DEVELOPMENT OF A SURVEY TO MEASURE EFFECTS OF INFORMAL WILDLIFE EDUCATION PROGRAMS ON VISITOR ATTITUDES AND BEHAVIORS CONCERNING SNAKES AND CITIZEN SCIENCE

By

SARAH HORSLEY

(Under the Direction of Gary T. Green)

ABSTRACT

Though snakes are the most highly reported fear among adults in the US and are often subjects of persecution, nature centers attempt to promote positive attitudes and behaviors concerning snakes through educational programs. Two wildlife education programs were examined to understand how effective current methods are toward influencing attitudes and behaviors regarding snakes. A nature center's 'Snake Day' provided the full interpretive treatment: information, exposure, direct contact, and modeling. The nature center's permanent exhibit of snakes provided only information and exposure. A survey was developed to measure visitors' attitudes and behaviors toward snakes. Data from post-test intercept surveys revealed six snake attitude and behavior dimensions through an exploratory factor analysis. A pre and post-test survey analysis revealed no significant differences between those entering and leaving Snake Day, but the exhibit produced a significant increase in four attitude components. Results indicated the exhibit had a greater capacity to change attitudes during a visit and the major difference between the events outcomes were with the Moralistic-Ecologistic dimension.

INDEX WORDS: Citizen science, Environmental education, Informal education, Nature center, Snakes, Snake day, Snake exhibits

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SARAH HORSLEY

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By

SARAH HORSLEY

Major Professor: Gary T. Green

Committee: Kris Irwin
John Maerz

Electronic Version Approved:
Suzanne Barbour
Dean of the Graduate School
The University of Georgia
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CHAPTER 1

LITERATURE REVIEW

Wildlife education is an important aspect of environmental education, as wildlife are often a gateway concept to which the public can easily empathize and connect in order to understand complex ideas such as ecological interrelationships, conservation, and management strategies (Adams & Thomas, 1986; Kimble, 2014). However, some wildlife are regarded negatively in the eyes of the general public and hence wildlife education programs are often used to help promote positive attitudes towards wildlife. Wildlife education programs such as "Snake Day," are held by nature centers with the goal of ameliorating misinformation and promoting positive and respectful attitudes toward snakes. However, for these programs to be considered worthwhile, they should succeed in producing a change in knowledge, attitudes, awareness, and action concerning wildlife (Morgan, 1992). Currently there is a deficiency of information concerning how effective certain wildlife education strategies are in producing such changes and an investigation of current methods could help practitioners better understand how to affect attitude and behaviors regarding snakes (Sanderson et al., 1979; Tierney & Connolly, 2013). Additionally, local programs such as Sandy Creek Nature Center's Snake Day in Athens-Clarke County, Georgia, often face reduced budgets and limited resources to promote such events. Hence, research that examines any possible impacts of hosting a Snake Day could help nature centers secure grants for further herpetological outreach programs.

Attitudes and Behaviors Concerning Snakes

A fear of snakes, or odiophobia, is commonly the most highly reported fears held by adults (M. H. Means, 1936; Seim & Spates, 2010), with over a third of people in the United States reporting they are 'very afraid' of them (Taylor, 1999) . Phobias are largely considered to be irrational responses, while

rational fear typically comes from negative experiences. A fear response toward snakes by humans is argued to be a physiological and behavioral process that has evolved from relationships between large and/or venomous snakes and danger to primates throughout evolutionary history and development (Isbell, 2009). Isbell suggests that certain traits held by snakes, such as venom toxicity or camouflage, and traits held by humans (among other primates), such as excellent vision and communicative fear responses to recognizing threats, emerged from co-evolutionary pressures between snakes and mammals as prey. There is research that demonstrates humans have subconscious responses of anxiety when they see an image of a snake displayed too quickly to consciously recognize, suggesting an innate fear response (Öhman & Soares, 1994). Additionally, examinations of other primates show a fear and avoidance responses toward snakes despite never having had any previous experience with a snake (Weiss, Brandl, & Frynta, 2015). However, there is also support for an amount of learned behavioral fear reactions to snakes, in which rhesus monkeys without any experience with snakes demonstrated fear responses toward images of snakes "vicariously" after see recordings of other rhesus monkeys reacting fearfully toward a snake (Cook, Mineka, Wolkenstein, & Laitsch, 1985). While fear of snakes is theorized to be a rational adaptive response developed throughout primate evolutionary history, it may no longer be a necessary adaptation for many people in certain parts of the world. For example, the fear of snakes reported by 36% of adults in the 1999 Harris poll was conducted in the United States, where only 0.06% of people who actually bitten by venomous snakes die from it, as reported by the Center for Disease Control and Prevention (2012). Globally, it is estimated that approximately 4.75% of people die when bitten by venomous snakes (Kasturiratne, 2008); this difference may be due to abundance of dangerous species (approximately 15% of species globally (Kasturiratne, 2008)), more limited access to antivenin and medical care, and greater exposure to the outdoors in more agrarian societies. Though the fear of snakes is rational in an evolutionary sense, many humans maintain the fear despite never having had direct negative experiences with dangerous snakes to support it. If humans act indiscriminately on the fear response, it could lead to excessive persecution of snakes, which can serve as both predators and prey in their environments. Ostfeld and Holt (2004) discuss the possibilities of an effect of predators, such as hawks,

mammals, and snakes, on human incidence of disease through predation of rodents, which can act as reservoirs for pathogens. The authors identify that these connections are assumed through theory and are not necessarily backed by evidence, as there is likely large variability within the effects of each of these factors, such as population dynamics and behavior. However, there are practices in the United States that intentionally remove snakes from their environments and while more research is needed to understand broad effects of these actions, they have direct impacts on those snake populations (D. B. Means, 2009). For instance, the southern United States has a history of "rattlesnake roundups" that feature community hunts to remove rattlesnakes, which result in detrimental environmental practices and risks of snakebites from unnecessary contact (Adams, Thomas, Strnadel, & Jester, 1994; D. B. Means, 2009). However, many of these roundups are being transitioned to wildlife festivals that celebrate the rattlesnake, among other animals. Understanding educational methods for attitude and behavior change regarding snakes could promote better communication of conservation decisions and action that is well accepted and supported by the general public. Effective wildlife education concerning snakes is important, as conservation of snakes is becoming an issue in many parts of the world. Globally, populations of many snake species are experiencing declines (Reading et al., 2010) and the IUCN celebrated 2013 as the Year of the Snake to help promote snake conservation (IUCN, 2013). In Georgia, the site of this present study, there are 41 species of snakes, of which 16 species are considered 'Species of Concern' by the state, 2 are considered 'Threatened' by the state, and 1 is federally listed as 'Threatened' (Jensen, 2008). Hence, wildlife education programs concerning snakes can help promote greater awareness of conservation issues regarding snakes to the public.

Wildlife Education Techniques

According to the Tbilisi Declaration, environmental education (EE) is guided by the goals of (1) fostering awareness of economic, social, political, and ecological interdependence, (2) provide people with opportunities to acquire knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment, and (3) create new patterns of behavior of individuals, groups, and society as a

whole towards the environment (Barry, United Nations Educational, & Cultural Organization, 1978). It is recommended that EE focuses its efforts within five categories: awareness, knowledge, attitudes, skills, and participation. The present study focuses on the capacity for attitude and related behavioral intention change within two informal education programs. Theories of attitude change, such as Ajzen and Fishbein's Theories of Reasoned Action and Planned Behavior, propose a hierarchical relationship between beliefs, attitudes, and behavior, where beliefs shape our attitudes toward an object, which then influence our intention in behaving a particular way regarding an object (Fishbein & Ajzen, 2010). That behavioral intention is further influenced by subjective norms described by a person's perceived social pressures concerning behaving that way. The Theory of Planned Behavior further modified this framework by proposing that behavioral intention is only one factor in a person's actual executed behavior, which can be altered by a person's perception of their control, or self-efficacy, in executing that behavior (Ajzen, 1991). With the exception of snake fear being weakly correlated with ignorance about snakes (Makashvili, Kaishauri, & Azmaiparashvili, 2014), positive attitudes have not always been correlated specifically with levels of knowledge (Lahart, 1981), which calls for an investigation of other affective elements of informal environmental education programs. Wildlife education programs featuring snakes often use a particular set of techniques associated with phobic-behavior, including exposure, modeling, direct contact, and information. Exposure involves only showing a person an object, which can result in a slight improvement of attitudes toward the object (Kress, 1975; Zajonc, 1968) but is not necessarily effective for those with snake-phobias (Bandura, Blanchard, & Ritter, 1969). Modeling involves a person observing another person's experience with an object, and has been found to be effective in attitude change of adults regarding snakes (Blanchard, 1970). Direct contact involves a person touching or holding a snake, which also can result in positive attitude change toward snakes (Blanchard, 1970) and is particularly effective when the negative attitudes were based on misinformation (Newcomb, Turner, & Converse, 1965). The information method consists of factual messages presented to a person, with no physical or visual interactions with the object. The information method was not found to be an effective technique to improve attitudes, but when paired with other techniques was effective in changing

children's attitudes toward snakes (Morgan & Gramann, 1989). However, it is important to understand how snake education programs affect adults, because they often visit education programs with their families and are likely property owners or consumers whose choices may have an effect on snake conservation.

With growing interests in non-consumptive activities regarding wildlife, such as birdwatching, and subsequent needs for enhanced wildlife education programs, it is important to identify and understand the attitudes and behaviors of humans toward wildlife (Morgan, 1992). Stephen Kellert developed a conceptual framework that describes human attitudes toward animals through a set of typologies, including the following, described further in Table 1.1: Aesthetic, Dominionistic, Ecologistic, Humanistic, Moralistic, Naturalistic, Negativistic, Scientistic, and Utilitarian (Kellert, 1980).

