THE EFFECT OF RECORDED NATURE FOOTAGE ON CHILDREN'S PERCEPTION OF NATURE

By

MAIA ELIZABETH WILENIUS

A Thesis Submitted to the W. A. Franke Honors College

In Partial Fulfullment of the bachelor's degree
With Honors in

Early Childhood Education

THE UNIVERSITY OF ARIZONA

M A Y 2 0 2 3

Approved by:

Dr. Sung Eun Jung
Department of Teaching, Learning, and Sociocultural Studies

Abstract

With the present-day increase in screen-based media, it is important to consider how such media should or should not be integrated into environmental education. Therefore, the goal of this study was to explore how watching recorded nature footage affects children's perception of nature and to examine whether such effects support environmental educators' recommendations for raising children into adults who are motivated to protect the Earth. Study participants consisted of 23 first-grade students divided into a control group and experimental group. The experimental group was shown a short clip of recorded nature footage for 15 consecutive school days, and written observations were taken during four of the clips. All students in the control and experimental groups completed surveys about their perceptions of nature, and this was completed both before and after the experimental group engaged in the intervention of watching the recorded nature footage. A select group of students from each group completed interviews before and after the intervention as well. The results indicated that watching recorded nature footage may cause children to associate nature with an academic subject more than with a leisure activity, believe that nature is frightening and distant more often than it is ordinary and nearby, and have increased positive emotions toward animals accompanied by a decreased recognition of rocks and landscapes as being part of nature. These results suggest that showing children recorded nature footage does not support their development of a positive emotional perception of nature.

Keywords: environmental education, recorded nature footage, perceptions of nature, nature documentaries

Table of Contents

The Effect of Recorded Nature Footage on Children's Perception of Nature

Today's rapid increase in children's screen time has been frequently criticized by experts in child development, and furthermore, environmental educators also tend to support the reduction or elimination of young children's exposure to various forms of electronic media (Domingues-Montanari, 2017; Lissak, 2018; Pergams & Zaradic, 2006; Truong & Clayton, 2020, Twenge & Campbell, 2018). However, one oft-overlooked aspect of electronic media falls in a somewhat grey zone: nature documentaries. Despite environmental educators' criticism of children's screen time, few such educators take a stance on recommendations surrounding nature documentaries and recorded nature footage, and even fewer have concrete evidence to support their positions (Charles & Wheeler, 2012; Louv, 2008; Orr, 1994).

An analysis of films tagged as "nature documentaries" reveals that *nature documentaries* can be defined as nonfiction films focusing on non-human life and habitats on the planet Earth (Internet Movie Database, 2023). Nature documentaries, specifically those consisting of authentic recorded nature footage, contribute toward exposure of both the natural environment and electronic screens. For the purpose of this study, *recorded nature footage* is defined as videos obtained by filming plants and animals in their natural habitats, with little to no human interference or artist-created animations. Therefore, this means that certain nature documentaries can be classified as recorded nature footage, but many others cannot due to the inclusion of human interference and animations. Though this study focuses on recorded nature footage, some studies involving the broader category of nature documentaries are also analyzed as a reference. It should also be noted that this study is considering watching recorded nature footage as an enhancement to children's real-life nature experiences, and as a replacement for such experiences

only when they are in an inaccessibly remote location—not as a replacement for nature that is reasonably accessible.

Given this context, this study uses a experimental mixed-methods case study approach in order to gain a greater understanding of how watching recorded nature footage affects how children perceive the natural environment. Previous studies have focused on specific animals or nature-oriented television shows (Barbas et al., 2009; Lamaestra & Murphy, 1999), or on the effect that nature documentaries have on adults (Arendt & Matthes, 2016; Hynes et al., 2021; Martin et al., 2020; Yeo et al., 2020), but there is a literature gap on the effect of recorded nature footage on young children. This leaves teachers, parents, and caregivers with a lack of information on best practice for exposing children to recorded nature footage. However, based on the existing literature on similar subjects, here are three conceivable hypotheses for the study:

1. Watching recorded nature footage will spark children's interest in nature, therefore causing them to view the natural environment with more excitement, curiosity, affection, and overall positive emotions.
2. Watching recorded nature footage will cause children to view professional quality and highly curated nature footage as the norm for what happens outside, therefore leading them to view the less-dramatic environments in their immediate surroundings with lower enthusiasm and interest.
3. Watching recorded nature footage will register as an entirely unique sort of experience in children's minds, therefore not affecting their emotional perceptions of the natural environment.

It is important that children develop an emotionally positive perception of the natural environment, for doing so is the most effective way of encouraging pro-environmental behaviors

(Arendt & Matthes, 2016; Barbas et al., 2009; Chawla & Cushing, 2007; Dong et al., 2020; Erickson & Ernst, 2011; Gould, 1994; Louv, 2008; Martin et al., 2020; Orr, 1994; Rejeski, 1982; Sobel, 1996), which are defined as actions that promote the health of the Earth (Arendt & Matthes, 2016; Martin et al., 2020). With this tenet in mind, this paper will now go on to discuss the literature related to this study, then explain the study's methodology, subsequently describe the results, and finally analyze the results and conclude with practical implications and suggestions for future research.

Literature Review

Recorded nature footage represents the intersection of two very different concepts: screen-based media, and the natural environment. Viewing recorded nature footage requires exposure to screen-based media, and therefore it stands to reason that the typical effects of engaging with such media could be expected. Likewise, it also stands to reason that viewing nature carries certain predicted effects as well, and many theories of psychology and environmental education have been established in the research of these effects (Martin et al., 2020; Orr, 1994; Rejeski, 2010; Truong & Clayton, 2020; Yeo et al., 2020). Some researchers have specifically studied the effects of nature documentaries, but the findings are limited, not specific to young children, and implore further research (Arendt & Matthes, 2016; Barbas et al., 2009; Hynes et al., 2021; Lamaestra & Murphy, 1999; Martin et al., 2020; Yeo et al., 2020). A literature review on the topics of children's use of screen-based media, effects of nature documentaries, theories of environmental education, and motivations for environmental preservation has revealed the following themes relevant to this study's line of research:

- the negative direct effects of screen time on children's overall development, and the negative indirect effects of screen time on the natural environment;

- conflicting positive and negative effects of nature documentaries on various populations;
- and the importance of hands-on, play-based, and local environmental learning in promoting a love of nature.

Children's Use of Screen-Based Media

The effects of exposing children to any form of screen-based media are important to explore, because as said before, it is possible that these overall effects are also present when showing children recorded nature footage. The most commonly-researched effects are those that affect children directly—many studies have discovered a negative correlation between children's screen time and various markers of health and wellbeing (Domingues-Montanari, 2017; Lissak, 2018; Twenge & Campbell, 2018). Domingues-Montanari found that increased screen time negatively impacts gross motor function, nutrition, healthy bodyweight, cognitive abilities, and socioemotional development. Lissak found that it is associated with poor sleep, higher risk of cardiovascular diseases and diabetes, higher rates of depression and suicidality, higher rates of addictive behaviors, and decreased prosocial behaviors. Twenge & Campbell found that it leads to increased diagnoses of mood disorders such as anxiety and depression, and decresased emotional stability, curiosity, self-control, and satisfying interpersonal relationships.

Furthermore, some scholars have connected these effects of screen-based media on children to effects on the natural environment. For example, Orr (1994) identified increased urbanization and technology as the two primary factors driving society's increased rejection of nature. Although he included both children and adults in this analysis, he specifically emphasized the importance of cultivating bonds between children and nature. Orr's theory may be over 25 years old, but urbanization and technology are continuing to rapidly increase, and a more recent study further supports his claims. Pergams & Zaradic (2006) found that electronic

media use is the main cause of the continuing 50-year decline of U.S. national park visits—it even supercedes the more-expected variables, federal funding and park capacities, which were not associated with the decline at all. Specifically, the forms of electronic media found to be factors in the decline are watching movies, playing video games, and using the internet. Therefore, this suggests that if children continue to be exposed to screens at or above the present rate, the next generation will continue the trend of decreased national park visits. With fewer young people enjoying the national parks, fewer future adults will feel inclined to protect them. As Louv (2008) put it, "If park and forest attendance stagnates as the visitor age rises, what happens to the future political constituency for parks and national forests?" (pp. 149-150).

Effects of Nature Documentaries

All of this information leads to the conclusion that screen time is harmful to both children and the natural environment; however, several theories and studies focused specifically on nature documentaries show positive effects instead of or alongside negative ones. Though this study focuses on recorded nature footage, not nature documentaries, it is still relevant to consider nature documentaries because they are the most similar form of media that has been previously researched. Perhaps the most similar study to this one is a 1999 study by Donna Lamaestra and and Heather Murphy, in which 15 children between 7 and 12 years of age were shown episodes of *Kratts' Creatures* in order to determine how the show impacted their perception of endangered species. The result was that the children were more appreciative of animals after viewing the episodes, but they did not retain more knowledge of the endangered species. Although Lamaestra and Murphy's result may serve as a predictor of this current study's results, there are two key differences between the study methods: One, the children in this study are six through seven years old, therefore younger than in Lamaestra and Murphy's study; and two, the videos shown

in this study are entirely authentic recorded nature footage, while *Kratts' Creatures* has large sections of animation as well as authentic footage. Furthermore, children's technology use has skyrocketed since 1999—just to give one example, the iPad wasn't invented until 2010, and the percentage of young children having access to a tablet went from 8% to 75% between 2011 and 2020 (Laricchea, 2022). With this drastic increase of overall screen time, increased television viewing may carry different effects. Therefore, it cannot be assumed that the results of the two studies will be the same.

