Walker Strauss
PSYCH 4700: Independent Study
December 13, 2023

Comparing the Effects of Forms of Environmental Education on Environmental Attitudes

Abstract

This study focuses on the effects of visual, graphical, and textual education on environmental attitudes of undergraduate students at Cornell University. The survey population consisted of one hundred and forty undergraduate students and three surveys were developed as an instrument for data collection. This paper reviews past research on the subject and suggests further research that should be done. Descriptive statistics, T tests and ANOVA were used for data analysis. The conclusion supported the idea that these interventions had a significant effect on environmental attitudes but did not support the idea that any one intervention is significantly more effective than the others.

Introduction

Environmental attitudes are the subject of much research, especially since the US environmental movement of the 1960s and 1970s (Dunlap, 20). Environmental education has also been the subject of many studies on environmental attitudes because it seeks to change the learner's attitudes toward the environment. It is especially important in present day society, where the urban landscape that many inhabit is separated from the natural world. Environmental education comes in many forms, including visual, graphical, and textual forms of teaching. Visual environmental education can be understood as environmental education that utilizes visual information or other visual interventions. This could be a painting, photograph, view of nature, or any other form of visual stimulation. Textual environmental education is environmental education that uses strictly textual information. This refers to books, articles, and other text that is meant to educate individuals about the environment. Graphical environmental education refers to a combination of the two and is a common form of environmental education. Graphs are used in many publications to provide a visual representation of information about the environment. However, little is known about differences in visual or infographic versus textual forms of environmental education (Lazard and Atkinson, 8). This study seeks to compare the effectiveness of these three forms of environmental education in

promoting pro-environmental attitudes in an effort to find the most effective form of environmental education. I hypothesize that visual environmental education will have the most dramatic effect on environmental attitudes, since visual stimuli often generate more emotions in individuals. I also hypothesize that graphical environmental education will have the second most dramatic effect on environmental attitudes, and that textual forms of education will be the least effective in increasing pro-environmental attitudes.

Literature Review

Many studies have examined the effects of visual, textual, and graphical environmental education on environmental attitudes. These studies have found varying results, with some finding a significant effect of one or more of these forms of education on environmental attitudes or behaviors.

One study found a significant effect of awe-eliciting stimuli like “extraordinary, panoramic views of nature” on two constructs that have been linked to pro-environmental attitudes (Ambrose et al, 6). The first construct, Inclusion of Nature in the Self (INS), is defined as the amount that people incorporate nature into their self-concept. The second, Nature Self-Size (NSS), is an individual’s perception of their size relative to nature. The study found that awe-eliciting views increases these constructs, and that environmental attitudes were linked to both (Ambrose et al, 7).

Another study on online shoppers in Taiwan found that the introduction of both infographics and green messages were correlated with an increase in environmental attitudes (Tu and Wang, 12). They developed a survey to measure environmental attitudes and demonstrated that the type of environmental message matters. They also found that graphical messages are more effective in increasing environmental attitudes than text-only messages (Tu and Wang, 16).

Additionally, many scales have been developed to measure environmental attitudes. Some of these scales also include measures of environmental behavior, while other focus solely on attitudes about the environment. The scale used in the study is the New Ecological Paradigm (NEP) scale. This scale is a reliable measure of a worldview that includes support of

environmental issues and is strongly correlated with perceived seriousness of ecological problems (Dunlap et al, 436). Importantly, the NEP scale does not measure environmental behavior, but attitudes about the environment. It is a likert scale with fifteen questions, seven of which are reverse coded. The NEP is commonly used in before-and-after studies that measure change in environmental attitudes after some form of intervention, including educational (Anderson, 261). The questions can be found in Appendix 1.