Table 1.1

Kellert's Typologies of Orientations Towards Wildlife

Typology	Description
Aesthetic	Interest in the artistic and symbolic characteristics of animals.
Dominionistic	Satisfactions derived from mastery and control over animals, typically in sporting situations.
Ecologistic	Concern for the environment as a system, for interrelationships between wildlife species and natural habitats.
Humanistic	Interest/affection for individual animals, principally pets.
Moralistic	Concern for the right and wrong treatment of animals, with strong opposition to exploitation of and cruelty toward animals
Naturalistic	Interest/affection for wildlife and the outdoors
Negativistic	Primary orientation an active avoidance of animals due to dislike or fear.
Neutralistic	Orientation of passive avoidance of animals due to indifference and lack of interest
Scientistic	Interest in the physical attributes and biological functioning of animals.
Utilitarian	Concern for the practical and material value of animals

However, investigations focusing on perceptions of snakes are often limited to fear while other types of attitudes are ignored. Prokop et al. note a lack of research into attitudes other than fear toward snakes, as well the neglect of factors such as venomous or nonvenomous snakes and snakes in the wild or as pets, which could provide valuable information about attitude differences (Prokop, Özel, & Uşak, 2009). A more complete understanding of attitudes and behaviors regarding snakes could help wildlife educators plan programming that may positively affect visitors' attitudes in more than one dimension. Hence, this study aimed to develop a survey that measured attitudes and behaviors concerning two subjects: 1) snakes and 2) citizen science (CS), which is a specific type of wildlife education program in which the public can contribute to scientific research.

Previous Surveys Concerning Snakes

Prokop et al. developed a Snake Attitudes Questionnaire (SAQ) based on adaptation of previous questionnaires that focused on unpopular animals such as bats and spiders (Prokop et al., 2009). An exploratory factor analysis of the SAQ data revealed a structure similar to Kellert's typologies of attitudes toward animals where multiple dimensions were present, including: Negativistic, Scientistic, Naturalistic, Ecologistic, and Knowledge. The Prokop et al. survey was designed for a comparison between students in Turkey and Slovakia, so many questions were designed to be geographically relevant to that area. The SAQ was also adapted and tested on pre-service biology teachers, revealing the attitude dimensions of Negativistic, Scientistic, Moralistic, and a behavioral dimension of Willingness (Tomazic, 2011). Other surveys regarding snakes were commonly designed for children, so responses were often in the simple format "Dislike or Like" or ranking attachment to types of animals (Ballouard, Provost, Barré, & Bonnet, 2012).

Citizen Science

Citizen Science (CS) is an area at the intersection of research and environmental education that allows non-scientists to participate in scientific research through opportunities such as volunteer data collection and project design. Citizen Science is seen as beneficial for conservation in two manners: access to volunteer data collection in more widespread geographic areas and engagement of the public with scientific learning opportunities. Projects have found that volunteers can produce credible data, however learning outcomes and attitude or behavior change of participants is not well understood (Brossard, Lewenstein, & Bonney, 2005; Crall et al., 2013; Toomey & Domroese, 2013).

With CS as a growing resource for scientific research, it is important to gauge interest of education program visitors in becoming citizen scientists, as they are already somewhat engaged with environmental learning. A review of the literature yielded few items that measure interest in participating in CS programs, and none that were snake-specific (Toomey & Domroese, 2013). However, an examination of the attitudes of potential and current CS participants can help research projects design the most appropriate methods to use when trying to obtain involvement from potential citizen scientists. It is also important to identify and understand the preferences of CS participants for retention and longevity, especially considering the scientific importance of long-term data collection (Chu, 2013), and to provide CS programs that appeal to many visitors, which this study aims to do through measuring attitudes and behaviors of visitors in different educational settings (Phillips, 2013). In order to have a well-design CS project, it is important for CS practitioners to recognize the preferences, education, and demographic information concerning potential participants in order to understand their abilities and interests.

A review of the literature revealed the presence of surveys that address specific qualities of existing CS programs, which limits their use in planning new programs or application across multiple programs (Crall et al., 2013; Toomey & Domroese, 2013). Previous CS surveys focused on measuring attitude change or learning outcomes concerning conservation, the nature of science, or concepts specific to the CS project (e.g. invasive species) (Brossard et al., 2005; Price & Lee, 2013), but there were no

existing assessments of how groups that weren't currently citizen scientists felt about non-scientists and public participation in scientific research (PPSR). This concept may be important to understand in planning future CS programs, as there is a growing disengagement of the general populace with science (Osborne, 2003), which could possibly lead to a reluctance to participate in CS programs from perceptions of science as 'too foreign' or inappropriate for non-scientists. Additionally, it may be important to understand how citizen scientists perceive their role in the scientific process (Price & Lee, 2013).

Study Site

Sandy Creek Nature Center (SCNC) in Athens-Clarke County, Georgia, is an environmental education center that offers programs and opportunities for learning and recreation to the public. The Nature Center is operated by Sandy Creek Nature Center, Inc., a private, non-profit organization who states their mission as "to support, promote and protect the environmental education and preservation efforts of Sandy Creek Nature Center. We work to ensure that natural science and environmental education opportunities are available to everyone in our local and regional community" (Sandy Creek Nature Center). The nature center building is located on grounds that include hiking trails, historic buildings, a pond, and a garden. SCNC offers two major programs to learn about snakes, including Snake Day, which occurs one day every summer, and their permanent exhibit, which is open Tuesday through Saturday throughout the year. Snake Day is a family-friendly event, offering opportunities to hear from experts and chances to touch nonvenomous snakes see venomous snakes and other native Georgia wildlife, including lizards, tortoises, or small mammals. This event occurs once a year during the summer and has approximately 800 visitors over the four hour period. The permanent exhibit is a space in the nature center where visitors have a chance to see snakes in naturalistic terraria and read interpretive signage including information about species names and characteristics, habitat, and diet. The permanent exhibit of snakes is located in a large exhibit room that also features marine and freshwater aquariua and terraria with other wildlife native to Georgia, such as frogs, lizards, and invertebrates. The room also

features interactive exhibits on sustainability and natural history, and a resource library. The admission to the permanent exhibit is free, while Snake Day charges a small admission fee ($3). There are currently CS programs that occur at the nature center, such as FrogWatch USA, Adopt-a-Stream, and Discover Life, but none that focus on snakes.

CHAPTER 2

DEVELOPING A SURVEY TO MEASURE VISITOR ATTITUDES AND BEHAVIORS REGARDING SNAKES AND SNAKE CITIZEN SCIENCE

Problem Statement

There is not a valid and reliable survey that jointly measures visitor attitudes and behaviors concerning snakes and snake Citizen Science (CS). In addition, existing snake attitudes surveys are often focused on snake species and cultural values that are not relevant in the Southeastern United States, where this main study is located.

Purpose Statement

The availability of surveys that incorporate both the topics of specific wildlife attitudes and associated CS perceptions is limited. The purpose of this research is to develop a valid and reliable survey that measures visitors' attitudes and behaviors concerning both snakes and snake CS.

Research Objective

Objective: Develop a valid and reliable survey that measures program visitor attitudes and behavioral intentions in regards to snakes and snake CS.

> *Null Hypothesis* H_1: Statistical analyses will fail to provide evidence that data from the Snakes and CS survey will reveal statistically significant reliable and valid responses concerning program visitor attitudes and behavioral intentions in regards to snakes and snake CS.

Alternative Hypothesis H_{1a}: Statistical analyses will provide evidence that data from the Snakes and CS survey will reveal statistically significant reliable and valid responses concerning program visitor's attitudes and behavioral intentions in regards to snakes and snake CS.

Methods

The Snakes and CS survey was created through an initial review of existing literature followed by adaptation and review by survey researchers and a pilot test, which resulted in further adaptation. The final survey contained 42 attitude and behavior items (using five point Likert scale responses to selected statements) out of 61 total items on the Snake and CS survey (Appendix A).

Survey Construction

Survey construction began with a literature review of previous surveys that measured people's attitudes and behaviors concerning snakes, general wildlife, and CS. Subsequently, items and related scales concerning snakes were adapted from three previous surveys (SAQ in Appendix C, Alves et al. in Appendix D, and Tomazic Factor Analysis in Appendix D) (Alves et al., 2014; Prokop et al., 2009; Tomazic, 2011). In particular, these items addressed snake fear, encounters, conservation actions, and place in nature. No items sets or scales were found in the literature that measured attitudes concerning public participation in scientific research or for likeliness to participate in CS involving snakes, but one item was identified that assessed interest in CS involving coyotes ("If there were a free coyote citizen science project available in your area, would you participate?"), so it was adapted for use with snake CS (Price & Lee, 2013). Hence, new questions and associated scales were developed and a draft survey was created. This draft survey was pilot tested to examine the validity and reliability of the survey before the survey was finalized. Items were arranged into sections within the survey to reflect item content, such as 'Attitudes about Snakes,' 'Contact with Snakes,' 'Learning about Snakes,' 'Behaviors,' 'Snake Conservation,' 'CS,' and 'CS and Snakes.' Sections varied in length from 4 items to 13 items. Responses were measured on a five point Likert-style scale that ranged from "strongly disagree to strongly agree" for attitudinal items and "very unlikely to very likely" for behavioral items. The full survey included three

other sections: five questions that addressed previous experience with snakes (as a pet or at a job) or previous educational programs involving snakes (measured with no or yes responses), five true or false questions about common snake myths (adapted from Prokop, Özel, & Uşak, 2009 and edited for relevance in US), and demographics including age, gender, area of residence (rural/suburban/urban), race, and level of education (based on existing Census questions). Survey instructions included definitions of CS, habitat, nonvenomous, and venomous. The pilot and final surveys were reviewed by several researchers familiar with survey design and additional minor changes were made. The survey was also translated into Spanish and reviewed by a native speaker.