Another similar study, done 10 years later, showed that sixth-graders had more positive emotions toward insects after watching 13 episodes of an insect documentary series (Barbas et al., 2009). However, there is no guarantee that children's reactions to insect documentaries will be the same as to general nature footage, or that sixth-graders' reactions will be the same as first-graders'. Several other studies focused on the effects of nature documentaries on adults, and the results were mixed:

- Arendt & Matthes found that among the Austrian general public, nature documentaries did not affect connection to nature, but increased donations to animal and environmental protection organizations for those who already felt such a connection (2016).
- Hynes found that among the Scottish general public, nature documentaries increased support of environmental conservation over infrastructure improvements, but did not change people's willingness to actually contribute money (2021).
- Martin et al. found that among the British general public, watching nature documentaries increased pro-environmental behaviors, but decreased self-reported life satisfaction (2020).

- Yeo et al. found that nature experiences through TV, 360° video, and computer-generated virtual reality decreased laboratory-induced boredom and increased nature connectedness, but that the effects were most significant for computer-generated virtual reality (2020).

Although these empirical studies provide concrete evidence, the results are often limited and contradictory, so some environmental education experts have developed their own theories on the effects of nature documentaries. Orr (1994) argues that nature documentaries often provide opposing and scientifically-unsound viewpoints just for the sake of entertainment, and therefore many do more harm than good. More recent researchers Truong and Clayton (2020) argue that nature documentaries lack sensory richness and "condition people to think that biodiversity is only composed by exotic, charismatic species from far-away places" (p. 12). These objections are much lower in evidence than the empirical studies, but they do bring up an important point. What do fast-paced documentaries have to offer people, or children, who don't even know all the birds and bugs in their backyards?

Theories of Environmental Education

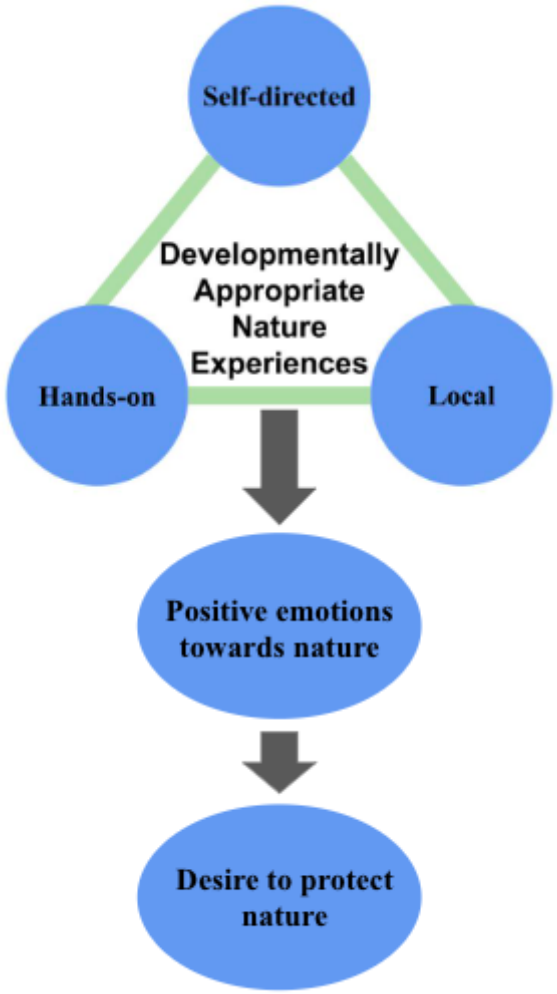
Whether intentional or not, nature documentaries and recorded nature footage function as a form of environmental education, and therefore it is relevant for this study to consider how recorded nature footage fits in with generalized theories in this field. Early childhood environmental education requires "coordinat[ing] a psychological view of the child with an ecological view of the world" (Rejeski, 1982, p. 27), and it has been well-proven that a love of nature is more effective in promoting environmental preservation than is knowledge of nature (Charles & Wheeler, 2012; Dong et al., 2020; Erickson & Ernst, 2011; Gould, 1994; Louv, 2008;

Orr, 1994; Sobel, 1996). Many texts on environmental education share the following recommendations for promoting this love of nature (see Figure 1):

- providing hands-on experiences in nature,
- prioritizing self-directed nature play over nature instruction,
- and establishing a foundation of learning at the local level.

Figure 1

Summary of theories of environmental education



Hands-On Nature Experiences

One major reason that environmental educators recommend hands-on nature experiences is that it is the most concrete way of experiencing nature (Orr, 1994; Sobel, 1996; Truong & Clayton, 2020). The importance of concrete learning has its roots in Piaget's Stages of Cognitive Development—according to Piaget's oft-cited theory, children don't develop abstract thinking skills until the formal operational stage, which doesn't begin until a child is about 11 years old (1971). Therefore, this means that abstract learning is not developmentally-appropriate until the child reaches about fifth or sixth grade. Even beyond this age, concrete learning also aligns with the "Explore" phase of the 5E Instructional Model, which is currently considered best practice for all ages and areas of science education (Bybee, 2014). Another reason that hands-on nature experiences are important is because they engage all five senses, therefore providing a wider breadth of input than indirect nature experiences such as recorded footage (Orr, 1994; Truong & Clayton, 2020). Though this does not negate any potential positive effects of recorded nature footage, it does suggest that any such benefits would be more limited than the benefits of being immersed in real-life nature.

Furthermore, a study of environmental activists shows that the vast majority of these activists had significant childhood experiences in nature such as hiking, camping, and free play. Many activists also had an influential family member or role model who showed care for the environment and accompanied them on nature experiences. Though indirect nature experiences such as reading books were also considered in this study, these indirect experiences were found to have a much lower correlation with the activists' prominent memories and reasons for environmental action (Chawla & Cushing, 2007), therefore further supporting the theory that children benefit most from nature when they experience it hands-on.

Nature Play

Though hands-on nature experiences are important, some types may be more beneficial than others. As Sobel (1996) says, “we teach too abstractly, too early” (p. 1), meaning that big-picture environmental education is not developmentally-appropriate for young children. In order to promote children’s involvement in and care for nature, children must explore and play outdoors before they are taught formal skills and knowledge (Charles & Wheeler, 2012; Chawla & Cushing, 2007; Erickson & Ernst, 2011; James et al., 2010; Sobel, 1996). Sobel also aruges that teaching young children about environmental destruction can be especially harmful because doing so associates nature with negative emotions, therefore activating the human tendency to avoid that which is unpleasant or frightening. A 2010 study corroborates Sobel’s hypothesis: Wray-Lake et al. discovered that adolescents’ concern for the environment has been declining since the 1990s, despite increased urgency of environmental crises such as global warming. They also discovered that instead of assuming personal responsibility for environmental problems, adolescents are increasingly blaming the government for such issues. Wray-Lake et al. were not able to determine the cause of this, but they did urge for better environmental education, and most modern educators concur that play is the best strategy there is (Cutter-Mackenzie & Edwards, 2013; Erickson & Ernst, 2011; Louv, 2008; Truong & Clayton, 2020).

In relation to recorded nature footage, this raises the question: Is watching recorded nature footage closer to receiving formal instruction, or engaging in exploratory play? One factor affecting this answer may be the audio accompanying the footage. Audio in recorded nature footage ranges from complex scientific explanations to only the sounds of the natural world, and the latter is definitely more playful than the former. However, Gould (1994) speaks in favor of all forms of nature exposure: “We cannot win this battle to save species and environments without

forging an emotional bond between ourselves and nature as well—for we will not fight to save what we do not love… So let them all continue—the films, the books, the television programs… Let them continue and expand because we must have visceral contact in order to love" (p. 40).

Local Learning

In addition to being hands-on and play-based, experts' opinions and studies agree that early childhood nature experiences should be focused on children's everyday surroundings (Charles & Wheeler, 2012; Chawla & Cushing, 2007; Louv, 2008; Orr, 1994; Sobel, 1996, Truong & Clayton, 2020). In the consideration of academic knowledge, one reason for this is that learning about faraway nature causes children to exclude local and less-famous species from their views of biodiversity (Truong & Clayton). But more importantly, the main reason for this argument is that overemphasizing faraway animals and natural wonders causes children to develop a loose and abstract connection with distant nature instead of a heartfelt and close connection with the nature in their communities (Chawla & Cushing, 2007; Louv, 2008; Orr, 1994; Sobel, 1996; Truong & Clayton, 2020). Louv says that "children learn about the rain forest, but usually not about their own region's forests" (p. 135), and having grown up in a forested area myself, I can attest to the truth of this irony. As environmental educators reiterate again and again, it is of the utmost importance that children develop a connection to and love of nature. A perspective of heartfelt love will grow into a motivation for environmental preservation, while a perspective of ambivalence or negativity will lead to the absence or opposite of such motivation (Arendt & Matthes, 2016; Chawla & Cushing, 2007; Gould, 1994; Louv, 2008; Orr, 1994; Rejeski, 1982; Sobel, 1996).

Evaluating Prominent Themes

Even with the existing research, it it difficult to predict whether watching recorded nature footage will support children's development of a positive relationship with nature. The strongest potential indicator of positive effects of recorded nature footage is students holding a greater appreciation of specific animals after seeing them featured in a nature-based television series (Lamaestra & Murphy, 1999; Barbas et al., 2009), and current theories of environmental education also suggest that positive effects may be likely if the footage is local and not accompanied by an excess of scientific explanation (Chawla & Cushing, 2007; Louv, 2008; Truong & Clayton, 2020, Wray-Lake et al., 2010). However, potential indicators of negative effects include the negative effects of screen time on children and the natural environment (Domingues-Montanari, 2017; Lissak, 2018; Orr, 1994; Pergams & Zaradic, 2006; Twenge & Campbell, 2018), the lack of sensory richness in virtual nature (Orr, 1994; Truong & Clayton, 2020), and the abstractness of viewing faraway nature on a screen (Louv, 2008; Orr, 1994; Sobel, 1996; Truong & Clayton, 2020). Therefore, in an effort to bring clarity to these conflicting implications and fill the gap in research related specifically to recorded nature footage, this study will now seek to identify whether exposing children to recorded nature footage benefits, harms, or does not affect children's perspective of the natural environment.