Methods

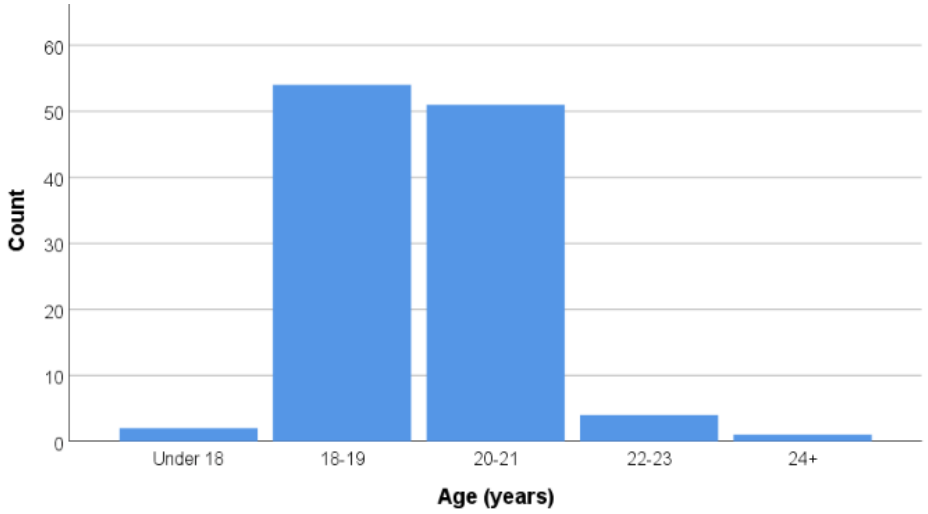
In this study, three quantitative surveys were developed to gather data on undergraduate students at Cornell University. The surveys included Likert scale questions from the NEP (New Ecological Paradigm) Scale, which was developed to measure pro-environmental attitudes. In the surveys, I administered the first seven questions of the NEP scale, exposed subjects to either visual, graphical, or textual forms of environmental education, and then administered the remaining questions of the NEP scale. The pictures, graphs, and text that were used in the survey are included in Appendix 2. For the visual and graphical groups, 3 out of 5 images were randomly presented to participants. For the textual group, 2 out of 5 blocks of text were randomly presented to participants. In both cases, JavaScript was added to ensure that participants could not skip viewing the images, graph, or text. Demographics were collected at the end of the surveys. Qualtrics was used to develop the surveys and they were all posted on SONA. The dependent variable in this study was environmental attitudes and the independent variable was type of environmental education (visual, graphical, or textual). After closing the surveys, the data was exported to Excel for data cleaning and imported into SPSS for data analysis. My hypothesis for the data is that visual environmental education will be significantly more effective than graphical and textual environmental education in promoting pro-environmental attitudes.

Results

In total my surveys received 172 responses, 141 of which I kept after cleaning my data. The visual survey received 57 responses, 46 of which I kept after cleaning my data. The graphical

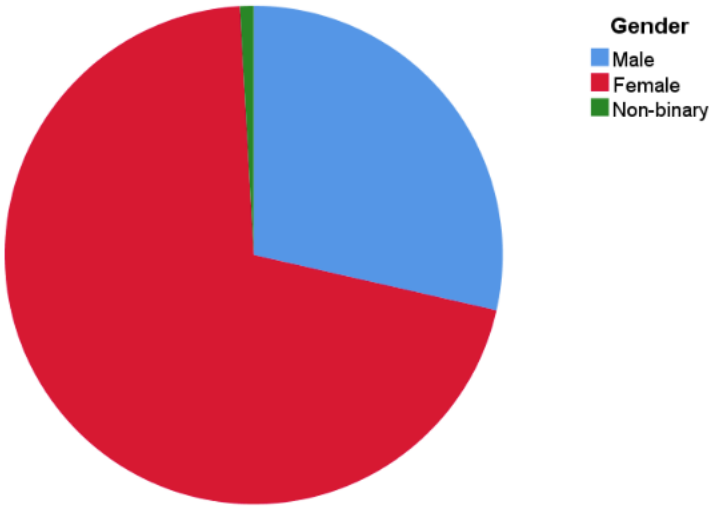
survey received 73 responses, 61 of which I kept after cleaning my data. The textual survey received 42 responses 31 of which I kept after cleaning my data. I also combined the data into one dataset for factor analysis. Visualizations or frequencies were performed for the demographics variables, age, gender, and race/ethnicity.

Graph 1: Simple Bar Count of Age



There were 2 participants under 18, 54 who were 18-19, 51 who were 20-21, 4 who were 22-23, and 1 who was over 24.

Graph 2: Pie Chart Count of Gender



There were 32 male and 79 female respondents, and one non-binary respondent.

Table 1: Frequencies for Race/Ethnicity (Case Summary)

	Valid		Missing		Total	
	N	%	N	%	N	%
Race/Ethnicity	112	79.4	28	20.6	140	100

Table 2: Frequencies for Race/Ethnicity (Frequencies)

	N	%
White or Caucasian	64	51.2
Black or African American	2	1.6
American Indian/Native American or Alaska Native	5	4.0
Asian	39	31.2
Native Hawaiian or Other Pacific Islander	1	0.8
Other	13	10.4
Prefer not to say	1	0.8

As mentioned previously, a glitch in the graphical survey resulting in the loss of some demographic data. The respondents whose demographic data we do have were 51.2% White or Caucasian, 1.6% Black or African American, 4.0% American Indian/Native American or Alaska Native, 31.2% Asian, 0.8% Native Hawaiian or Other Pacific Islander, 10.4% other, and 0.8% preferred not to say.