Pilot Test

The draft survey (N=30) was administered to visitors ages 18 and older to Sandy Creek Nature Center in Athens, GA to evaluate the viability of visitors taking the survey while viewing the nature center exhibits or as an exit survey. The pilot test was conducted over four days in May 2014 at randomly selected two-hour morning and afternoon blocks. The draft survey included 76 items total (61 attitude and behavior items; Appendix B), which took visitors ten to fifteen minutes to complete. Items deemed problematic based on low Cronbach alpha reliability estimates (>0.7) (Cronbach, 1951), questions and comments from pilot participants, and review by researchers were deleted or rephrased. Survey items developed from the pilot test were reviewed again by researchers before the survey was finalized and distributed.

Final Survey Distribution and Sampling

Snake Day

Pre-test and post-test surveys were conducted on visitors of Snake Day, who served as one treatment group. Snake Day served as an active free-choice learning activity. Snake Day data were collected during the duration of the event (12 pm – 4pm, June 7th, 2014). As the majority of visitors attending came in groups, subjects were stratified by group. The researcher or a trained assistant asked all

adults (age 18 and over) in every other group entering the event through the front of the building to complete the pre-test survey and adults from every other group of visitors exiting the event through the back of the building (where outdoor Snake Day games and activities were located) to complete the post-test survey. For the duration of the event, the researcher or trained assistant was posted at either the entrance or exit and periodically would switch locations.

Nature Center Permanent Exhibit

Visitors to the nature center's permanent exhibit, a passive free-choice learning activity, served as the second treatment group. Permanent nature center exhibit data were collected from mid-June through mid-September. Before surveying took place, average visitors per hour for mornings and evenings were measured for weekdays and weekends at the nature center to estimate visitation and find peak times. Then, random morning and afternoon blocks were selected for week days and weekend days (i.e., created a sampling calendar) to reach an equal amount of visitors from each group (Morning: 10-12am; Afternoon: 2-4 pm). This procedure resulted in oversampling of mornings and weekdays to account for lower visitation rates during those blocks. Sundays and Mondays were not included in this calendar because the nature center building is closed these days. Pre-test surveys were issued by a researcher or trained assistant to the adults of every other group of visitors who were entering the room with the permanent snake exhibit and post-test surveys were issued to adults of every other group leaving the exhibit. Observations were made to ensure that adults who were issued the post-test did spend time looking at the exhibits.

Current Citizen Scientists

A post-test survey was also conducted on those who already engage in reptile-based CS projects by sending an electronic Qualtrics survey to current CS participants through reptile-based project emails listservs or social media groups. These groups were found with a snowball sampling method, where coordinators from already known CS projects were asked to suggest other projects they know of, and

coordinators of those projects suggested other projects, and so on, until the data collection ended in November. Because these participants were contacted electronically via email and sent a link to the electronic survey, they were informed (twice) before beginning the survey that the intended audience was people who participate in reptile CS (to reduce other types of citizen scientists or non-citizen scientists from completing the survey). There was an additional open-ended question on the survey for these participants that asked in which reptile based CS projects they have participated (Appendix F). Due to the nature of this sampling method, obtaining a valid response rate for the internet version of the survey given to current citizen scientists was not feasible.

Control

Visitors to the nature center grounds and trails when the nature center is not open served as the control group. The control group was only issued a post-test survey by a researcher or trained assistant. Control group sampling was completed as a parking lot exit survey during randomly selected mornings and afternoons of Sundays and Mondays from mid-June to mid-September based in a sampling calendar. Surveying was completed on Sundays and Mondays because the nature center is closed those days, and hence no treatment (i.e., services) was available to them. Additionally, the survey contained a question that asked visitors if they had previously visited snake day or the exhibits. Ten participants who had been to Snake Day before were removed from the control group, as their scores were significantly different from the other members of the control group on two dependent variables: Negativistic ($t=3.08$; $p<.05$) and Protection Advocacy ($t=5.18$; $p<.001$). Control group participants who had previously attended the permanent exhibit were retained because their scores were not significantly different than those who had never attended the permanent exhibit before.

Estimated response rates were as follow: Snake Day pre-test 55%, Snake Day post-test 40%, permanent exhibit pre-test 70%, permanent exhibit post-test 50% , and control post-test 30% .

Analysis

Survey coding and analysis are based on methods outlined by Vaske (2008). Five-point Likert-scale responses were coded into values of one for strongly disagree/very unlikely to five for strongly agree/very likely. Negative items were reverse coded for analysis with positive items. In the Statistical Package for the Social Sciences, Cronbach's alpha coefficients were used to examine internal consistency of pilot survey items used for item reduction and scale development of new questions or items assessed within the draft survey. If the removal of an item increased the reliability of the item set, it was removed. Survey reliability and validity analyses on the final survey were conducted using post-tests only (N= 259) to include data from each treatment and control group. Cronbach's alpha coefficients were used to assess internal consistency of the survey among treatment and control groups. An exploratory factor analysis extracted a number of underlying attitude and behavior components used to examine the validity of scales and associated items.

Results

Pilot Survey

All sections of the pilot had high coefficients for reliability (≥ 0.90). Therefore, participant oral or written concerns about any newly created items were the first measures addressed for item reduction and alteration. Then, remaining items with low reliability were deleted or adapted, resulting in a reduction from 61 attitude and behavior items in the pilot to 42 items (with two added during data collection that specified attitudes toward killing nonvenomous and venomous snakes in the 'Values of Snakes' section) in the final survey. Because of the minimally acceptable pilot sample size (N=30) and therefore increased potential for error, some items with lower reliability were retained for further analysis in the final survey distribution. Reliability of new CS attitudes and behaviors scales were high (see Table 1), so they were deemed suitable to use on the final survey.

Table 2.1

Cronbach's α Reliability Analysis for Pilot Test Attitude and Behavioral Constructs

Construct	Number of Questions	N	Cronbach's α
Snakes			
Attitudes	30	30	0.93
Behaviors	21	30	0.90
Citizen Science			
Attitudes	7	30	0.92
Behaviors	3	30	0.93
Total	61	30	0.97

Final Survey

Table 2.2

Cronbach's α Reliability Analysis of Final Survey across Pre-test and Post-test Groups

Test	N	Cronbach's Alpha
Pre-Test All	107[a]	0.96
Snake Day Entrance	57	0.96
Permanent Exhibit Entrance	50	0.96
Post Test All	220[b]	0.97
Snake Day Exit	56	0.94
Permanent Exhibit Exit	48	0.96
Citizen Scientists	77	0.96
Control	39	0.96

[a] 10 of the 117 surveys were omitted because of incomplete data.
[b] 70 of the 290 surveys were omitted because of incomplete data.

The overall reliability for the final survey across all treatment and control groups was high ($\alpha \geq 0.94$). Only 40 items were tested for reliability because two were added during data collection, and therefore not reported by all groups. Only post-test data was used for the exploratory factor analysis, as it represents responses from all treatment groups.

Attitudes Concerning Snakes

An exploratory factor analysis examined underlying components of data from items designed to measure attitudes toward snakes. The sample size for this analysis met the recommended ratio of between five and ten times the number of items (Pallant, 2013). Bartlett's test of Sphericity was significant ($p \leq 0.001$) (Bartlett 1954) and the Kaiser-Meyer-Olkin measure of sampling adequacy reported a value of

0.94, which was above the recommended value of 0.60 (Kaiser 1970). The principal component analysis extracted four components with eigenvalues greater than one; component one had an eigenvalue of 10.55 with 50.24% of the variance, component two had an eigenvalue of 1.72 with 8.19% of the variance, component three had an eigenvalue of 1.59 with 7.56% of the variance, and component four had an eigenvalue of 1.04 with 4.97% of the variance. Component one accounted for approximately half of the variance and total variance explained was 70.96%.

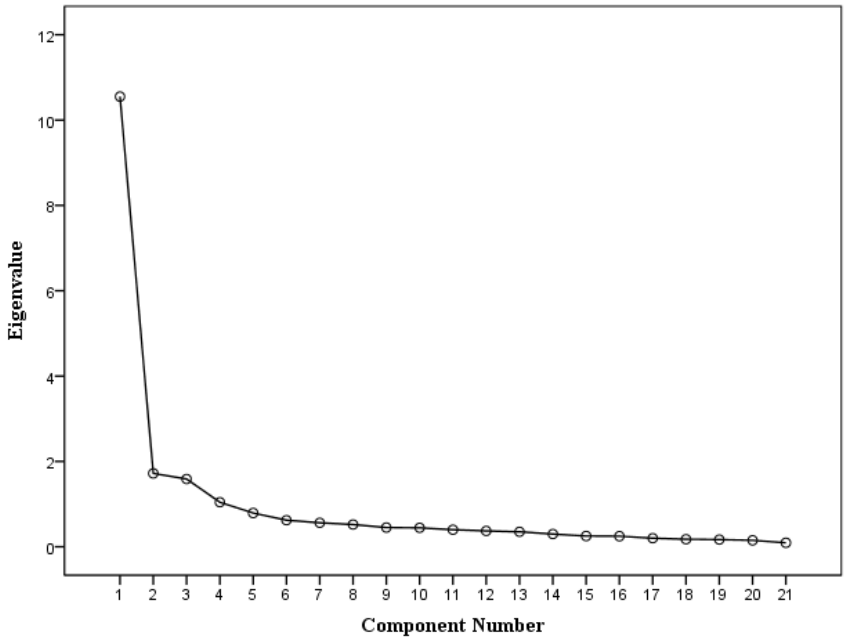

Figure 2.1. Principal components analysis Scree plot for post-test snake attitude item data.