Methods

This study was an experimental mixed methods case study, meaning that it included the collection of both quantitative and qualitative data, therefore optimizing the balance between data breadth and depth. It consisted of the intervention, watching recorded nature footage, with its effects measured through quantitative surveys, qualitative interviews, and qualitative anecdotal notes. There was an experimental group who received the intervention and a control group who did not, and all participants were given both a pre- and post-survey. Selected

participants from each group were also given both a pre-interview and post-interview. Participants completed all parts of the study during October and November of 2022, and the study was approved by the University of Arizona Institutional Review Board before the commencement of any study activities.

Participants

There were a total of 23 participants in this study. The criteria for selection were that they must be students in one of two first-grade classes at a specific public elementary school in Tucson, Arizona; have signed parent or guardian consent to participate in the study; and also provide their own verbal assent for participation. The elementary school and school district have asked not to be named in the publication of any research study. However, further relevant information that I am able to provide about the school and classroom is that the school is in a primarily middle to upper-class area and that the teachers of the two selected classes teach science for an average of 75 minutes per week. As part of science class, the teachers show short clips of recorded nature footage occasionally, but not every week. These clips include informational narration and are intended for use in teaching children. For clarity, it should also be noted that in this study, *students* refers to the study participants and *children* refers to the broader category of youth between the approximate ages of 6 and 11 years old (see pages 25-26).

All the participating students in one class were assigned to be the experimental group, and all the participating students in the other class were assigned to be the control group. The experimental group had 16 participants, and the control group had 7 participants. The intention of this study was to have equal numbers of participants in each group, but due to one class returning many more signed consent forms, this did not end up being the case. Neither students, parents or guardians, teachers, nor administrators received any compensation for the study.

Demographics for each group and for the total participants, which were obtained via official school records, are shown in Table 1. It should be noted that the reason for including only three ethic categories was that those were the only ethnicities reported among all the participants. Demographics for the entire elementary school, also obtained via official school records, are shown in Table 2.

I also selected six participants from the experimental group and four participants from the control group to complete a pre- and post-interview. The criteria for selection were that they must have signed parent or guardian consent for the audio-recorded interviews, provide verbal assent to the audio-recorded interviews, and include a diverse demographic of students.

Table 1

Participant Demographics

Variable	Experimental group		Control group		Total participants	
	n	%	*n*	%	*n*	%
Gender						
Female	9	56.3	4	57.1	13	56.5
Male	7	43.8	3	42.9	10	43.5
Total	16	100.0	7	100.0	23	100.0
Ethnicity						
Hispanic	9	56.3	2	28.6	11	47.8
White/Anglo	5	31.3	5	71.4	10	43.5
Two or More	2	12.3	0	0	2	8.7
Total	16	100.0	7	100.0	23	100.0

Table 2

Elementary School Demographics

Variable	First grade		All students (K-5th grade)	
	n	%	*n*	%
Gender				
Female	27	50.0	162	49.7
Male	27	50.0	164	50.3
Total	54	100.0	326	100.0
Ethnicity				
African American	3	5.6	25	7.7
Asian American	0	0	6	1.8
Hispanic	21	38.9	153	46.9
Native American	2	3.7	3	0.9
White/Anglo	23	42.6	121	37.1
Two or More	5	9.3	18	5.5
Total	54	100.0	326	100.0

Absences

Of the students in the experimental group, there were an average of 1.6 (10%) of the 16 students absent during each video shown. Due to student privacy, it was not possible to determine which students were absent for each video. Students who were absent missed the study activities for that day and were unable to make them up at another time.

For the first round of surveys and interviews, two students (12.5%) from the experimental group and two students (28.6%) from the control group were absent. For the second round of

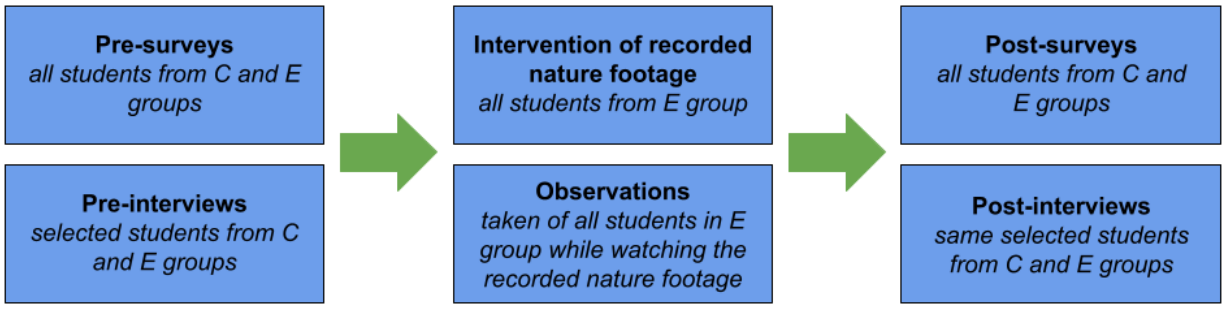
surveys and interviews, one student (6.3%) from the experimental group and no students (0%) from the control group were absent. The student absent from the experimental group during the second round was a student who had been selected for the interviews, so therefore, this student was not able to complete the second round of interviews. However, all data collected was still included in the analysis.

Research Methods and Procedures

Research methods consisted of quantitative survey analysis, qualitative interview analysis, and qualitative observations of students watching recorded nature footage. Research tools included the selected clips of recorded nature footage, the survey statements and response sheets, and the interview questions. The order of the research procedure is shown in Figure 2.

Figure 2

The research procedure



Note. C group stands for the control group, and E group stands for the experimental group. Also, I took observations of the experimental group during only four of the clips of recorded nature footage. This is described in more detail later in this section.

Pre- and Post- Surveys

The day before showing the first clip of recorded nature footage to the experimental group, I administered the pre-survey to all students in the control and experimental groups. The day after the final clip had been shown, I administered the post-survey to all of those same students again. The instructions and procedure for the post-survey were the exact same as for the pre-survey. The dictated instructions included that there were no right or wrong answers, that they should not talk during the survey, and that they should raise their hand if they had any questions or needed me to slow down. The complete survey instructions script can be found in Appendix C. Privacy dividers were also put up between the students so that they could not see each other's response sheets. For students who struggled to complete the survey with the rest of the class, a teacher sat with them individually and had them verbally provide their answer, which the teacher then helped them circle.

I read the survey statements aloud to the group of participating students, and each student had their own printed response sheet (see Appendix D). Survey statements (see Appendix B) consisted of 22 statements to which students responded using a simplified Likert scale on their response sheets: They circled a thumbs-up to indicate that they agreed with the statement, a person shrugging to indicate that they weren't sure if they agreed with the statement, or a thumbs-down to indicate that they didn't agree with the statement. The first 11 statements were phrased in the positive, such as "I like spending time in nature." When deciding upon the first 11 statements, I chose statements with the goal of reflecting the following in students' answers:

- emotional perceptions of nature, which are important because a positive emotional perception of nature is the strongest motivator for pro-environmental behaviors (Arendt & Matthes, 2016; Barbas et al., 2009; Chawla & Cushing, 2007; Dong et al., 2020;

Erickson & Ernst, 2011; Gould, 1994; Louv, 2008; Martin et al., 2020; Orr, 1994; Rejeski, 1982; Sobel, 1996);

- personal definitions of nature, which are important because a definition encompassing hyperlocal nature such as the schoolyard may indicate a day-to-day emotional connection with the environment (Louv, 2008; Sobel, 1996; Truong & Clayton, 2020; Rejeski, 1982), while a definition encompassing zoos may indicate that they view nature as something exotic and disconnected from their personal lives (Orr, 1994; Truong & Clayton, 2020);
- and feelings of competence in pro-environmental behaviors, which are important because children with high self-perceived ability are more likely than children with low self-perceived ability to succeed at a task, even if their actual abilities are the same (Müller et al., 2015).

The second 11 statements were the same statements as the first 11 except phrased in the negative, such as "I don't like spending time in nature." By repeating the statements in the negative, the goal was to reduce the statements' tendency to imply a preferred answer.

Pre- and Post-Interviews

On the same days as the pre- and post-surveys, respectively, I administered the pre- and post-interviews to the selected students in the experimental and control groups. I had selected six students in the experimental group and four students in the control group, but one student selected from the experimental group was absent for the post-interview. Besides this student, all students who completed a pre-interview also completed a post-interview. The structure of the post-interviews was identical to that of the pre-interviews, except that the post-interviews for the experimental group contained an additional three questions (see Appendix B). These questions

were about students' thoughts on the recorded nature footage that they had watched during the intervention phase of the study.

Each interview was conducted individually and audio-recorded. The pre-interviews lasted between 2 ½ and 9 minutes, while due to the additional three questions, some of the post-interviews lasted as long as 12 minutes. The dictated introduction to each interview included that there were no right or wrong answers, that it was okay not to answer any question, and that I would audio-record the conversation. The complete interview introduction script can be found in Appendix C.