After importing my data into SPSS and observing demographics, I constructed new variables for descriptive statistics and analysis. The first, FirstHalfAvgNEP, was constructed by taking the average of scores on questions in the first half of the NEP scale. The second, SecondHalfAvgNEP, was constructed by taking an average of scores on questions in the second half of the NEP scale. The third, Difference1and2NEP, was constructed by subtracting FirstHalfAvgNEP from SecondHalfAvgNEP. A positive Difference1and2NEP score indicates an increase in average score between the first and second half of the NEP scale. The likert scale questions were one to five and there were fifteen questions so the lowest possible total score would be 15 and the highest possible total score would be 75. The descriptive statistics are reported below.

Table 3: Descriptive Statistics for the Visual Survey

	N	Minimum	Maximum	Mean	Std. Dev.
Total Score	46	47.0	75.0	61.5	6.29
1st Half Avg	46	1.29	3.14	2.27	.399
2nd Half Avg	46	1.75	3.63	2.80	.408
Difference1and2NEP	46	-0.38	1.82	.526	.442

The participants in the visual survey had an average of 2.27 for the average score of questions in the first half of the NEP scale and an average score of 2.80 on the questions in the second half of the NEP scale. The average of Difference1and2NEP for the visual group was .526.

Table 4: Descriptive Statistics for the Graphical Survey

	N	Minimum	Maximum	Mean	Std. Dev.
Total Score	63	48.0	75.0	62.9	6.14
1st Half Avg	63	1.14	3.43	2.28	.391
2nd Half Avg	63	1.63	3.75	2.87	.333
Difference1and2NEP	63	-0.80	2.32	.582	.448

The participants in the graphical survey had an average of 2.28 for the average score of questions in the first half of the NEP scale and an average score of 2.87 on the questions in the second half of the NEP scale. The average of Difference1and2NEP for the graphical group was .582.

Table 5: Descriptive Statistics for the Textual Survey

	N	Minimum	Maximum	Mean	Std. Dev.
Total Score	31	35.0	75.0	62.7	8.60
1st Half Avg	31	1.00	3.43	2.38	.464
2nd Half Avg	31	2.13	3.50	2.90	.330
Difference1and2NEP	31	-0.87	2.38	.521	.568

The participants in the textual survey had an average of 2.38 for the average score of questions in the first half of the NEP scale and an average score of 2.90 on the questions in the second half of the NEP scale. The average Difference1and2NEP for the textual group was .568.

Table 6: Descriptive Statistics for All Surveys

	N	Minimum	Maximum	Mean	Std. Dev.
Total Score	140	35.0	75.0	62.4	6.78
1st Half Avg	140	1.00	3.43	2.30	.410
2nd Half Avg	140	1.63	3.75	2.85	.359
Difference1and2NEP	140	-0.87	2.38	.550	.473

For participants in all surveys, the mean average score on the questions in the first half of the NEP scale was 2.30 and the mean average score on the questions in the second half of the NEP scale was 2.85. The average Difference1and2NEP for all participants was .550.

Analysis

My first step of data analysis was to see if the exposures had a significant effect on NEP score. I used paired samples t tests to analyze this effect, where the pair was 1st half average and 2nd half average. The results of the t tests are reported below.

Table 7: T Test for Visual Group

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Dev	Std. Err. Mean	Lower	Upper	t	df	Sig. (two-tailed)
Pair: 1st avg 2nd avg	.526	.442	.065	.340	.658	8.08	45	.000

For the visual survey the paired samples test found a significant effect of visual environmental education on average score for half of NEP scale with a t statistic of 8.08 at a significance level of .000

Table 8: T Test for Graphical Group

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Dev	Std. Err. Mean	Lower	Upper	t	df	Sig. (two-tailed)
Pair: 1st avg 2nd avg	.582	.448	.056	.469	.694	10.3	62	.000

For the graphical survey the paired samples test found a significant effect of graphical environmental education on average score for half of NEP scale with a t statistic of 10.3 at a significance level of .000.

Table 9: T test for Textual Group

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Dev	Std. Err. Mean	Lower	Upper	t	df	Sig. (two-tailed)
Pair: 1st avg 2nd avg	.521	.568	.102	.312	.729	5.10	30	.000

For the textual survey the paired samples test found a significant effect of textual environmental education on average score for half of NEP scale with a t statistic of 5.10 at a significance level of .000.

After finding a significant effect of all my exposures on average score for half of NEP scale, I used one-way ANOVA to compare the effects of the different forms of environmental education on difference of average score on first and second half of NEP scale. The results of the ANOVA are reported below.

Table 10: ANOVA of Difference1and2NEP Between Surveys

	Sum of squares	df	Mean square	F	Sig.
Between Groups	.115	2	.058	.255	.775
Within Groups	30.9	137	.226		
Total	31.0	139			

The one-way ANOVA revealed that there was not a statistically significant difference in Difference1and2NEP between at least two groups (F (2, 137) = .255, p = .775). This suggests there was not one form of environmental education that was significantly more effective than the others. However, to confirm this, I performed independent samples t tests between the groups. The group statistics of Difference1and2NEP and the results of the t tests performed are reported below.