According to item content and factor structure of a source survey in Appendix E (Tomazic, 2011), components extracted from the EFA were designated as the following: Moralistic-Ecologisitic (component 1), Negativistic (component 2), Utilitarian-Ecologistic (component 3), and Scientistic (component 4). Moralistic referred to ethical and human concerns for animals, Ecologistic referred to concern for dependencies between animals and their natural habitat, Negativistic referred to fear or avoidance, Utilitarian referred to usefulness and purpose of animals, and Scientistic referred to an interest

in the biological or physical characteristics of animals (Kellert 1980). As subsequent studies examining Kellert's typologies have identified combination typologies (Barney, Mintzes, & Yen, 2005; Rauwald & Moore, 2002; Thompson & Mintzes, 2002), Moralistic-Ecologistic referred to protection of snakes and their habitats and the items that loaded as Utilitarian-Ecologistic referred to the value and usefulness of snakes as a part of their ecosystems.

A Varimax rotation converged in six iterations and items that did not present any rotation loadings greater than 0.40 were removed from the analysis. Additionally, items that loaded greater than 0.50 on more than one component were removed. A simple structure was achieved (Thurstone 1974) with eight items loading strongly as Moralistic-Ecologistic, six items as Negativistic, four items as Utilitarian-Ecologistic, and three items as Scientistic (see Table 5). Structure of certain adapted items was fairly consistent with the factor analysis preformed on the source survey (Tomazic 2011), with minor differences created by interactions with new items. Items marked with an asterisk in Tables 2.3 and 2.4 were coded in reverse for analysis with positively worded items. Three items did not load with other items and were removed.

Behaviors Concerning Snakes

An exploratory factor analysis of post-test data extracted underlying components from items designed to measure behavioral intention regarding snakes. The sample size for this analysis met the recommended ratio of between three and ten times the number of items (Pallant, 2013). Bartlett's test of Sphericity was significant ($p \leq .001$) (Bartlett 1954) and the Kaiser-Meyer-Olkin measure was 0.84. A principal component analysis extracted two components with eigenvalues greater than one; component one had an eigenvalue of 4.21 with 60.18% of the variance, component two had an eigenvalue of 1.51 with 21.58% of the variance. A scree plot demonstrated a break at component 3. A Varimax rotation converged in three iterations and revealed four items loading strongly ($\geq .50$) under component 1 and three items loading strongly under component 2. Component 1 was named "Protection Advocacy" and component 2 was named "Contact Willingness" based on item content. Items that were negatively worded

were reverse coded for analysis with positively worded items, as designated by an asterisk in Table 2.4. The analysis revealed a simple structure (Thurstone 1974), as no items loaded strongly in the rotated matrix on more than one factor and no items did not load strongly on any factor.

Table 2.3

Component Loadings with a Varimax Rotation and Cronbach's α Reliability Analysis for Post-Test Snake Attitude Item Data

	Component			
Item	Moralistic-Ecologistic	Negativistic	Utilitarian-Ecologistic	Scientistic
There should be more laws that protect snakes.	0.83			
Snakes in the wild need more protection.	0.74			
There should be more laws that protect snake habitat.	0.75			
A person should be punished if they harm snakes.	0.69			
If I gave money to protect snakes, it would (not) be a waste.*	0.66			
I would be willing to donate money to protect snakes.	0.69			
I want to help protect snakes.	0.70			
Killing snakes is wrong.	0.57			
I am (not) afraid of snakes.*		0.85		
I am (not) scared more by snakes than any other animal.*		0.78		
If I see a snake, I (do not) tense up.*		0.81		
If I am in the woods, I want to see a snake.*		0.74		
I (do not) think snakes are dangerous.*		0.68		
I would like to see some snakes in nature.		0.61		
Snakes are important, as they kill mice and other rodents.			0.78	
Snakes are an important part of nature.			0.74	
Snakes have the same right to live as any other animal.			0.65	
Protecting snakes is (not) a waste of time.*			0.64	
I would like to learn more about snakes.				0.83
I would like to know how snakes eat, smell, and hear.				0.80
I would like to observe what snakes do in nature.				0.77
Cronbach's Alpha	0.91	0.91	0.80	0.94
% Variance	50.24	8.19	7.56	4.97
% Total Variance		70.96		

*These items were reverse coded

Table 2.4

Component Loadings with a Varimax Rotation and Cronbach's α Reliability Analysis for Post-Test Snake Behavior Item Data

	Component	
Item	Protection Advocacy	Contact Willingness
If you saw someone trying to kill a snake, how likely are you to:		
let them*	0.92	
do nothing*	0.89	
tell them to stop	0.86	
tell them the benefits of snakes	0.74	
How likely are you to :		
touch a live, nonvenomous snake		0.93
stand near someone holding a live, nonvenomous snake		0.91
hold a live, nonvenomous snake		0.86
Cronbach's alpha	0.91	0.91
% Variance	60.18	21.58
% Total Variance	81.76	

*These items were reverse coded

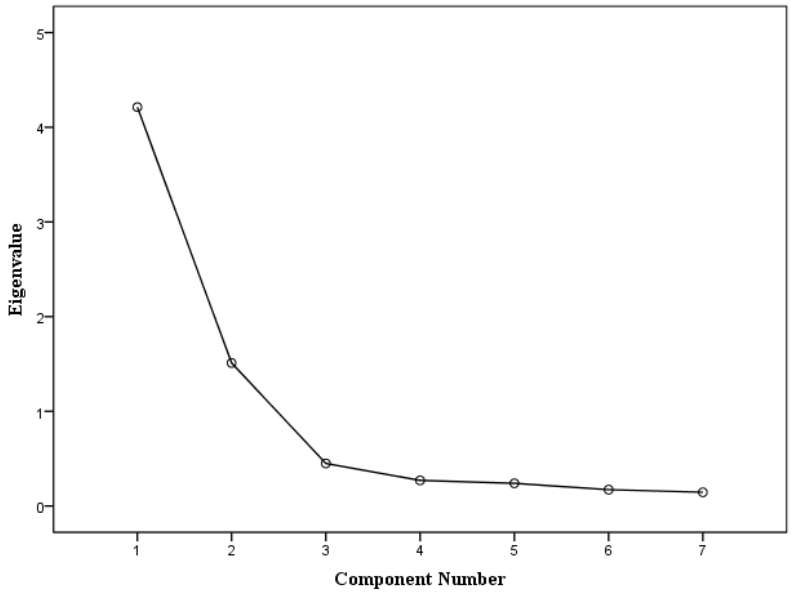

Figure 2.2. Principal components analysis Scree plot for post-test snake behavior item data.

Attitudes and Behaviors Regarding CS

Two novel constructs were assessed with an exploratory factor analysis of post-test data. Proper sample size, significant Bartlett's test of Sphericity ($p \leq 0$ .001) (Bartlett 1954) and the Kaiser-Meyer-Olkin measure of 0.81 confirmed this data was appropriate for this type of analysis. A principal component analysis extracted two components with eigenvalues greater than one: component one with an eigenvalue of 4.24 and 53.05% of the variance and component two with an eigenvalue of 2.22 and 27.77% of the variance. Hence, total variance explained was 80.8%. A scree plot demonstrated a break at component three. A Varimax rotation converged in three iterations and revealed three items loading strongly (≥0.50) under component one and five items loading strongly under component two. Component one was named "Snake CS Willingness" and component 2 was named "Public Participation in Scientific Research (PPSR) Attitudes" based on item content. Items that were negatively worded were reverse coded for analysis with positively worded items. The analysis revealed a simple structure (Thurstone 1974), as no items loaded strongly (≥0.50) in the pattern or structure matrices on more than one factor or not on any factor.

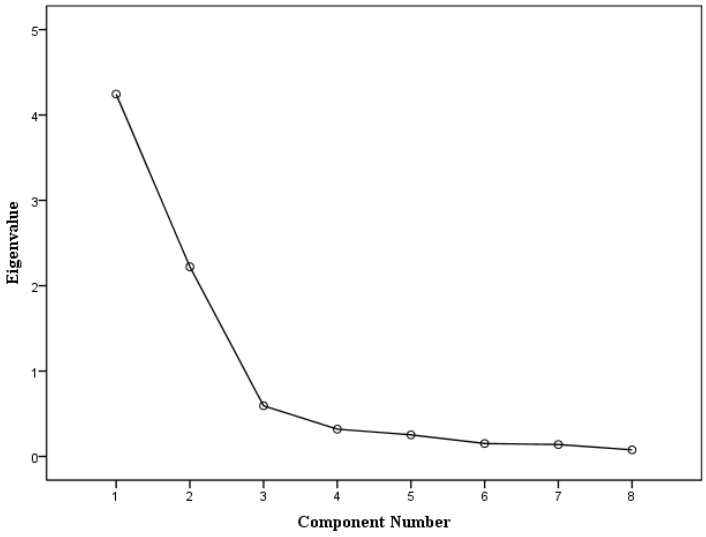

Figure 2.3. Principal components analysis Scree plot for post-test citizen science item data.

