traditionally been marginalized in the USA and elsewhere. The demographics of our participants were somewhat biased toward this group to ensure that we captured their knowledge and perceptions. Whereas this may not be entirely representative of the overall population within the District, multiple states and many cities within the USA are majority African American or another ethnic minority group. If current trends in birthrates and immigration, the minority population within the United States will continue to increase and will be the majority by 2041-2046 [66].

In conclusion, an emphasis by people with lower educational attainment on local versus global environmental issues is a novel finding that deserves to be studied in other contexts to see if the results are more broadly applicable. Future work that would build upon our findings and validate our work includes conducting surveys across a broad geographic area. This should include urban and rural areas, areas with a homogenous population versus a diverse population, and areas with a majority-minority population versus predominantly white. This would help ascertain whether our main result that educational attainment is linked to a local versus global environmental emphasis holds or whether the results are also influenced by geography and race.

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