I read aloud the interview questions individually to each student selected for the interviews, and students gave their responses verbally. In order to make the students comfortable, I tried to make the interviews feel as casual and conversational as possible, and I omitted certain questions if the student had already answered them or if they did not fit into the conversation. There were a total of nine interview questions for the pre-interviews, and I asked these same nine questions again during the post-interviews (see Appendix B). I chose the nine questions with the goal of having them be very similar to the survey statements, but inviting students to share more detailed answers. As mentioned before, I also asked the experimental group three additional questions during the post-interviews only. These three questions can be found in the findings section, and they can also be found in Appendix B along with the nine questions asked of all groups.

The Intervention of the Recorded Nature Footage

I selected a total of 15 clips of recorded nature footage for use in this study, and all were provided to the teachers via VideoLink in order to prevent advertisements and auto-play of subsequent videos. I found all the clips on YouTube from channels such as National Geographic

and BBC Earth, and the complete list can be found in Appendix A. The basic criteria for selection was as follows:

- less than five minutes in length;
- no excessive gore, violence, or mating details;
- little to no visuals that are not authentic recorded nature footage, such as animation;
- a selection of clips with diversity of narration, music, and/or recorded nature sounds;
- and a selection of clips with diversity of animals and landscapes.

This intervention of the recorded nature footage was given to all of the students in the experimental group and none of the students in the control group, and it began the day after the pre-surveys and pre-interviews. For the experimental group, one selected clip of recorded nature footage was shown each day on the classroom projector for 15 consecutive school days, for a cumulative total of approximately 50 minutes of recorded nature footage. The teacher's instructions were to show each clip on its specified day, to make sure as many participating students as possible were present, to not lead a discussion or provide any answers about the clips' content, to not force any student to watch against their will, and to record the number of students who watched each clip. The detailed teacher instructions can be found in Appendix A.

Observations

For four of the 15 clips of recorded nature footage that composed the intervention, I visited the classroom to observe the students as they watched. These observations were recorded through the use of anecdotal notes, and they included students' quotes, facial expressions, and levels of focus on the clips being shown.

Data Analysis

As previously described, I collected three forms of data for this study: quantitative survey data, qualitative interview data, and qualitative observational data. For the survey data, I tallied the number of students in each group who selected each response choice, then used percentage-difference equations to calculate how much the experimental group's responses changed between the two rounds of surveys in comparison to that same change among the control group. I used a percentage-difference equation instead of a percentage-change equation since the control and experimental groups were not the same size, and more information on the percentage-difference equation is located in the findings section. For the interview data, I used the thematic analysis approach (Braun & Clarke, 2006; Xu & Zammit, 2020) to quantify the information using codes. I then compared that coded information in the same method as for the survey data, though due to the small sample size for the interviews, I focused on general trends rather than exact percentages. Finally, for the observational data, I treated each observational session as a case study to be analyzed both individually and in combination with the other observational sessions. Results were determined based on the combined data of the surveys, interviews, and observations.

The confidence interval and margin of error should also be noted for this study. I used the standard margin of error equation with a 95% confidence interval, which is the typical choice for most research studies (Qualtrics Experience Management, 2022). As a result, the equation showed a 20.4% margin of error for the survey data and a 31.0% margin of error for the interview data. Since I treated the observational data as a case study and analyzed it in a purely qualitative manner, a margin of error is not applicable in its analysis.

In calculating the margins of error, I considered the population size to be all children in the United States between the ages of 6 and 11, which was 24.5 million as of the most recent data

collected in 2021 (Duffin, 2023). Though all the participants in this study were 6 or 7 years old, I was unable to obtain a population statistic for these specific ages. However, most children between the ages of 6 and 11 are in the concrete operational stage of cognitive development (Piaget, 1971), therefore making it likely that their responses to viewing recorded nature footage will be similar or the same to other children in that same stage.

Findings

In order to comprehensively report this study's findings on the effect of recorded nature footage on children's perception of the natural environment, it is again relevant to list the three sources of data. Likert-scale pre- and post-survey responses, open-ended pre- and post-interview questions, and anecdotal notes observing the students as they watched the footage were all analyzed as being equally relevant in determining these results, so therefore, each category of data is presented below.

Survey Data

The percentage-difference equation (see Figure 3), which is considered to be a valid form of analysis for quantitative studies with a small sample size (Cole & Altman, 2017; Curran-Everett & Williams, 2015), forms the basis for the survey data analysis. However, in order to account for multiple variables such as the presence of the control group and each statement being given in both the positive and negative, I needed to add a few additional calculations before and after using the percentage-difference equation. The complete list of steps is described below, along with an explanation of the variables that required each calculation.

Figure 3

The percentage-difference equation

$$\Delta_{\alpha i} = (n_{i1} - n_{i2}) / \tfrac{1}{2} (N_{1\alpha} + N_{2\alpha})$$

The percentage difference of the number of students in group α (control or experimental) who picked answer *i* (agree, neutral, or disagree).

equals

The difference between the number of students who picked answer *i* in the first round and the number of students who picked that same answer in the second round.

divided by

The average number of students in each round of surveys for group α. By averaging the number of students in each round instead of just using the number of students in the first round, this accounts for student absences.

After collating all survey responses, I first combined the responses from statements 1-11 with the inverse responses from statements 12-22, meaning that each "agree" or "disagree" answer to statements 12-22 counted as the reverse answer to the corresponding statement given in the positive for statements 1-11. These corresponding statements were included in order to negate the leading nature of each statement, therefore reducing students' bias toward a particular answer. Therefore, in order to analyze them, I needed to combine them into one statement. Next, I used the equation described in Figure 3 to determine the percentage difference of the number of students in each group who picked each answer. Then, I subtracted the percentage difference of the control group from the percentage difference of the experimental group. Finally, I added the inverse of the percentage difference of each "disagree" answer to the percentage difference of the corresponding "agree" answer, and the percentage difference remaining was the result for that statement. A positive percentage difference indicated an increase, and a negative percentage difference indicated a decrease. However, due to the margin of error calculation discussed in the

previous section of this paper, any percentage difference of ±20.4% was not statistically significant. All survey results, including those not statistically significant, are shown in Table 3.

Table 3

Survey Data Results

Statement number	Numerical result	Descriptive result
1 (+ inverse 12)	-0.9%	No statistically significant difference in the number of students who like nature.
2 (+ inverse 13)	-46.6%	46.6% fewer students like spending time in nature.
3 (+ inverse 14)	40.8%	40.8% more students like learning about nature.
4 (+ inverse 15)	-29.0%	29.0% fewer students like when people talk to them about nature.
5 (+ inverse 16)	-3.4%	No statistically significant difference in the number of students who like playing inside better than playing outside.
6 (+ inverse 17)	47.7%	47.7% more students think that they know how to help the environment.
7 (+ inverse 18)	-11.2%	No statistically significant difference in the number of students who think they are old enough to help the environment.
8 (+ inverse 19)	-7.8%	No statistically significant difference in the number of students who think that the schoolyard is nature.
9 (+ inverse 20)	-3.7%	No statistically significant difference in the number of students who think that zoos are nature.
10 (+ inverse 21)	-2.9%	No statistically significant difference in the number of students who think that they can find nature within walking distance of where they live.
11 (+ inverse 22)	-7.8%	No statistically significant difference in the number of students who think that watching nature videos is more fun than seeing nature outside.

Interview Data

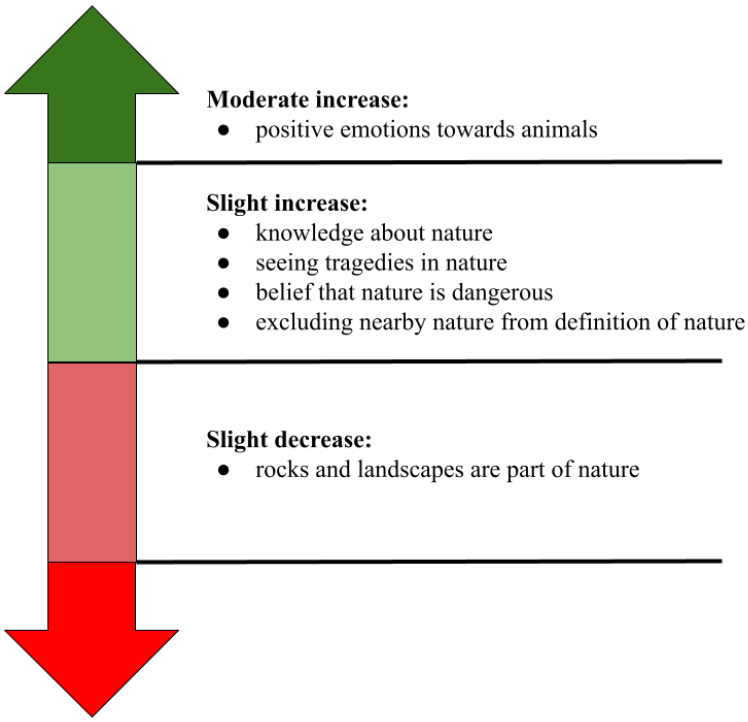
To analyze the data obtained from the pre- and post-interviews, I used the thematic analysis method, which is widely used by educational researchers for qualitative data (Xu & Zammit, 2020). In most studies using thematic analysis, the analysis is done using the six-step method developed by Braun & Clarke (2006), so I used this same method as well, which is described as follows:

1. Familiarize oneself with the data.
2. Generate initial codes.
3. Search for themes.
4. Review potential themes.
5. Define and name themes.
6. Produce the report.