Table 2.5

Component Loadings with a Varimax Rotation and Cronbach's α Reliability Analysis for Post-Test Citizen Science Item Data

	Component	
Item	PPSR Attitudes	CS Willingness
I cannot contribute to scientific research if I am not a scientist*	0.83	
Research can only be done by scientists*	0.87	
Only scientists should be interested in research about snakes*	0.86	
Only scientists should care about understanding snakes*	0.87	.
Only scientists should contribute to scientific research*	0.83	
How likely are you to…		
Go outdoors to help a scientist look for nonvenomous snakes		0.95
Participate in a free citizen science project in your area that involves snakes		0.96
Volunteer your times to help scientists research snakes		0.4
Cronbach's Alpha:	0.91	0.96
% Variance	52.65	28.12
% Total Variance	80.76	

*These items were reverse coded.

Discussion

It was essential to test the reliability and validity of the survey instrument, as it was constructed from a combination of various snake attitudes surveys (some of which were previously tested for validity and reliability and some that were not) and new items. Furthermore, standardizing a valid and reliable snake-attitudes survey across cultures and geographic ranges was difficult because of differences in cultural meanings associated with snakes and variations in species (and therefore, potential threat to human health). However, a survey that could be standardized at a large scale could provide further insight into the nature of people's attitudes and behaviors associated with snakes, especially fear. A snake-attitudes and behavior survey that is valid and reliable at a regional level could be very useful where there is species or group-specific persecution, such as rattlesnakes in the southeastern United States. It is also beneficial to create a standard snake attitudes and behavior survey across subgroups, such as the differing types of snake conservation education and engagement tested in this study. Additionally, the integration

of CS measures into a survey concerning a specific group of animals can be beneficial for understanding how attitudes and behaviors affect a party's interest in pursuing a particular conservation activity. A standardized survey that integrates CS items with attitudes and behavior concerning particular wildlife could be adapted across taxonomic groups for future studies.

The Snakes and CS survey created in this study contained more items than previous surveys that assess attitudes and behaviors concerning either snakes or CS, as the survey was adapted from multiple surveys and integrated two new subjects. However, the item reduction from the pilot test analysis and the final survey exploratory factor analysis reduced the items to those with high reliability and fit strongly with underlying components. The resulting survey demonstrated reliability through high Cronbach's alpha values across pre-test and post-test groups, as well as treatments and control groups. Therefore, there was sufficient evidence to reject the null hypothesis H_1. The exploratory factor analysis of each subject of the survey revealed significant eigenvalues that reflect underlying components within each attitudinal and behavioral section. The six components within the snake attitudes and behaviors sections all displayed high reliability ($\geq$0.80). However, external validity of the survey may be limited, as participants self-selected from groups that are associated with CS or nature centers and likely are predisposed to towards snakes and snake CS. One challenge in developing attitude and behavioral scales that address snakes as a whole was differences in attitudes and behaviors regarding venomous and nonvenomous snakes. While it may have been clearer to fully specify each attitude and behavior measure with both venomous and nonvenomous snakes, the majority of survey items applied to snakes in general to decrease survey length and burden on the participant, and to use the survey in education events that promote positive attitudes and behavior toward all snakes. This problem is addressed by specifying the type of snake where a potential for danger to humans would be most relevant (i.e. How likely are you to touch a live, nonvenomous snake versus I would like to learn more about snakes). This distinction was not clear to all participants, so two questions were added for clarification concerning killing snakes during final survey implementation. However, these questions did not load strongly in the exploratory factor

analysis and were therefore excluded from further analysis. This result possibly indicated this survey did not sufficiently measure attitude and behavioral differences regarding killing venomous versus nonvenomous snakes and further scale development is necessary to increase sensitivity in these areas.

The scales associated with CS were specific to snakes in some items, but written in a way that other wildlife or topics could be substituted for future studies. The Public Participation in Scientific Research (PPSR) scale addresses one specific component of CS attitudes that had not been adequately measured in previous surveys. Results from these items only serve as a limited measure of CS attitudes and behavior, and should be combined with other scales for a more robust assessment of CS attitudes and behavior in future surveys. However, the new items assessed in this survey demonstrated reliability and each item had a high component loading. Additionally, the CS Willingness scale reliably measured willingness to participate in CS activities involving snakes across post-test groups. It is recommended that novel scales created for this survey be further tested for validity and reliability with different groups and adaptability with other topics.

Participants of the survey were self-selected, which is a source of inherent bias. Data collected from visitors to Sandy Creek Nature Center reflect only a small sample of visitors to nature centers and other "Snake Days," and results may vary across geographic regions, especially with those with differing species of snakes. Random selection of participants for treatments was not possible, however groups of visitors were randomly selected to complete the survey. Additionally, differences present prior to treatment could be controlled to a certain extent through statistical procedures. Because of the free choice, self-selected nature of the treatment groups, it was difficult to ensure equal amounts of exposure to the treatment across groups. Observations were made to verify that participants received exposure to snakes in the nature center permanent exhibit and Snake Day by taking note of where they entered and exited. Overall, the items in the survey each demonstrated internal consistency and significant underlying components with post-test data. New and adapted items were confirmed as valid and reliable

measurement tools with these sets of post-test data, but external validity is unknown and further testing is recommended for use with different groups.

CHAPTER 3

EFFECTS OF INFORMAL EDUCATION ON VISITOR ATTITUDES AND BEHAVIORS REGARDING SNAKES

Problem Statement

Studies that examine attitudes toward snakes are usually limited to the dimensions of fear and avoidance and focus less on ecological values and conservation so the effects of informal education programs on a multiple dimensions of attitudes and behaviors have not been adequately assessed.

Purpose Statement

This research was conducted to examine whether a Snake Day and permanent snake exhibit at a nature center affect visitor's attitudes and behaviors concerning snakes and their conservation as measured by a Snakes and CS survey.

Research Objective

Objective: Examine impacts of a Snake Day event and nature center snake exhibit on visitors' attitudes and behavioral intentions concerning snakes and their conservation.

Null Hypothesis (H2a): There will be no statistically significant differences in visitor's attitudes and behavioral intentions concerning snakes and snake conservation between pre and post-test groups of Snake Day and permanent exhibit treatment groups.

Alternate Hypothesis (H2b): There will be statistically significant differences in visitor's attitudes and behaviors toward snakes and snake conservation between pre and post-test groups of Snake Day and permanent exhibit treatment groups.

Null Hypothesis (H2c): There will be no statistically significant difference in visitor's attitudes and behaviors among control, Snake Day, and permanent exhibit post-test groups.

Alternate Hypothesis (H2d): There will be statistically significant differences in visitor's attitudes and behavioral intentions among control, Snake Day, and permanent exhibit post-test groups.

Methods:

The survey Snakes and CS survey was created through an initial review of existing literature followed by adaptation and review by survey researchers and a pilot test, which resulted in further adaptation. A selection of twenty eight items (with five point Likert scale responses) designed to measure visitor's attitudes and behavioral intention regarding snakes from the full survey were used in the present chapter.

Survey Construction

Survey construction began with a literature review of previous surveys that measured attitudes and behaviors concerning snakes, and general wildlife. Subsequently, items and related scales concerning snakes were adapted from three previous surveys (Alves et al., 2014; Prokop et al., 2009; Tomazic, 2011). In particular, these items addressed snake fear, encounters, conservation actions, and place in nature. A draft survey was developed and pilot tested to examine the reliability of the survey before the survey was finalized. Results from the final survey were tested with an exploratory factor analysis and Cronbach's alpha for validity and reliability. Items were arranged into sections within the survey to reflect item content, such as 'Attitudes about Snakes,' 'Contact with Snakes,' 'Learning about Snakes,' 'Behaviors,' and 'Snake Conservation.' Sections varied in length from 4 items to 13 items. Responses were measured on a five point Likert-style scale that ranged from "strongly disagree to strongly agree" for attitudinal

items and "very unlikely to very likely" for behavioral items. The full survey included three other sections: five questions that addressed previous experience with snakes (as a pet or at a job) or previous educational programs involving snakes measured with yes or no responses, five true or false questions about common snake myths (adapted from Prokop, Özel, & Uşak, 2009 and edited for relevance in US), and demographics including age, gender, area of residence (rural/suburban/urban), race, and level of education (based on existing Census questions). Survey instructions included definitions of habitat, nonvenomous, venomous. The survey was also translated into Spanish and reviewed by a native speaker.

Final Survey Distribution and Sampling

Snake Day

Pre-test and post-test surveys were conducted on visitors of Snake Day, who served as one treatment group. Snake Day served as an active free-choice learning activity. Snake Day data were collected during the duration of the event (12 pm – 4pm, June 7th, 2014). As the majority of visitors attending came in groups, subjects were stratified by group. The researcher or a trained assistant asked all adults (age 18 and over) in every other group entering the event through the front of the building to complete the pre-test survey and adults from every other group of visitors exiting the event through the back of the building (where outdoor Snake Day games and activities were located) to complete the post-test survey. For the duration of the event, the researcher or trained assistant was posted at either the entrance or exit and periodically would switch locations.

Nature Center Permanent Exhibit

Visitors to the nature center's permanent exhibit, a passive free-choice learning activity, served as the second treatment group. Permanent Nature Center Exhibit data were collected from mid-June through mid-September. Before surveying took place, average visitors per hour for mornings and evenings were measured for weekdays and weekends at the nature center to estimate visitation and find peak times. Then, random morning and afternoon blocks were selected for week days and weekend days to reach an

equal amount of visitors from each group (Morning: 10-12am; Afternoon: 2-4 pm). This procedure resulted in oversampling of mornings and weekdays to account for lower visitation rates during those blocks. Sundays and Mondays were not included in this calendar because the nature center building is closed these days. Pre-test surveys were issued to the adults of every other group of visitors who were entering the room with the permanent snake exhibit and post-test surveys were issued by a researcher or trained assistant to adults of every other group leaving the exhibit. Observations were made to ensure that adults who were issued the post-test did spend time looking at the exhibits.