Table 11: Group Statistics for Difference1and2NEP

Type of Survey	N	Mean	Std. Deviation	Std. Error Mean
Visual	46	.526	.442	.065
Graphical	63	.582	.448	.056
Textual	31	.520	.568	.102

As previously stated, the average Difference1and2NEP was .526, .582 and .520 for the visual, graphical, and textual groups respectively. The standard deviation of Difference1and2NEP was .442, .448, .568 for the visual, graphical, and textual groups respectively. The standard error of the mean was .065, .056, and .102 for the visual, graphical, and textual groups respectively.

Table 12: Independent Samples T Test for Visual and Graphical Surveys (Difference1and2NEP)

	Levene's Test for Equality of Variances		T-Test for Equality of Means				95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed	Mean Dif.	Std. Error Dif.	Lower	Upper
Equal variances assumed	.073	.787	-.639	107	.524	-.055	.086	-.226	.116
Equal variances not assumed			-.641	98	.523	-.055	.086	-.277	.116

The independent samples t-test for visual and graphical survey Difference1and2NEP revealed that there was not a significant difference in Difference1and2NEP for the visual and graphical group (t(107) = -.639, p = .524). This suggests that although both visual and graphical exposure had a significant effect on score on half of the NEP scale, there was not a significant difference between their effect on the difference of average scores in the first and second half of the NEP.

Table 13: Independent Samples T Test for Visual and Textual Surveys (Difference1and2NEP)

	Levene's Test for Equality of Variances		T-Test for Equality of Means				95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed	Mean Dif.	Std. Error Dif.	Lower	Upper
Equal variances assumed	.372	.544	.049	75	.961	-.006	.115	-.224	.235
Equal variances not assumed			.047	53	.963	-.006	.121	-.237	.249

The independent samples t-test for visual and textual survey Difference1and2NEP revealed that there was not a significant difference in Difference1and2NEP for the visual and textual group (t(75) = -.049, p = .961). This suggests that although both visual and textual exposure had a significant effect on score on half of the NEP scale, there was not a significant difference between their effect on the difference of average scores in the first and second half of the NEP.

Table 14: Independent Samples T Test for Graphical and Textual Surveys (Difference1and2NEP)

	Levene's Test for Equality of Variances		T-Test for Equality of Means				95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed	Mean Dif.	Std. Error Dif.	Lower	Upper
Equal variances assumed	.702	.404	.566	92	.572	-.060	.108	-.153	.275
Equal variances not assumed			.522	48	.604	-.060	.117	-.174	.295

The independent samples t-test for graphical and textual survey Difference1and2NEP revealed that there was not a significant difference in Difference1and2NEP for the graphical and textual group (t(92) = -.566, p = .572). This suggests that although both graphical and textual exposure had a significant effect on score on half of the NEP scale, there was not a significant difference between their effect on the difference of average scores in the first and second half of the NEP.

Discussion

The purpose of the study was to observe if there was a significant difference in effect between visual, graphical, and textual forms of environmental education on environmental attitudes. The data analysis performed did not allow me to confirm my hypothesis that visual environmental education would be significantly more effective than other forms of environmental education on environmental attitudes as measured by the NEP scale. This is because the ANOVA in Table 10 did not find a significant result, and the related independent samples t tests also did not find a significant effect. However, t-tests reported in Table 7, 8 and 9 found a significant effect on average score on half of the NEP scale for all the forms of environmental education. This means that that all these forms of environmental education have a significant effect on environmental attitudes as measured by half of the NEP scale, but that none of these forms was significantly more effective than the others. Overall, this study

revealed that all forms of environmental education used are effective in increasing environmental attitudes as measured by half of the NEP scale.

Conclusion

Importantly, the number of respondents used in this study is limited when compared to previous studies that had many more participants, which may have led to the inability to confirm my hypothesis. Additionally, the participants were all undergraduate students at Cornell University, which might have led to trends in environmental attitudes that were unrelated to the type of environmental education included in the survey taken. Moreover, some data was removed because survey respondents failed to answer the check question or complete the survey in its entirety. Removing these data could have affected the results of data analysis, since they were not accounted for in the data used for analysis. Lastly, an assumption is made in my study that the first seven questions of the NEP scale measure the same construct as the last eight questions of the NEP scale. However, even with these limitations my study adds to a general understanding of the topic because a significant effect of visual, graphical, and textual forms of environmental education on environmental attitudes was found. In terms of the final results of the study, this study did not find a significant difference when comparing the effects of these forms of environmental education on difference of average score on the first and second half of the NEP.