In the context of this study, familiarizing myself with the data meant transcribing the interviews using an online transcription tool and then reviewing the transcriptions manually. Then, in generating initial codes, I used a combination of inductive and deductive approaches to determine which codes to include. By the end of the fifth step, defining and naming themes, there were a total of 30 themes present. However, only six of these themes showed a statistically significant difference between the pre- and post-interviews (see Figure 4).

Figure 4

Interview data results



Note. This figure excludes themes whose prevalence did not change, or had no statistically significant difference, between the pre- and post-interviews. Due to the small sample size, exact percentage-differences are not sufficiently accurate to be presented, so therefore they have been grouped into general categories. The categories of large increase, moderate decrease, and large decrease are not pictured because no themes were found to match those categories.

The definition of a statistically significant difference was determined in a similar manner as in the survey data analysis. First, I used the same percentage-difference equation as for the survey data to determine the percentage difference of the number of students in each group who picked each answer. This equation can be found in Figure 3, but note that in this case, *i* represents the given theme rather than the given survey answer. Then, I subtracted the percentage

difference of the control group from the percentage difference of the experimental group. If the absolute value of the remaining difference was less than or equal to 31.0%, it was not statistically significant, as determined using the standard margin of error equation (see page 25).

All of the themes presented in Figure 4 were elicited from students' responses to questions that were discussed during all interviews. However, as described on pages 22-23, I asked students in the experimental group three additional questions during the post-interviews only. These questions are as follows:

1. What do you think of the nature videos you watched? How do they make you feel?
2. Do you think you'll ever see something like what you saw in those videos in real life? What do you think you would/would never see?
3. Did you prefer the videos with someone talking in the background, or the videos without talking? Why?

The results show clear patterns for the first and third questions, but slightly less so for the second. All five students in the experimental group who completed a post-interview expressed positive emotions toward watching the videos, and none of the students said that they prefer the videos with talking/narration. Three students said that they prefer the videos that had audio of only real-life nature sounds, while the other two students said they weren't sure what type of audio they preferred.

As for the second question, regarding whether the students believed they would see something like what they watched in the videos in real life, the students had mixed opinions. Three of them said that they would, one said that they might, and one said that they would not. When asked what they would or would not see in real life, all of the students gave examples of

animals. Some examples seemed scientifically likely, such as seeing a real fox, while others were less so—such as seeing a penguin on a trip to Denver, or never seeing a bird singing.

Observational Data

Observational data results are direct reports of the anecdotal notes taken while the students were watching the recorded nature footage. I observed four such clips this way, and due to the small amount of data collected, I have presented all of the data in its entirety instead of summarizing it into thematic codes. It should be noted that it was not my original intention to focus on one student as much as I did. However, the student to whom I assigned the identifier E5 displayed much stronger reactions to the clips than any of her classmates, therefore making her the easiest to observe and recognize by name. Each observation record is listed below, along with an accompanying explanation.

Vignette 1: Singing Nightingale

Most of the 14 students were looking at the screen the entire time. E5 was laughing almost the entire time, and another student said to her, “It’s not funny!”. Nonetheless, that other student did laugh once or twice himself, and some other students laughed periodically as well. Another student responded to E5 by yelling, “Stop!”, and another student mumbled “It’s so annoying.” I was uncertain whether that student was responding to E5 or to the video. Yet another student said, without annoyance, “It’s not funny at all. It’s cool.” After the video was over, that same student said, “He’s trying to speak. ‘Hello, hello, hello’.”

This is quite possibly the simplest of the video clips shown because it was just 2 ½ minutes of a nightingale sitting on a branch and continuously singing. Taken altogether, Vignette 1 shows that the majority of the students were engaged by the video and greatly enjoyed it, and that some found it very funny.

Vignette 2: Birds

All of the students were looking at the screen the entire time, but they rarely smiled, were mostly quiet, and only laughed at the very end. E5 was the first to speak when she breathed "Wow" at a slow-motion hummingbird a little bit in. The next time some students talked was at the kiwi: One said "What?", another said "Oh," and another said "Kiwi." Then, when a peacock came up, several spoke, such as: "And a peacock." "Beautiful." One boy said "Woah" when birds at a feeder came up, then all the students were quiet and solemnly focused for a little while. E5 broke the silence by saying "I have baby chicks," then when a baby bird came up, there was a collective "Awwwww!". At the very end of the video, when it said "Goodbye til next time!", a few laughed and one waved. For this video, 14 students were present at the beginning, then 2 more arrived partway through.

Similarly to Vignette 1, this video clip described in Vignette 2 focused on birds, but the main differences were that it showed many different types of birds and had a narrator speaking as the footage played. Throughout the video, all of the students were engaged, some were intrigued, and many believed that the baby bird was cute.

Vignette 3: Scorpions

When the video first came on, E5 said excitedly, “Scorpions!” Almost all of the students were looking at the screen the entire time, and smiled or laughed occasionally at the jokes. They didn’t seem repulsed or disturbed, with the exception of one boy who said “That was not funny at all!” in response to another student saying “That was funny!”, and E5 scrunching up her face at one point. But at most times, E5 was sitting enthralled with her mouth hanging open. Afterwards, the teacher gave them a minute to talk among themselves about the video, and a lot of the chatter was off-topic. For example, a couple boys were talking about a shirt one of them was wearing. However, three boys did begin having a conversation about spiders, saying things such as “Spiders have venom.” For context, the video talked about scorpion venom and mentioned that it was similar to spider venom. All of the students were present for this video.

This video clip consisted of footage of various different scorpions with a narrator speaking throughout. Overall, almost all of the students in Vignette 3 were engaged by the video, some found the narrator to be funny, two had moments when they felt repulsed, and only a few discussed topics related to the video when they were given the chance to talk at the end.

Vignette 4: Fireflies

Throughout the video, many of the kids had their mouths hanging open, but there was very little smiling. Also throughout the video, there was a lot of unrelated arguing between each other. For example, one student called another a “crybaby.”. At the beginning of the video, one boy gasped. Later in the video, one student said “woah” when

seeing a close-up image of a firefly. Near the end, when the fireflies were doing their dance, one girl said “it looks weird.” All of the students were present for this video.

This video clip showed how a very large number of fireflies will occasionally gather in the forests of Mexico and pulse in sync, and it narrated the information in the style of telling a story. Unlike the previous vignettes, many of the students in Vignette 4 were not very engaged by the video, although some still were. Also, many of the students were surprised or awestruck at times, but they did not smile or laugh nearly as much as in the other videos I observed.

Discussion

The purpose of this study was to determine how watching recorded nature footage affects children’s perception of nature, and the changes revealed in the children’s perception of nature can be categorized into three overarching themes. These themes are listed as follows, in comparison to their perceptions before watching the footage:

- Children’s schema of nature aligns more with a subject taught in the classroom than with a leisure activity.
- Children believe that nature is frightening and distant more often than it is ordinary and nearby.
- Children have increased positive emotions toward animals, yet decreased recognition of rocks and landscapes as being part of nature.

It should also be remembered that the children referenced in this study are assumed to be between the ages of 6 and 11 years old and living in the United States. The word *children* refers to all children within that demographic, while the word *students* refers to the participants in this study.

Children's Schema of Nature

The most prominent and well-supported theme found in the results was a change in how children perceive nature in their daily lives. Prior to watching the recorded nature footage, the students considered nature with a less-academic mindset than after the completion of the study, meaning that their schema of nature shifted from being a place for enjoyment toward being a place that is studied in school. One result that supports this theme is a moderate increase in students' enjoyment of learning about nature (see Table 3). Since it is very common for teachers to emphasize the importance of learning in school, it would make sense that children tend to associate learning with school and academics more than with self-driven exploration and play, even though they do learn during their self-chosen activities. Enjoyment of learning is something that many teachers strive for their students to achieve, but it is interesting to note that the results also show a moderate decrease in students who enjoy spending time in nature (see Table 3). This further suggests that watching recorded nature footage may cause children to view enjoyment of nature as something that happens in a classroom rather than outside. However, the students also experienced a slightly decreased enjoyment of people talking to them about nature, as shown in the survey results (see Table 3), experimental group post-interview results (see page 31), and their reactions to narrated versus non-narrated videos (see pages 32-35). In combination with the moderate increase in students who enjoy learning about nature, this result may indicate that although watching recorded nature footage supports children's enjoyment of self-directed learning about nature, children do not like learning about nature through adults' verbal explanations. A similar possible interpretation is that children believe recorded nature footage is supposed to be educational, and though they enjoy watching it, they don't enjoy academic lessons about nature. Finally, one more interpretation is that watching recorded nature footage is

entirely supportive of children's enjoyment of learning about nature, but talking about nature as required during the surveys and interviews felt tedious and unenjoyable. Since watching recorded nature footage outside of this study does not typically involve completing surveys or interviews, this interpretation presents a possible inaccuracy in the study results.

Another factor demonstrating the shift of children's nature schemas from association with leisure to association with academics is the slight increase in students' expression of knowledge about nature (see Figure 3). This factor may also be a cause of students' moderate increase in their self-perceived action competence for sustainability, as shown in the survey data (see Table 3). Self-perceived action competence for sustainability refers to an individual's belief in their own abilities to help the environment (Olsson et al., 2020), and this cause-effect relationship makes sense because an increase in knowledge on a topic tends to lead to increased confidence in completing actions related to that topic (Peterson & Pitz, 1988). Though some environmental educators may strive to increase children's knowledge about nature and self-perceived action competence for sustainability, it is important to again mention that gaining knowledge about nature is not nearly as effective as developing a love of nature in promoting environmental preservation, and therefore gaining knowledge should not be the focus of environmental education in early childhood (Charles & Wheeler, 2012; Dong et al., 2020; Erickson & Ernst, 2011; Gould, 1994; Louv, 2008; Orr, 1994; Sobel, 1996). Also, researchers of environmental education have established that engaging in self-directed nature play is the most effective way of developing an emotional affinity for nature (Charles & Wheeler, 2012; Chawla & Cushing, 2007; Erickson & Ernst, 2011; James et al., 2010; Sobel, 1996), yet most elementary school education is teacher-directed and focused on gaining knowledge. In combination with the decrease in students who enjoy spending time in nature, this means that students' expression of nature-based

knowledge is likely to represent a belief that the concept of nature should be considered alongside academic subjects such as math and reading, and that this association is not supportive of current evidence-based recommendations for developing children's care for the natural environment.