Control

Visitors to the nature center grounds and trails when the nature center is not open served as the control group. The control group was only issued a post-test survey by a researcher or trained assistant. Control group sampling was completed as a parking lot exit survey during randomly selected mornings and afternoons of Sundays and Mondays from mid-June to mid-September. Surveying was completed on Sundays and Mondays because the nature center is closed those days, so there was no chance that the control subject underwent either treatment that day. Additionally, the survey contained a question that asked respondents if they had previously visited snake day or the exhibits. Ten participants who had been to Snake Day before were removed from the control group, as their scores were significantly different from the other members of the control group on two dependent variables: Negativistic ($t=3.08$; $p < .05$) and Protection Advocacy ($t=5.18$; $p < .001$). Control group participants who had previously attended the permanent exhibit were retained because their scores were not significantly different than those who had never attended the permanent exhibit before.

Estimated response rates were as follow: Snake Day pre-test 55%, Snake Day post-test 40%, permanent exhibit pre-test 70%, permanent exhibit post-test 50% , and control post-test 30% .

Analysis

Survey coding and analysis are based on methods outlined by Vaske (2008). Five-point Likert-scale responses were coded into values of one for strongly disagree/very unlikely to five for strongly agree/very likely. Negative items were reverse coded for analysis with positive items. Component scores were calculated by adding ascribed scale values reported for the items in each component and dividing by the number of items in each component. Independent t-tests were used to examine any differences between pre and post-test group scores for these component scores for both Snake Day and the permanent exhibit. Analysis of covariance was used to examine component score differences between the control, permanent exhibit, and Snake Day post-test groups. The effects of the covariates of gender and pet snake ownership were controlled for in the analyses.

Table 3.1

Pre-Test and Post-Test Implementation and Analysis for Treatment and Control Groups

Group	Pre-Test	Post-Test	Analysis
Snake Day	X	X	Independent *t* test (within) ANCOVA between all post-tests
Permanent Exhibit	X	X	Independent *t* test (within) ANCOVA between all post-tests
Control		X	ANCOVA between all post-tests

Results

Table 3.2

Descriptive Statistics for Dependent Variables and Post-Test Treatment Groups

Dependent Variable	Treatment	N	Unadjusted Mean	Unadjusted SD	Adjusted Mean	Adjusted SE
Moralistic-Ecologistic	Control	39	3.23	0.50	3.23	0.08
	Permanent Exhibit	50	3.25	0.63	3.25	0.08
	Snake Day	60	3.65	0.47	3.65	0.07
Negativistic	Control	39	3.42	1.00	3.80	0.16
	Permanent Exhibit	50	3.53	1.25	3.50	0.14
	Snake Day	60	3.46	1.03	3.45	0.13
Scientistic	Control	39	3.75	0.97	3.75	0.12
	Permanent Exhibit	50	4.14	0.67	4.15	0.10
	Snake Day	60	4.42	0.54	4.42	0.09
Utilitarian-Ecologistic	Control	39	3.79	0.32	3.80	0.05
	Permanent Exhibit	50	3.82	0.30	3.82	0.05
	Snake Day	60	3.80	0.32	3.80	0.04
Contact Willingness	Control	49	3.86	1.23	3.92	0.18
	Permanent Exhibit	50	3.99	1.23	3.95	0.16
	Snake Day	60	4.11	1.08	4.10	0.14
Protection Advocacy	Control	49	3.11	0.95	3.12	0.15
	Permanent Exhibit	50	3.52	1.09	3.52	0.13
	Snake Day	60	3.79	0.80	4.78	0.12

Table 3.3

Descriptive Statistics for Dichotomous Demographic and Snake Experience Items by Group

		Gender		Permanent Exhibit Before		Snake Day Before		Pet		At Job	
Treatment	Test	%Male	%Female	%Yes	%No	%Yes	%No	%Yes	%No	%Yes	%No
Control	Post	41	59	40	60	0	100	9	91	7	93
Snake	Pre	42	58	68	32	32	68	20	80	20	80
Day	Post	44	56	53	47	34	66	11	89	14	86
Permanent	Pre	40	60	56	44	15	85	7	93	9	91
Exhibit	Post	52	48	83	17	18	82	9	91	11	89

Within Group Differences

There were no significant differences between pre and post-test groups for Snake Day. There were significant differences between the permanent exhibit pre and post-test groups, including: Moralistic-Ecologistic ($t(110) = 2.26$, $p = 0.026$), Negativistic ($t(111) = 2.38$, $p = 0.019$), Scientistic ($t(109) = 2.64$, $p = 0.009$), and Contact Willingness ($t(112) = 2.01$, $p = 0.047$). Significance was measured at $\alpha = 0.05$. The magnitude of mean differences for these dimensions were moderate (see Table 4).

Table 3.4

T-test Results Comparing Permanent Exhibit Pre and Post-Tests

Dimension	t	df	*p*	Mean Difference	Std. Error Difference	95% CI for Mean Difference	
Moralistic-Ecologistic	2.25	110	0.026	0.27	0.12	-0.50	-0.03
Negativistic	2.38	111	0.019	0.52	0.22	-0.95	-0.09
Utilitarian-Ecologistic*	0.62	103	0.539	0.05	0.07	-0.19	0.10
Scientistic*	2.67	102	0.009	0.42	0.16	-0.72	-0.11
Protection Advocacy	1.88	109	0.063	0.40	0.21	-0.83	0.02
Contact Willingness*	2.02	111	0.046	0.50	0.25	-1.00	-0.01

*Equal variances not assumed: Utilitarian-Ecologistic, F= 7.013, *p* = 0.009; Scientistic, F = 4.174, *p* =0.043; Contact Willingness F = 3.929, *p* =0.05.

Between Group Differences

A multivariate analysis of variance was preformed to investigate treatment differences in post-test groups for attitudes and behaviors regarding snakes. Six dependent variables were used: Moralistic-Ecologistic attitudes, Negativistic attitudes, Utilitarian-Ecologistic attitudes, Scientistic attitudes, Protection Advocacy, and Contact Willingness. The independent variable was treatment type: control, snake day, permanent exhibit. Preliminary assumption testing was conducted to check for normality, linearity, outliers, homogeneity of variance-covariance matrices, and multicollinearity with no serious violations. Box's M Test of Equality of Covariance Matrices was not significant, but post test data for two of the six dependent variables produced significant values for Levene's Test of Equality of Error variances. Hence, a more stringent alpha value of 0.01 was used for analysis of the Negativistic and

Protection Advocacy variables. Two covariates were tested for independence from the treatment effect, gender and pet snake ownership, and neither violated the assumption on any dependent variable ($p >$ 0.05). The multivariate test was significant ($F(12,278) = 4.48$, $p < 0.001$; Wilks' lambda = 0.70; partial eta squared = 0.16), indicating the presence of differences across treatment groups for the combined dependent variables. When considered separately, three of the six dependent variables were significantly different between groups after controlling for pet snake ownership and gender: Moralistic-Ecologistic, $F(2,144) = 10.58$, $p < 0.001$, Scientistic, $F(2,144) = 10.13$, $p < 0.001$, and Protection Advocacy, $F(2,144) = 5.96$, $p < 0.05$.

Table 3.5

Analysis of Covariance Results Among Control and Treatment Post-Test Groups

Dimension	SS	df	MS	F	P
Moralistic-Ecologistic	5.83	2	2.92	10.58	0.001
Negativistic	0.08	2	0.04	0.04	0.961
Scientistic	10.45	2	5.23	10.13	0.001
Utilitarian-Ecologistic	0.01	2	0.01	0.06	0.938
Contact Willingness	0.91	2	0.45	0.36	0.696
Protection Advocacy	10.42	2	5.21	5.96	0.003

Pairwise comparisons of estimated marginal means were conducted with Bonferroni corrections to examine differences in component means between groups (bar graph visualizations in Appendix G). Visitors leaving Snake Day exhibit reported statistically significantly higher levels of Moralistic-Ecologistic attitudes (M=3.65, SE= 0.07) than the control post-test group (M = 3.23, SE= 0.08) and permanent exhibit post-test group (M= 3.25, SE= 0.08) but no significant difference between the permanent and control groups. Snake Day (M=4.41, SE=0.12) and the Permanent Exhibit (M=4.15, SE=0.10) both reported statistically significantly higher levels of Scientistic attitudes than the control post-test group (M= 3.75, SE= 0.15), but were not statistically significantly different from each other. Snake Day post-test visitors (M=3.78, SE= 0.12) reported statistically significantly higher Protection

Advocacy behavioral intentions than the control (M=3.12, SE= 0.15), and the permanent exhibit was not significantly different from either group. The difference in Scientistic attitudes and Protection Advocacy behavioral intent both exhibited the largest mean difference between Snake Day and the control at 0.67, which is more than half of a step increase on the 1-5 Likert-style scale, while the difference between these groups was 0.42 for Moralistic-Ecologistic attitudes.

Discussion

Theories of attitude change, such as Ajzen and Fishbein's Theory of Reasoned Action, propose a hierarchical relationship between beliefs, attitudes, and behavioral intention, where behavior regarding an object is influenced by attitudes about the object, which are shaped by beliefs concerning the object (Fishbein & Ajzen, 2010). Informal wildlife education programs aim to promote attitudes that emerge from beliefs shaped by factual information. For instance, the exhibits and events at Sandy Creek Nature Center that feature snakes provided information about snakes so that visitors may form attitudes and subsequent behaviors that are based on fact, not misinformation and myths that are often associated with snakes. However, with the exception of snake fear (Makashvili et al., 2014) positive attitudes have not always been correlated specifically with levels of knowledge (Lahart, 1981), which calls for an investigation of other affective elements of informal environmental education programs. Morgan and Gramann (1989) found that the information method only was not effective in positively influencing attitudes toward snakes. In order to be effective, information must also be presented with interpretive techniques, including modeling or direct contact and the greatest attitude change resulted from a combination of information and exposure, modeling, or direct contact interpretive techniques. In the present study, the experience in the permanent exhibit, which provided only exposure and information, was compared to a full treatment of modeling, exposure, direct contact, and information provided at Snake Day.