Works Cited

Dunlap, Riley E. “A brief history of sociological research on environmental concern.” Green European: Environmental behavior and attitudes in Europe in a historical and cross-cultural comparative perspective (2017). 20-23.

Ambrose, Lauren E., et al. “Images of nature, nature-self representation, and environmental attitudes.” *Sustainability* 13.14 (2021). 8025.

Tu, Jui-Che, Ya-Wen Tu, and Tai-Ran Wang. “An investigation of the effects of infographics and green messages on the environmental attitudes of Taiwanese online shoppers.” *Sustainability* 10.11 (2018): 3993.

Dunlap, Riley E., et al. “New trends in measuring environmental attitudes: measuring endorsement of the new ecological paradigm: a revised NEP scale.” *Journal of social issues* 56.3 (2000): 425-442.

Anderson, Mark W. “New Ecological Paradigm (NEP) Scale.” *The Berkshire Encyclopedia of Sustainability: Measurements, Indicators, and Research Methods for Sustainability*, Volume 6, (2012). 260-262.

Lazard, A., & Atkinson, L. (2015). “Putting Environmental Infographics Center Stage: The Role of Visuals at the Elaboration Likelihood Model’s Critical Point of Persuasion.” *Science Communication*, *37*(1), 6-33.

Appendix 1

Table 13: Statements in the NEP scale

1. We are approaching the limit of the number of people the Earth can support.
2. Humans have the right to modify the natural environment to suit their needs.
3. When humans interfere with nature it often produces disastrous consequences.
4. Human ingenuity will ensure that we do not make the Earth unlivable.
5. Humans are seriously abusing the environment.
6. The Earth has plenty of natural resources if we just learn how to develop them.
7. Plants and animals have as much right as humans to exist.
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
9. Despite out special abilities, humans are still subject to the laws of nature.
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.
11. The Earth is like a spaceship with very limited room and resources.
12. Humans were meant to rule over the rest of nature.
13. The balance of nature is very delicate and easily upset.
14. Humans will eventually learn enough about how nature works to be able to control it.
15. If things continue on their present course, we will soon experience a major ecological catastrophe.

Source: Dunlap et al. (2000)

The seven even numbers, if agreed to by a respondent, are meant to represent statements endorsed by the dominant social paradigm (DSP). The eight odd items, if agreed to by a respondent, are meant to reflect endorsement of the new ecological paradigm (NEP).

Appendix 2

Image 1: Image for Visual Survey #1

Source: Apollo 17, NASA. (1972).