It is also interesting to note that the students' increase in expression of knowledge about nature is contrary to the findings of a similar study by Lamaestra and Murphy (1999). In their study, students were more appreciative of endangered species after watching episodes of *Kratts' Creatures*, but not more knowledgable about them. I am not sure of the reason for our differing results, but it could be because *Kratts' Creatures* contains both animation and recorded nature footage, or because the students in Lamaestra and Murphy's study had a different level of preexisting knowledge about nature. However, since the sample sizes in both of our studies were quite small and composed of a population from a single school, it is also possible that these limitations reduced the validity of either or both results.

In the interviews, students also exhibited a slight increase in awareness of tragedies occurring in nature (see Figure 3). For an example of this, one student in the experimental group said during their post-interview, "People who want houses and no nature or animals… they shoot down cheetahs so that the fur can become coats." Not only is this a sort of expression of knowledge about nature, but more specifically, it is an expression of knowledge about nature that is far away and suggestive of negative emotions. Topics of environmental destruction are frequently found in academic discussions of nature, but in discussing these topics with young children, the associated negative emotions may cause them to view nature as a place of sadness rather than a place to be enjoyed for leisure and play (Orr, 1994; Sobel, 1996; Truong & Clayton, 2020).

Perceived Danger and Proximity of Nature

The second theme of the results, supported primarily by the interview data and also by the observational data, is that watching recorded nature footage caused the students to have a slightly increased recognition of nature's hazards and a slightly decreased recognition of its nearby proximity (see Figure 3). I consider these two concepts to be related because it is common to sense danger in what we do not understand, and it is common to not understand that which is not in close proximity to our daily lives. For example, when some students failed to point out the tree next to them when asked where the closest nature could be found, I believe that they were expressing the subconscious belief that nature is found primarily in remote locations. Since nearly all of the recorded nature footage shown in this study was of animals and scenes not present in the Tucson area, it makes sense that the students might associate the concept of nature with nonlocal environments. Furthermore, it is also relevant that while I was observing the students' reactions to the video clips, I noticed that they seemed happier and more engaged while watching a simple video of a nightingale singing than while watching any of the other video clips I observed (see pages 32-35). Though nightingales are not native to Arizona, there are numerous other songbirds that are, and a bird singing was the only thing that the students saw as a primary feature in a video that they would be likely to see locally in real life. Therefore, in combination with the evidence from the interview data, this may suggest that viewing local recorded nature footage is more beneficial than viewing nonlocal footage in encouraging children to care about the natural environment.

If it is assumed to be true that the students associate nature with nonlocal environments as a result of watching the videos, this means that they may exclude local nature from their understanding and definition of nature. Though I would not assume an increased fear of nature

based on this result alone, two of the five students in the experimental group directly stated such fear or sense of danger in their post-interviews, therefore leading me to believe that the increased association of nature with nonlocal environments may have been a factor causing the increased fear of nature. Also, several of the video clips shown to students in this study included footage of aggressive animal behavior, such as scorpions fighting and a fox eating a vole (see Appendix A). Though the footage did not show any blood and was not intended to frighten students, it is entirely conceivable that it could have that unintended effect. While observing the students as they watched the video about scorpions, two students expressed disgust toward the scorpions, but I did not notice any fear (see page 34). However, none of the other videos I observed contained aggressive animal behavior. If I had been able to observe every video, I may have been able to better determine if the animal aggression present in the footage was relevant to the study results, but scheduling conflicts prevented this from being possible.

To apply these findings more broadly, it is important to remember that videos of nature are recorded and watched all over the globe. This means that only a small fraction of the footage available is local to a given viewer's environment, and therefore, most children watching recorded nature footage are viewing animals and scenes that are not local to their hometowns. Thus, students' decreased recognition of local nature in this study may imply that watching recorded nature footage causes children to be less likely to recognize nature in their local environments. It is also relevant to reiterate that researchers of environmental education argue that children need more experiences in local nature in order to motivate them to protect nature when they are older (Chawla & Cushing, 2007; Louv, 2008; Orr, 1994; Sobel, 1996; Truong & Clayton, 2020). This suggests the possibility that if people do not recognize nature in their local environments when they are children, they may not think of their childhood nature play as a

motivator for protecting the Earth. Furthermore, it is also worth considering whether a decreased awareness of local nature might cause children to play less in that nature surrounding them.

As for the students' increased perception of the dangers present in nature, this could be attributed to the unfamiliarity of the nonlocal footage, or the aggressive animal behavior found in some footage. If the former, the effects found in this study would likely be relevant to children outside of this study, for the same reason as just described. If the latter, then it could be hypothesized that watching recorded nature footage depicting animal aggression or other potential hazards causes some children to have an increased awareness of nature's hazards, while watching more peaceful nature footage may not have that same effect. Being more aware of nature's hazards may cause children to behave in a more safe manner around elements of nature that have a significant safety risk, therefore helping to avoid injuries and negative experiences with nature; but it could also cause them to avoid hands-on experiences in nature, which would reduce their likelihood of developing a desire to protect the natural environment (Charles & Wheeler, 2012; Chawla & Cushing, 2007; Louv, 2008).

However, in order to make a definitive conclusion, more research would be needed. One reason for this is that the decreased recognition of local nature was only present in the interview data, not the survey data. Therefore, the sample size was very small, and not corroborated by all methods of data collection. Also, this study did not study the difference between watching local and nonlocal recorded nature footage, or between aggressive and nonaggressive. If a future study was set up to account for these variables, it is possible that the results could be very different. Though there are currently no studies such as this, researchers Truong and Clayton argue that technology-mediated nature "condition[s] people to think that biodiversity is only composed by exotic, charismatic species from far-away places" (2020, p. 12), which does align with this

study's finding that watching recorded nature footage causes children to be less aware of nearby nature.

Animals versus Non-Living Nature

The third and final theme, supported by the interview and observational results, was a moderate increase in positive emotions toward animals accompanied by a slight decrease in recognition of rocks and landscapes as being part of nature (see Figure 3). However, this theme may be due to a flaw in the study design. Though rocks and landscapes were present in nearly all of the clips shown to the students, the animals were the focus in all but one of the 15 clips. Therefore, it makes sense that the students felt positive emotions toward the animals they were seeing but thought less about the role of rocks and landscapes in nature. This was also reflected in their immediate reactions to the video clips, for many students smiled or laughed when watching animal behaviors such as a nightingale singing or scorpions crawling around, but I did not observe any strong emotional reactions to non-animal aspects of nature (see pages 32-35).

As an alternate argument, most recorded nature footage does focus more on animals than rocks and landscapes, therefore meaning that most children watching recorded nature footage would have a similarly-biased viewing experience as the students in this study. Also, a similar study in which sixth-graders watched insect documentaries found that the documentaries increased students' positive emotions toward insects (Barbas et al., 2009), so it makes sense that watching the footage in this study would increase students' positive emotions toward animals. This is a relevant finding because an increase in positive emotions toward animals is likely to increase children's motivation to protect animals when they are older (Charles & Wheeler, 2012; Dong et al., 2020; Erickson & Ernst, 2011; Gould, 1994; Louv, 2008; Orr, 1994; Sobel, 1996). However, the decrease in recognizing rocks and landscapes as part of nature could carry some

effects that are not as supportive of protecting the natural environment. For example, if a child doesn't consider rocks and landscapes to be as important to nature as animals, they might not think twice before going off-path and causing erosion while hiking. Though this does not negate the aforementioned effect of increasing children's positive emotions toward animals, it is still an important point to consider.

Conclusion

The evidence is clear that watching recorded nature footage has an effect on children's perception of nature, and furthermore, the evidence also suggests that most of these effects are not supportive of children developing a positive relationship with the natural environment—it causes an increased association of nature with academics, and an increased perceived danger and geographical remoteness of nature. However, this is not to say that every effect is unsupportive of this positive relationship. The most notable effect supporting children's emotional connection to nature is an increase in positive emotions toward animals, albeit accompanied by a decrease in recognition of rocks and landscapes as nature, and there are also several other effects supporting this connection if they are considered separately from their implications in broader themes.

Due to the aforementioned effects, if educators and caregivers want to inspire children to care for the natural environment, the evidence of this study suggests that showing children recorded nature footage may not be an effective method of achieving that goal. In order to affect children's perception of nature in a way that is beneficial to both the children and their relationship with the natural environment, it is instead recommended to engage them in play-based, hands-on, and local environmental exploration. This recommendation is well-supported by other studies on effective environmental education, and it carries all the effects of watching recorded nature footage that benefit children's relationship with nature, yet

excludes those effects that do not (Charles & Wheeler, 2012; Chawla & Cushing, 2007; James et al., 2010; Truong & Clayton, 2020). By engaging in self-directed nature play near their own homes, children are highly likely to develop and retain the desire to protect the natural environment (Charles & Wheeler, 2012; Chawla & Cushing, 2007; Erickson & Ernst, 2011; James et al., 2010; Louv, 2008; Orr, 1994; Sobel, 1996; Truong & Clayton, 2020).