Analysis of Snake Day data did not reveal a significant difference in attitudes between pre and post-test groups, but the visitors leaving the permanent exhibit reported lower Negativistic attitudes and

higher Moralistic-Ecologistic and Scientistic attitudes, and higher Contact Willingness than the pre-test group, even though greater than 50% of visitors had seen the permanent exhibit before. These results do not align with previous research that found the full treatment to be most effective (Morgan & Gramann, 1989), but the full treatment in the present study involved adults that already had moderately positive attitudes and behaviors toward snakes. In addition, participants who attended the two types of events self-selected the treatment and were not assigned, so visitors attending Snake Day may have been predisposed to positive attitudes toward snakes, hence more sensitive instruments may be needed to understand the effects of treatments involving advanced levels of the subject matter (Phillips, 2013). Within the permanent exhibit, differences may have not been significant in the Utilitarian-Ecologistic dimension because of a greater content focus on specific snake species and biology than ecological role in nature. Including exposure to ecologically important species or umbrella species, such as the Indigo Snake, and including a greater depth of information on the ecological functions and benefits of snakes may affect the Utilitarian-Ecologistic dimension in a significant way. Changes in Protection Advocacy also may not have been significant because the permanent exhibit featured more venomous snakes than nonvenomous, which may have evoked different intentions for protection, and only exposure techniques or the interpretive signage did not offer any ethically affective information. More nonvenomous species than venomous in the live snake exhibits and signage that includes ethically affective information that may convey empathy toward snakes are possible ways to affect the Protection Advocacy dimensions.

The analysis of variance of post-test groups including the control, the permanent exhibit, and Snake Day revealed significant differences between groups in the Moralistic-Ecologistic, Scientistic, and Protection Advocacy dimensions. Snake Day post-test visitors had significantly higher levels of Moralistic-Ecologistic attitudes than the permanent exhibit and control, which were not significantly different themselves. This may have resulted from the addition of direct contact and modeling that was provided at Snake Day. These findings were similar to research by Morgan and Gramann (1989) where mere exposure was not found to be effective on its own, but modeling was effective on its own. Snake

Day and permanent exhibit post-test visitors both had significantly higher Scientistic attitudes than the control group, but the Snake Day and permanent exhibit groups were not significantly different from either. Snake Day provided depth of information and access to snake experts not experienced by control participants that may have promoted Scientistic attitudes and desire to learn more. Those visiting the permanent exhibit also had access to information and exposure, which also may have promoted learning attitudes. However, it is important to consider any effects the education center as a whole may have had on scientistic snake attitudes, as there were other educational exhibits and a resource library in the same setting. Additionally, the Snake Day post-test group reported higher levels of Protection Advocacy than the control group, which indicates that those leaving Snake Day report that they are more likely to advocate for the protection of snakes if someone were trying to kill one than those who just came to Sandy Creek for outdoor recreation. The higher Scientistic, Moralistic-Ecologistic, and Protection Advocacy dimensions of the Snake Day post-test group are those of the tested dimensions most closely related to conservation support, which suggests that Snake Day visitors may be best to further engage with conservation activities, such as citizen science.

Differences between groups were controlled for by using the covariates of pet snake ownership and gender. It has been found that fear of snakes is more pronounced in females (Fredrikson, Annas, Fischer, & Wik, 1996), however, a t-test of Negativistic attitudes ($t(117) = 2.75$, $p = 0.007$) for all post-test participants, separated by gender, showed that males ($M=3.75$, $SD = 0.97$) had significantly higher scores within post-test participants than females ($M=3.30$, $SD = 1.11$). Pet snake ownership was corrected for because of the greater number of times experiencing direct contact and exposure that snake owners will have had. This covariate had a significant effect on the Moralistic-Ecologistic and Negativistic attitudes and Contact Willingness behaviors of post-test groups, which were the dimensions that experienced the most change from the treatment that only had mere exposure as the opportunity for engagement with snakes.

Limitations

Participants of the survey are self-selected, which is a source of inherent bias. Data collected from visitors to Sandy Creek Nature Center reflect only a small sample of visitors to nature centers and other "Snake Days," and results may vary across geographic regions, especially with those with differing species of snakes. It is also important to consider differences in contact that may occur across those presenting snakes at Snake Day, as some allow independent handling and contact between the visitor and a live snake, while others may limit contact to the "scientific touch", which is two fingers down the back of an animal held by a handler. Further investigation is needed to understand attitude change that may occur at differing levels of contact, as this study only examine the opportunity of direct contact.

Random selection of participants for treatments was not possible, however groups of visitors were randomly selected to ask to complete the survey. Additionally, differences present prior to treatment can be controlled to a certain extent through statistical procedures and inclusion of covariate analyses. Because of the free choice, self-selected nature of the treatment groups, it was difficult to ensure equal amounts of exposure to the treatment across groups. Efforts were made to verify that participants received exposure to snakes in the nature center permanent exhibit and Snake Day by observing where they entered and exited.

Questions were included in the first section of the survey to determine if the subject had been exposed to either the Snake Day treatment or permanent nature center exhibit treatment before. While this study focuses on short term attitude change from exposure to different education treatments, results from these items may help in understanding prior exposure to other treatment groups. Within each group, more than half of participants had seen the permanent exhibit before. Of the permanent exhibit post-test group, 83.3% (N=50), reported they had seen snakes in the permanent exhibit before, but the item did not specify if it included their current trip, so this result was not included in the analysis. Approximately 30% of the Snake Day post-test group (N=60) and approximately 15% of control (N=39) and permanent exhibits (N=39) reported they had seen the snakes at Snake Day before. Ten participants

who had been to Snake Day before were removed from the control group, as their scores were significantly different from the other members of the control group on two dependent variables: Negativistic ($t=3.08$; $p < .05$) and Protection Advocacy ($t=5.18$; $p < .001$). However, control group participants who had previously attended the permanent exhibit were retained because their scores were not significantly different than those who had never attended the permanent exhibit before.

The survey used in this study was developed with data from the present groups, but also a CS treatment group that was not included in results in this study. The CS group was excluded in this study because the types of snake interpretive techniques that citizen scientists were exposed too were not consistent across the group and inclusion violated Box's M test.

As a parametric test, the analysis of variance test used to examine differences between groups is intended for continuous variables while response data from this survey was measured by ordinal levels with lower and upper bounds. While this bounded scale could cause compression of the variance on the lower and upper ends of those bounds and affect the validity of the test, means tested within the analysis of variance did not closely approach these bounds, so compression of variance of the bounded data is not a large concern. Additionally, the F-test can remain fairly robust to these violations (Carifio & Perla, 2007).

This survey did not always distinguish if the statements concerning snakes applied to nonvenomous or venomous snakes because of limitations on number of statements and length of survey, so it is possible that those statements may not have accurately measure attitudes and behaviors that may be different depending on the type of snake. However, most statements that concerned proximity to or contact with a snake noted whether it applied to snakes that were nonvenomous or venomous.

Recommendations

Findings from this research indicate the permanent exhibit positively affected these dimensions: Moralistic-Ecologistic, Negativistic, Scientistic, and Contact Willingness. In order to affect Utilitarian-Ecologistic and Protection Advocacy dimensions, a greater focus within the exhibit on the importance of snakes in their ecosystems may be necessary. Limitations on direct contact and modeling may make the Protection Advocacy dimension difficult to affect, however these elements may be addressed with increased exposure to additional nonvenomous species and enhanced content in signage. Further research with more sensitive survey instruments is recommended to understand the full effect of Snake Day. However, because attitudes and behaviors of Snake Day participants were already fairly positive, it is recommended that the nature center enhance visitor interaction with the interpretive techniques of factual content, exposure, modeling, and direct contact on Snake Day to produce attitude change that may be comparable to the permanent exhibit. Because there were no significant differences between the post-test permanent exhibit group and control, enhancing the number of snake exhibits and depth of content of the interpretive signs may produce a difference in attitudes and behaviors between these groups.

CHAPTER 4

SUMMARY

Conclusions and Recommendations

This study examined visitors' attitude and behavior change following two types of snake education programs. A survey was developed that aimed to address multiple dimensions of attitudes and behaviors towards snakes rather than just fear and avoidance attitudes, which is a gap in the literature noted by previous researchers (Prokop et al., 2009). It is important to have a valid and reliable survey that measures multiple dimensions of attitudes and behaviors regarding snakes because a more complete understanding could help wildlife educators plan programming that is effective in producing positive attitudes toward snakes, which are often persecuted due to misinformation and fear.

The survey developed from previous snake attitudes surveys and new questions was found to be valid and reliable through an exploratory factor analysis and Cronbach's alpha coefficient of reliability. The exploratory factor analysis of survey items found four underlying attitude dimensions (Ecologistic-Moralistic, Negativistic, Scientistic, and Utilitarian-Ecologistic) which had a foundation of Kellert's typologies of attitudes towards wildlife (Kellert & Berry, 1982) but demonstrated variations similar to those found from a factor analysis of a source snake attitudes survey (Tomazic, 2011). Two behavior dimensions were identified (Contact Willingness and Protection Advocacy) through the factor analysis. Overall, the items in the survey each demonstrated high internal consistency and significant underlying components with post-test data. New and adapted items were confirmed as valid and reliable measurement tools, but external validity is unknown and further testing is recommended for use with different groups. There is additional development and testing needed to address possible attitude differences concerning venomous or nonvenomous snakes or snakes as pets or in the wild, as this survey

did not fully address those distinctions. This survey was also developed in a format that allows adaptation for other types of wildlife, however, adaptations should be tested for validity and reliability.