Image 2: Image for Visual Survey #2

Source: Superstorm Sandy, 6abc

Image 3: Image for Visual Survey #3

Source: TheCrimsonMonkey, Getty Images

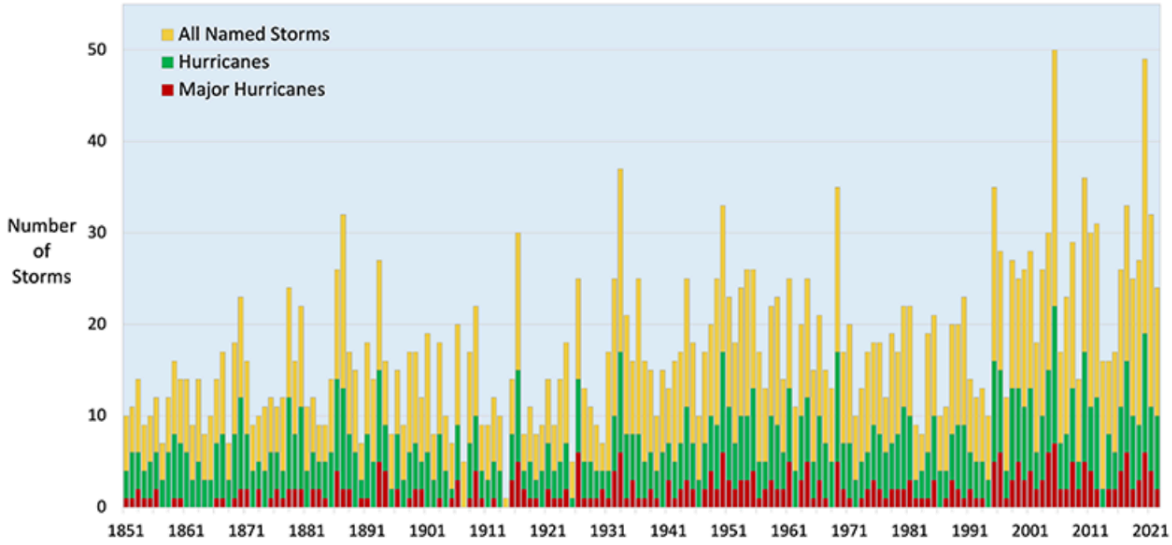
Image 4: Image for Visual Survey #4

Source: Bill Steven, Inciweb

Image 5: Image for Visual Survey #5

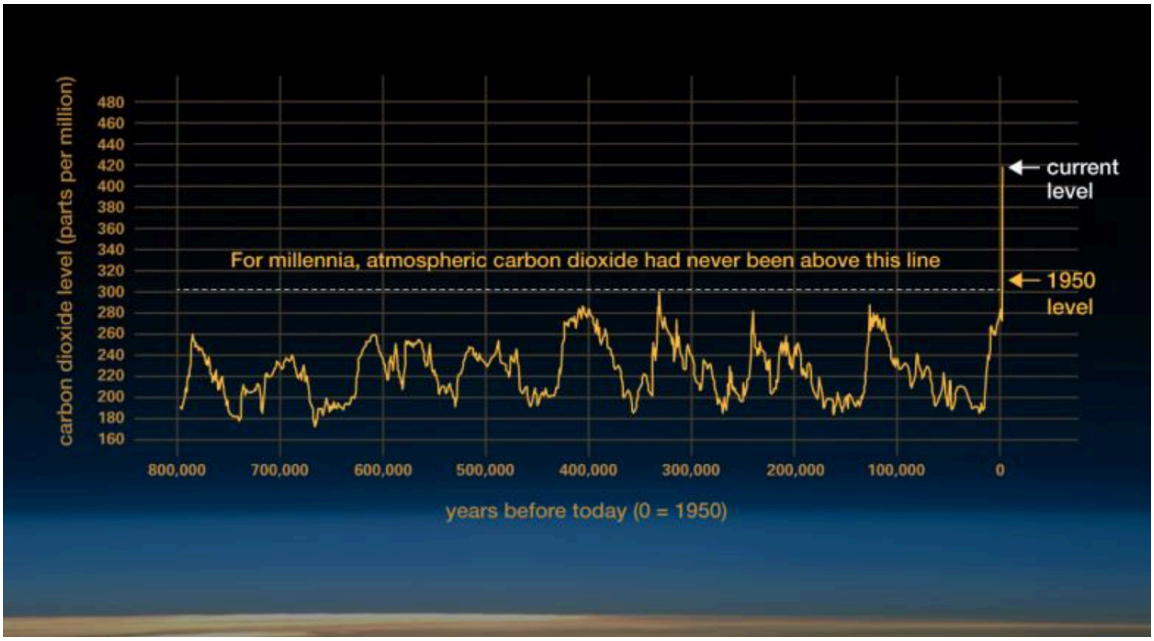
Source: John Constable, 1815

Image 6: Image for Graphical Survey #1



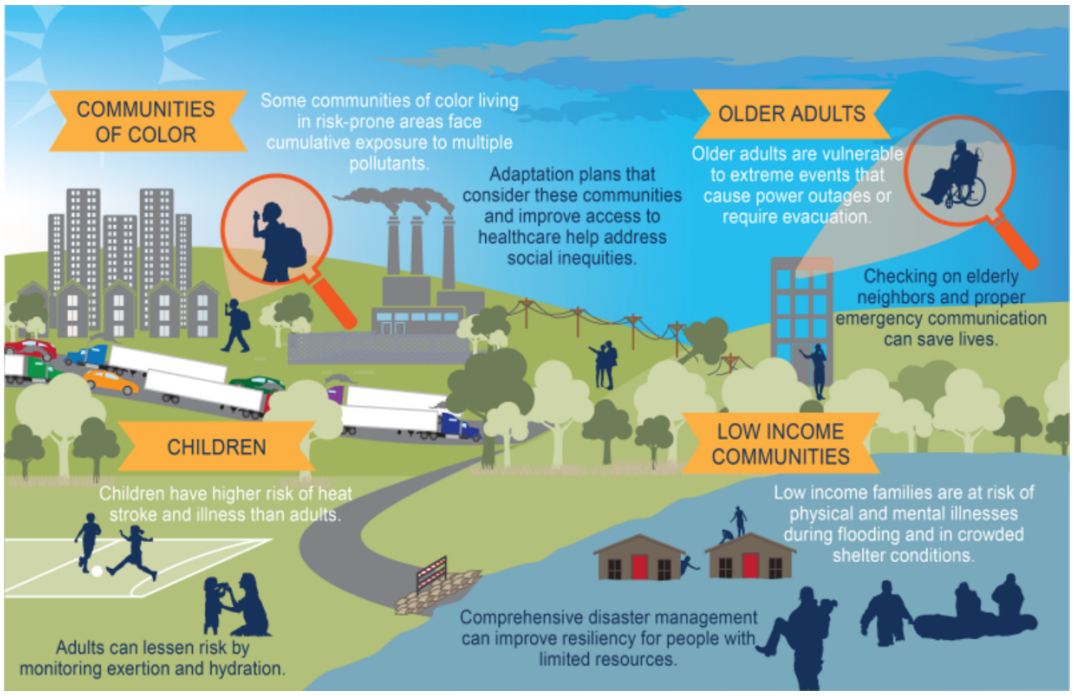