However, the recommendation against recorded nature footage for supporting children's positive relationship with nature should not be generalized beyond the reference population of children who are between 6 and 11 years of age and living in the United States. For children who are younger or older, or who live elsewhere, more research would be needed in order to make an evidence-based recommendation on watching recorded nature footage. And even among children within the reference population, further research would still be valuable in testing this study's findings with a larger sample size.

Furthermore, there are multiple subtypes of recorded nature footage, and this study was not designed to determine the different effects of these subtypes. Future studies may find different results if they focus on comparing subtypes such as local versus nonlocal footage, narrated footage versus footage with recorded nature audio, peaceful footage versus footage with animal conflict, or footage with animals versus footage without. In particular, it stands to reason that watching local recorded nature footage may not carry some of the effects that are unsupportive of children's positive relationship with the natural environment, such as an increase in the perceived danger and geographical remoteness of nature. Nonetheless, this hypothesis would need to be tested by a future study. The effect of recorded nature footage on children is a very new topic of research, so at the present moment, children's caregivers must rely on a

combination of the limited evidence available and their own best judgments in order to make informed decisions regarding their children's viewing of recorded nature footage.

References

Arendt, F., & Matthes, J. (2016). Nature documentaries, connectedness to nature, and pro-environmental behavior. *Environmental Communication, 10*(4), 453-472. https://doi.org/10.1080/17524032.2014.993415.

Barbas, T. A., Paraskevopoulos, S., & Stamou, A. G. (2009). The effect of nature documentaries on students' environmental sensitivity: A case study. *Learning, Media, and Technology, 34*(1), 61-69. https://doi.org/10.1080/17439880902759943.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa.

Bybee, R. W. (2014). Guest Editorial: The BSCS 5E Instructional Model: Personal reflections and contemporary implications. *Science and Children, 51*(8), 10-13. http://www.jstor.org/stable/43691919.

Charles, C., & Wheeler, K. (2012). Children & nature worldwide: An exploration of children's experiences of the outdoors and nature with associated risks and benefits. *Children & Nature Network and the IUCN's Commission on Education and Communication*, 1-68. https://api.semanticscholar.org/CorpusID:198908803.

Chawla, L., & Cushing, D. F. (2007). Education for strategic environmental behaviour. *Environmental Education Research, 13*(4), 437-452. https://doi.org/10.1080/13504620701581539.

Cole, T. J., & Altman, D. G. (2017). Statistics notes: What is a percentage difference? *The British Medical Journal 358*. https://doi.org/10.1136/bmj.j3663.

Curran-Everett, D., & Williams, C. L. (2015). Explorations in statistics: The analysis of change. *Advances in Physiology Education, 39*(2), 49-54. https://doi.org/10.1152/advan.00018.2015.

Cutter-Mackenzie, A., & Edwards, S. (2013). Toward a model for early childhood environmental education: Foregrounding, developing, and connecting knowledge through play-based learning. *The Journal of Environmental Education, 44*(3), 195-213. https://doi.org/10.1080/00958964.2012.751892.

Domingues-Montanari, S. (2017). Clinical and psychological effects of excessive screen time on children. *Journal of Paediatrics and Child Health, 53*(4), 333-338. https://doi.org/10.1111/jpc.13462.

Dong, X., Liu, S., Li, H., Yang, Z., Liang, S., & Deng, N. (2020). Love of nature as a mediator between connectedness to nature and sustainable consumption behavior. *Journal of Cleaner Production, 242*(1). https://doi.org/10.1016/j.jclepro.2019.118451.

Duffin, E. (2023). Number of children in the United States in 2021, by age group. *Statista*, https://www.statista.com/statistics/457786/number-of-children-in-the-us-by-age/.

Erickson, D. M., & Ernst, J. A. (2011). The real benefits of nature play every day. *Wonder: Newsletter of the Nature Action Collaborative for Children*, July/August, 97-100.

Gould, S. J. (1994). *Eight little piggies: Reflections in natural history.* W. W. Norton.

Hynes, S., Ankamah-Yeboah, I., O'Neill, S., Needham, K., Xuan, B. B., & Armstrong, C. (2021). The impact of nature documentaries on public environmental preferences and willingness to pay: Entropy balancing and the blue planet II effect. *Journal of Environmental Planning and Management, (64)*8, 1428-1456. https://doi.org/10.1080/09640568.2020.1828840.

Internet Movie Database (2023). Most popular movies and TV shows tagged with keyword 'nature-documentary.' *IMDb.com*, https://www.imdb.com/search/keyword/?keywords=nature-documentary.

James, J. J., Bixler, R. D., & Vadala, C. E. (2010). From play in nature, to recreation then vocation: A developmental model for natural history-oriented environmental professionals. *Children, Youth and Environments, 20*(1), 231-256. https://www.jstor.org/stable/10.7721/chilyoutenvi.20.1.0231.

Lamaestra, D., & Murphy, H. L. (1999). The effect of nature documentaries on children's perceptions of endangered species. *Worcester Polytechnic Institute*, https://digital.wpi.edu/pdfviewer/v118rf16h.

Laricchia, Federica (2022). U.S. households with children owning mobile devices 2011-2020. *Statista*. www.statista.com/statistics/1293211/mobile-devices-us-households-children/.

Lissak, G. (2018). Adverse physiological and psychological effects of screen time on children and adolescents: Literature review and case study. *Environmental Research, 164*(1), 149-157. https://doi.org/10.1016/j.envres.2018.01.015.

Louv, R. (2008). *Last child in the woods: Saving our children from nature-deficit disorder, Updated and expanded.* Algonquin Books.

Martin, L., White, M. P., Hunt, A., Richardson, M., Pahl, S., & Burt, J. (2020). Nature contact, nature connectedness and associations with health, wellbeing and pro-environmental behaviours. *Journal of Environmental Psychology, 68*(1). https://doi.org/10.1016/j.jenvp.2020.101389.

Müller, E., Wustmann Seiler, C., Perren, S., & Simoni, H. (2015). Young children's self-perceived ability: Development, factor structure and initial validation of a self-report

instrument for preschoolers. *Journal of Psychopathology and Behavioral Assessment*, *37*(2), 256-273. https://doi.org/10.1007/s10862-014-9447-9.

Olsson, D., Gericke, N., Sass, W., Boeve-de Pauw, J. (2020). Self-perceived action competence for sustainability: The theoretical grounding and empirical validation of a novel research instrument. *Environmental Education Research, 26*(5), 742-760. https://doi.org/10.1080/13504622.2020.1736991.

Orr, D. W. (1994). *Earth in mind: On education, environment, and the human prospect.* Island Press.

Pergams, O. R. W., & Zaradic, P. A. (2006). Is love of nature in the US becoming love of electronic media? 16-year downtrend in national park visits explained by watching movies, playing video games, internet use, and oil prices. *Journal of Environmental Management 80*(4), 387-393. https://doi.org/10.1016/j.jenvman.2006.02.001.

Peterson, D. K., & Pitz, G. F. (1988). Confidence, uncertainty, and the use of information. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 14*(1), 85–92. https://doi.org/10.1037/0278-7393.14.1.85.

Piaget, J. (1971). The theory of stages in cognitive development. In D. R. Green, M. P. Ford, & G. B. Flamer, *Measurement and Piaget*. McGraw-Hill.

Qualtrics Experience Management (2022). Guide to margin of error. *Qualtrics.com*, https://www.qualtrics.com/experience-management/research/margin-of-error/.

Rejeski, D. W. (1982). Children look at nature: Environmental perception and education. *The Journal of Environmental Education, 13*(4), 27-40. https://doi.org/10.1080/00958964.1982.9942653.

Sobel, D. (1996). *Beyond ecophobia: Reclaiming the heart in nature education.* Orion Society.

Truong, M., & Clayton, S. (2020). Technologically transformed experiences of nature: A challenge for environmental conservation? *Biological Conservation, 244*(1). https://doi.org/10.1016/j.biocon.2020.108532.

Twenge, J. M., & Campbell, W. K. (2018). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Preventative Medicine Reports, 12*(1), 271-283. https://doi.org/10.1016/j.pmedr.2018.10.003.

Wray-Lake, L., Flanagan, C. A., & Osgood, D. W. (2010). Examining trends in adolescent environmental attitudes, beliefs, and behaviors across three decades. *Environment and Behavior, 42*(1), 61-85. https://doi.org/10.1177/0013916509335163.

Xu, W., & Zammit, K. (2020). Applying thematic analysis to education: A hybrid approach to interpreting data in practitioner research. *International Journal of Qualitative Methods, 19*. https://doi.org/10.1177/1609406920918810.

Yeo, N. L., White, M. P., Alcock, I., Garside, R., Dean, S. G., Smalley, A. J., & Gatersleben, B. (2020). What is the best way of delivering virtual nature for improving mood? An experimental comparison of high definition TV, 360° video, and computer generated virtual reality. *Journal of Environmental Psychology, 72*(1). https://doi.org/10.1016/j.jenvp.2020.101500.

Appendix A

Teacher Instructions and Clips of Recorded Nature Footage

The following instructions were provided to the teacher of students in the experimental group. Some formatting has been edited for clarity.

Safe YouTube links are provided for each video. Please observe the following directions when showing the videos. If you have any questions, please reach out. Thank you for your help in this study!