Source: National Hurricane Center, NOAA

Image 7: Image for Graphical Survey #2



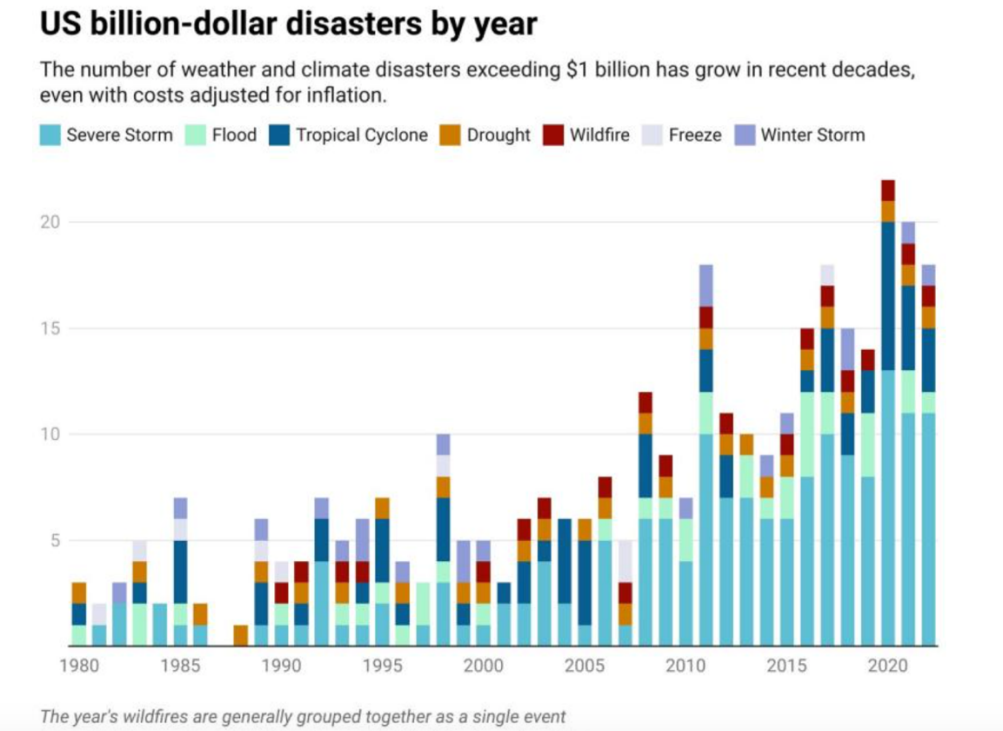
Source: NASA Climate Change, climate.nasa.gov

Image 8: Image for Graphical Survey #3



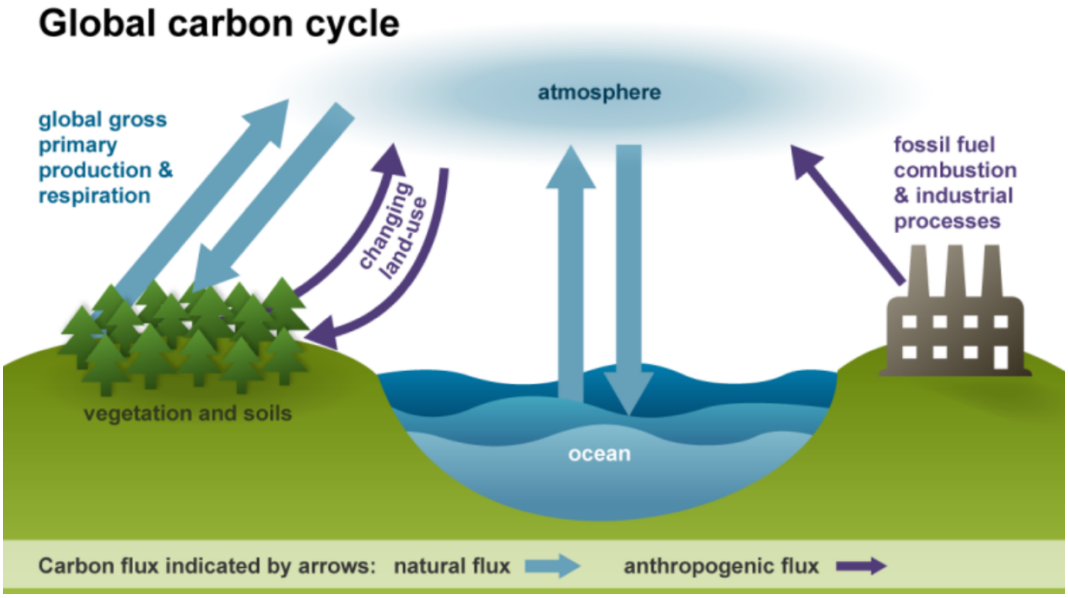
Source: National Climate Assessment, Figure 12.2

Image 9: Image for Graphical Survey #4



Source: NCEI/NOAA Billion-Dollar Weather and Climate Disasters.

Image 10: Image for Graphical Survey #5



Source: adapted from Intergovernmental Panel on Climate Change, *Climate Change 2007: The Physical Science Basis,* Figure 7.3, (2007).

Block 1: Text for Textual Survey #1

"Climate scientists have showed that humans are responsible for virtually all global heating over the last 200 years. Human activities like the ones mentioned above are causing greenhouse gases that are warming the world faster than at any time in at least the last two thousand years. The average temperature of the Earth's surface is now about 1.1°C warmer than it was in the late 1800s (before the industrial revolution) and warmer than at any time in the last 100,000 years. The last decade (2011-2020) was the warmest on record, and each of the last four decades has been warmer than any previous decade since 1850. Many people think climate change mainly means warmer temperatures. But temperature rise is only the beginning of the story. Because the Earth is a system, where everything is connected, changes in one area can influence changes in all others. The consequences of climate change now include, among others, intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms, and declining biodiversity."

Source: United Nations Climate Change. "What is Climate Change?" United Nations.

Block 2: Text for Textual Survey #2

"In a series of UN reports, thousands of scientists and government reviewers agreed that limiting global temperature rise to no more than 1.5°C would help us avoid the worst climate impacts and maintain a livable climate. Yet policies currently in place point to a 2.8°C temperature rise by the end of the century. The emissions that cause climate change come from every part of the world and affect everyone, but some countries produce much more than others. The seven biggest emitters alone (China, the United States of America, India, the European Union, Indonesia, the Russian Federation, and Brazil) accounted for about half of all global greenhouse gas emissions in 2020. Everyone must take climate action, but people and countries creating more of the problem have a greater responsibility to act first."

Source: United Nations Climate Change. "What is Climate Change?" United Nations.

Block 3: Text for Textual Survey #3

"Global climate change is not a future problem. Changes to Earth's climate driven by increased human emissions of heat-trapping greenhouse gases are already having widespread effects on the environment: glaciers and ice sheets are shrinking, river and lake ice is breaking up earlier, plant and animal geographic ranges are shifting, and plants and trees are blooming sooner. Effects that scientists had long predicted would result from global climate change are now occurring, such as sea ice loss, accelerated sea level rise, and longer, more intense heat waves. Some changes (such as droughts, wildfires, and extreme rainfall) are happening faster than scientists previously assessed. In fact, according to the International Panel On Climate Change (IPCC) — the United Nations body established to assess the science related to climate change — modern humans have never before seen the observed changes in our global climate, and some of these changes are irreversible over the next hundreds to thousands of years."

Source: NASA Climate Change. "Effects of Climate Change." NASA.

Block 4: Text for Textual Survey #4

"Climate change is already impacting human health. Changes in weather and climate patterns can put lives at risk. Heat is one of the most deadly weather phenomena. As ocean temperatures rise, hurricanes are getting stronger and wetter, which can cause direct and indirect deaths. Dry conditions lead to more wildfires, which bring many health risks. Higher incidences of flooding can lead to the spread of waterborne diseases, injuries, and chemical hazards. As geographic ranges of mosquitoes and ticks expand, they can carry diseases to new locations. The most vulnerable groups, including children, the elderly, people with preexisting health conditions, outdoor workers, people of color, and people with low income, are at an even higher risk because of the compounding factors from climate change. But public health groups can work with local communities to help people understand and build resilience to climate change health impacts."

Source: National Oceanic and Atmospheric Administration (NOAA). "Climate Change Impact." NOAA.

Block 5: Text for Textual Survey #5

"Scientists demonstrated the heat-trapping nature of carbon dioxide and other gases in the mid-19th century. Many of the science instruments NASA uses to study our climate focus on how these gases affect the movement of infrared radiation through the atmosphere. From the measured impacts of increases in these gases, there is no question that increased greenhouse gas levels warm Earth in response. Ice cores drawn from Greenland, Antarctica, and tropical mountain glaciers show that Earth's climate responds to changes in greenhouse gas levels. Ancient evidence can also be found in tree rings, ocean sediments, coral reefs, and layers of sedimentary rocks. This ancient, or paleoclimate, evidence reveals that current warming is occurring roughly 10 times faster than the average rate of warming after an ice age. Carbon dioxide from human activities is increasing about 250 times faster than it did from natural sources after the last Ice Age."

Source: NASA Climate Change. "Evidence." NASA.