1. Watch each video on the specified day of the study. Make sure that as many participating students as possible are present during the time it is shown, and record the total number of participating students who watched the video. I will be coming to observe clips 7, 8, 9, and 13; we can work out the time for showing those videos later.
2. If students ask any questions about the content in the videos, do not give a reply that provides them with the answer, even if you are sure of the correct answer. For example, if a student asks “Do penguins live on the North Pole or the South Pole?,” an appropriate answer would be “Hm, that’s a good question.” The only exception to this is that you may read them any text shown in the video, and you may tell them the description I have provided.
3. Do not lead a discussion or ask questions about the video afterward. However, if the students want to talk about something they saw or heard, you may facilitate the discussion by simply calling on students and giving a nod, “ok,” “hm, perhaps,” restating their statement, or another similar response. The students may debate questions and ideas among themselves if they wish and if you have the time to allow for it.
4. If at any time a student expresses discomfort about watching a video, you may tell them that they are allowed to turn around so they can’t see it. If this happens and they miss over half the video because of it, do not count them as a participating student. None of the videos are expected to be distressing; this is simply a precaution in case of a student having a strong phobia of a particular animal.

Table A1

Clips of recorded nature footage

Clip # (Day)	Description	Length	Link
1 (10/18)	Our Beautiful World	2:17	https://video.link/w/m58pd
2 (10/19)	Frogs	2:36	https://video.link/w/h6Zpd
3 (10/20)	Banded Mongoose	1:46	https://video.link/w/108pd
4 (10/21)	Surviving in the Snow	4:19	https://video.link/w/G92xd
5 (10/24)	Mountains	2:31	https://video.link/w/pB8pd
6 (10/25)	Wolf Queen and Cubs	3:06	https://video.link/w/x48pd
7 (10/26)	Singing Nightingale	2:28	https://video.link/w/SM8pd
8 (10/27)	Birds	4:19	https://video.link/w/yG8pd
9 (10/28)	Scorpions	1:46	https://video.link/w/q28pd
10 (10/31)	Underwater	3:10	https://video.link/w/G2Zpd
11 (11/1)	Pandas	4:11	https://video.link/w/YI8pd
12 (11/2)	Koalas	4:05	https://video.link/w/h98pd
13 (11/4)	Fireflies	3:01	https://video.link/w/I9Zpd
14 (11/7)	Baby Penguin	4:22	https://video.link/w/Vv8pd
15 (11/8)	17 Different Species of Penguins	4:03	https://video.link/w/Cw8pd

Note. More detailed information regarding the source for each clip is listed in Table A2. The sources are provided for reference purposes but were not part of the instructions provided to the teacher.

Table A2

Sources for clips of recorded nature footage

#	Source
1	National Geographic Wild. (2018, April 22). *Watch the first 2 minutes of symphony for our world*. [Video link no longer available].
2	National Geographic Wild. (2017, July 3). *The glass frog: Ultimate ninja dad*. https://youtu.be/U7zARByAu1c.
3	National Geographic Kids. (2015, December 18). *Banded mongoose: Amazing animals*. https://youtu.be/jRzFs39gNOs.
4	BBC Earth. (2021, June 17). *Fox dives head first in to snow*. https://youtu.be/l9GMrP-2-Wc.
5	Signorini, F. (2019, July 15). *Mountains: Drone aerial footage*. https://youtu.be/Wp7iq6kc4Pc.
6	National Geographic Wild. (2019, August 19). *The wolf queen and cubs: Kingdom of the white wolf*. https://youtu.be/PCr65iD8Id4.
7	Wildlife World. (2015, October 26). *Singing nightingale: The best bird song*. https://youtu.be/XdlIbNrki5o.
8	Free School. (2015, November 9). *All about birds for children: Animal learning for kid*s. https://youtu.be/jF0Id-hH9y4.
9	National Geographic Kids. (2015, November 27). *Scorpion: Amazing animals*. https://youtu.be/eT89nvkYNDM.
10	National Geographic. (2017, January 18). *Beautiful "underwater kaleidoscope"*. https://youtu.be/4i6VSrIYRYY.
11	Free School. (2016, September 15). *All about pandas for kids*. https://youtu.be/VNxx8jVEm3I.
12	National Geographic Wild. (2019, May 9). *Koalas 101*. https://youtu.be/oI3ADcDH0Uc.
13	Congdon, B. (2019, May 24). *Mexico's magical fireflies*. https://youtu.be/GXr6qMwPkFs.
14	BBC Earth. (2021, December 18). *Baby penguin tries to make friends: Snow chick, a penguin's tale*. https://youtu.be/q3uXXh1sHcI.
15	Sidey, R. (2021, March 3). *17 penguin species in one video*. https://youtu.be/JxyGKmJIB1Y.

Appendix B

Survey Statements and Interview Questions

Table B1

Statements for both the pre- and post-survey

#	Symbol	Statement
1	sun	I like nature.
2	triangle	I like spending time in nature.
3	eye	I like learning about nature.
4	umbrella	I like when people talk to me about nature.
5	truck	I think playing inside is more fun than playing outside.
6	circle	I know how to help the environment.
7	airplane	As a first grader, I am able to help the environment.
8	square	The schoolyard is nature.
9	moon	Zoos are nature.
10	hand	I can find nature within walking distance of where I live.
11	house	I think that looking at videos of nature is more fun than seeing nature outside.
12	bike	I do not like nature.
13	cloud	I do not like spending time in nature.
14	shirt	I do not like learning about nature.
15	star	I do not like when people talk to me about nature.
16	boot	I think playing outside is more fun than playing inside.
17	palm tree	I do not know how to help the environment.
18	fork	I'm not old enough to help the environment.
19	sailboat	The schoolyard isn't really nature.
20	bell	Zoos aren't really nature.

#	Symbol	Statement
21	chair	I have to travel in a car or bus in order to get to nature.
22	baseball cap	I think that seeing nature outside is more fun than looking at videos of nature.

Questions for Both the Pre- and Post-Interviews

Any questions asked will be from this list, but students may not be asked every question.

1. What is nature? What do you think of when you think of nature?
2. Do you like nature? Why/why not?
3. Do you like learning about nature? Why/why not?
4. Do you prefer to spend time inside or outside? Why?
5. How can we take care of nature?
6. Where's the closest place I can find nature?
7. Do you have a yard? What's your yard like? Is your yard nature?
8. Would you rather look at a video of nature, or look at it outside in Tucson/your yard? Why?
9. How do you feel about zoos? Do you think they are nature?

Questions for Research Group Post-Interview Only

1. What do you think of the nature videos you watched? How do they make you feel?
2. Do you think you'll ever see something like what you saw in those videos in real life? What do you think you would/would never see?
3. Did you prefer the videos with someone talking in the background, or the videos without talking? Why?

Appendix C

Survey and Interview Introduction Scripts

Survey Introduction Script

As I told you about before, now I'm going to give you all a/another survey about what you think about nature. A survey is meant to help people understand what you think. Surveys aren't like tests because surveys have no right or wrong answers. I won't be upset with any answer you give; I just want to know what's going on in your brain, and nobody but me will know who gave what answers.

In just a moment, we'll start passing out the surveys. Once everyone has one, I'll read a statement. If you agree with the statement you'll circle the thumbs-up, if you disagree with it you'll circle the thumbs-down, and if you're neutral or in the middle you'll circle the person shrugging. And if you don't want to answer a question, you can leave it blank. The numbers and pictures along the side are just to help keep us all together on the same question.

So for example, if I said to put your finger on the backpack, you'd put your finger on the backpack. Then I might say something like, 'I like to swim.' If you like to swim, you'd circle the thumbs-up next to the backpack. If you don't like to swim, you'd circle the thumbs-down next to the backpack. If you're neutral or in the middle about swimming, you'd circle the person shrugging next to the backpack. Then we'll repeat that for each statement.

We're going to stay quiet during this survey because I want you all to give your own answers. So if your friend turns to you and says what they're answering, that might make you feel unsure about your answer, so that's why we're not going to tell anyone else what we answer or do any other talking. If you have a question during the survey or need me to slow down, just stay in your seat and raise your hand. Does anybody have any questions before we get started?

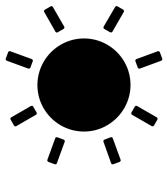
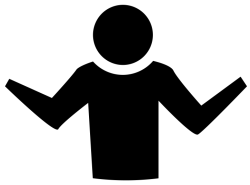
Interview Introduction Script

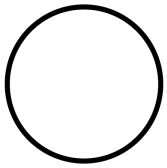
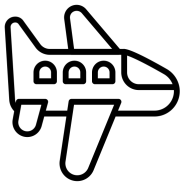
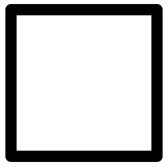
I know you already did the survey about nature, but those surveys don't give you a chance to explain your answers, and I'm interested in having a conversation about what you think about nature. Just like the surveys, the questions I'd like to ask you have no right or wrong answers, I won't be upset with any answer you give, and if I share any answers I won't tell anybody it was you who said them. And if you don't want to answer a question, you can just tell me to skip it and that's ok. Would it be ok with you if we sat outside the classroom for a few minutes to talk about what you think about nature? Your parents have already said it's ok. [wait for response, and if affirmative, continue] And would it be ok with you if I recorded just the voice of our conversation? Your parents gave their permission for this, and I won't record any pictures or videos, just the sound.

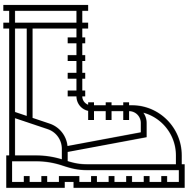
Appendix D

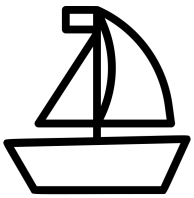
Survey Response Sheets

Response ID: _____

1				
2				
3				
4				
5				

6				
7				
8				
9				
10				
11				

12				
13				
14				
15				
16				
17				

18				
19				
20				
21				
22