Two new item sets concerning citizen science (CS) were tested in the development of the Snake and CS survey. One underlying attitude dimension (Public Participation in Science) and one behavior dimension (CS Willingness) was identified through an exploratory factor analysis. These item sets demonstrated high reliability. Perceptions of these dimensions held by potential participants may be important to understand for planning future CS programs, as there is a growing disengagement of the general populace with science (Osborne, 2003), which could possibly lead to a reluctance to participate in CS programs from perceptions of science as 'too foreign' or inappropriate for non-scientists. Results from these items only serve as a limited measure of CS attitudes and behavior, and should be combined with other scales for a more robust assessment of CS attitudes and behavior in future studies. External validity of these scales is unknown, so further testing is recommended.

The Snake and CS survey was used to examine the effects of two snake education programs (Snake Day and Nature Center Permanent Exhibit) on visitors' attitudes and behaviors concerning snakes. An analysis of within-group change indicated the permanent exhibit positively affected four dimensions (Moralistic-Ecologistic, Negativistic, Scientistic, and Contact Willingness) but Snake Day did not significantly affect any dimensions between pre and post-test visitors. Within the permanent exhibit, differences may not have been significant in the Utilitarian-Ecologistic dimension because of a greater content focus on specific snake species and biology rather than ecological role in nature. Limitations on direct contact and modeling in this program may make the Protection Advocacy dimension difficult to affect. However, these elements may be addressed with increased exposure to additional nonvenomous species and enhanced content in signage. Changes in Protection Advocacy also may not have been significant because the permanent exhibit featured more venomous snakes than nonvenomous, which may have evoked different intentions for protection, and mere exposure and interpretive signage did not offer any ethically affective information. In order to affect Utilitarian-

Ecologistic and Protection Advocacy dimensions, a greater focus within the exhibit on the importance of snakes in their ecosystems may be necessary.

A comparison of the control, the permanent exhibit, and Snake Day only revealed significant differences between post-test groups in the Moralistic-Ecologistic, Scientistic,and Protection Advocacy dimensions. Snake Day post-test visitors had significantly higher levels of Moralistic-Ecologistic attitudes than the permanent exhibit and control, possibly resulting from the additional interpretive techniques of direct contact and modeling that was available at Snake Day. These findings were similar to research by Morgan and Gramann (1989) where mere exposure was not found to be effective on its own, but modeling was effective on its own. Snake Day visitors had significantly higher Scientistic attitudes than the control group, as Snake Day provided depth of information and access to snake experts not experienced by control participants that may have promoted Scientistic attitudes and desire to learn more. Additionally, the Snake Day post-test group reported higher levels of Protection Advocacy than the control group, which indicates that those leaving Snake Day report that they are more likely to advocate for the protection of snakes if someone were trying to kill one than those who just came to Sandy Creek for outdoor recreation. The higher Scientistic, Moralistic-Ecologistic, and Protection Advocacy dimensions of the Snake Day post-test group are those of the tested dimensions most closely related to conservation support, which suggests that Snake Day visitors may be best to further engage with conservation activities, such as citizen science.

Differences between groups were controlled for by using the covariates of pet snake ownership and gender. It has been found that fear of snakes is more pronounced in females (Fredrikson et al., 1996), however, in this study males had reported significantly higher Negativistic attitudes than females. Pet snake ownership was corrected for because of the greater number of times experiencing direct contact and exposure that snake owners will have had. The pet covariate had a significant effect on the Moralistic-Ecologistic and Negativistic attitudes and Contact Willingness behaviors, which were the dimensions that experienced the most change from the permanent exhibit, in which mere exposure was used and direct

contact and modeling were not. This finding suggests the importance of direct experience in understanding that many snakes can be handled and touched without negative effects on humans.

Results from a comparison of interpretive techniques used in each treatment did not align with previous research that found the full treatment to be most effective (Morgan & Gramann, 1989), but the full treatment in the present study involved adults that already had moderate to high positive attitudes and behaviors toward snakes and may have less of an ability to experience positive attitude change. In addition, participants who attended the two types of events self-selected the treatment, so visitors attending Snake Day may have been predisposed to positive attitudes toward snakes, hence more sensitive instruments may be needed to understand the effects of treatments involving advanced levels of the subject matter (Phillips, 2013). However, it is recommended that the nature center enhance visitor interaction with the interpretive techniques of factual content, exposure, modeling, and direct contact on Snake Day to produce attitude change that may be comparable to the permanent exhibit. Because there were no significant differences between the permanent exhibit group and control, enhancing the number of snake exhibits and depth of content of the interpretive signs may produce a significant difference in attitudes and behaviors between those that only experience nature (control) and see the permanent snake exhibit. Although some effects were found immediately following the programs, a delayed post-test is necessary to examine the long term effects of these programs on attitudes and behaviors.

Implications

These two snake education programs allowed an opportunity to not only provide factual information and awareness, but also to affect the attitudes and behaviors of visitors towards snakes. Positive attitudes regarding snakes, an appreciation of their importance in nature, and less unnecessary harm from humans all may help to promote snake protection and survival. An understanding of the effects of various interpretive techniques that are often used in snake education programs allow educators to design effective programming concerning species that are often feared and misunderstood. Additionally, visitors to these types of nature center education programs are good candidates to recruit as citizen

scientists because of their interest in public programs, education, and nature. However, snake CS is a new and not well understood area that needs examination due to the common negative perceptions of snakes. Hence, the Snake and CS survey tested two new scales regarding public participation in science and willingness to participate in snake CS. While these scales were only tested for survey development in the present study, they may be useful in future studies to understand attitudes of nature center visitors toward participation in CS and developing appropriate recruitment and marketing strategies.

Based on the findings of this study, education programs provided some direct positive effect on attitudes of visitors regarding snakes. Examining the techniques and settings in which the nature center visitors learn about snakes is important for educators to best allocate their resources to provide an educational experience that also promotes positive attitudes and behaviors towards these animals.

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APPENDIX A

The University of Georgia
WARNELL
SCHOOL OF FORESTRY & NATURAL RESOURCES

This survey will examine your attitudes and behavior concerning snakes and snake conservation. Your responses will help Sandy Creek Nature Center better understand visitor needs in their educational programming centered on snakes. Please answer all questions. There are no right or wrong answers. Thank you for participating in this survey.

Please *circle one response, yes or no, to the statements below.*

I have….		
had a snake as a pet.	Yes	No
worked with snakes at my job.	Yes	No
previously seen the snakes that are permanently on display at Sandy Creek Nature Center.	Yes	No
previously attended Sandy Creek Nature Center's Snake Day.	Yes	No
previously volunteered to help a scientist research snakes (known as citizen science).	Yes	No

Non-venomous snakes are snakes that cannot inject venom (poison) with their bite.
Habitat is the land that an animal needs to survive.

After you read each item, there will be five choices: Strongly Disagree, Disagree, Neither Disagree nor Agree, Agree, and Strongly Agree. Check the one that best describes how you feel about each statement.

Section 2: Attitudes about Snakes	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
I am afraid of snakes.	◯	◯	◯	◯	◯
I think snakes are dangerous.	◯	◯	◯	◯	◯
I am scared more by snakes than any other animal.	◯	◯	◯	◯	◯
I would like to see some snakes in nature.	◯	◯	◯	◯	◯
If I see a snake, I tense up.	◯	◯	◯	◯	◯
If I am in the woods, I do not want to see a snake.	◯	◯	◯	◯	◯

These items have five choices: Very Unlikely, Unlikely, Neither Likely nor Unlikely, Likely, and Very Likely. Please check the one that best describes how you feel about each statement.

Section 3: Contact with Snakes **How likely are you to…**	Very Unlikely	Unlikely	Neither Likely nor Unlikely	Likely	Very Likely
hold a live (nonvenomous) snake in your hands.	◯	◯	◯	◯	◯
touch a live (nonvenomous) snake's skin.	◯	◯	◯	◯	◯
stand near someone holding a live (nonvenomous) snake.	◯	◯	◯	◯	◯

After you read each item, check the option that best describes how you feel about each statement.

Section 4: Values of Snakes	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
I would like to know how snakes eat, smell, and hear.	◯	◯	◯	◯	◯
I would like to learn more about snakes.	◯	◯	◯	◯	◯
I would like to observe what snakes do in nature.	◯	◯	◯	◯	◯
Snakes are an important part of nature.	◯	◯	◯	◯	◯
Snakes are important, as they kill mice and other rodents	◯	◯	◯	◯	◯
I am interested in whether a snake is endangered or not.	◯	◯	◯	◯	◯
It is good for a garden to have a snake in it.	◯	◯	◯	◯	◯
Snakes have the same right to live as any other animal.	◯	◯	◯	◯	◯
Killing snakes is wrong.	◯	◯	◯	◯	◯
A person should be punished if they harm snakes.	◯	◯	◯	◯	◯
Snakes should be killed.	◯	◯	◯	◯	◯
Killing nonvenomous snakes is wrong.	◯	◯	◯	◯	◯
Venomous snakes should be killed.	◯	◯	◯	◯	◯

After you read each item, check the option that best describes how you feel about each statement.

Section 5: Behaviors **If you saw someone trying to kill a snake, how likely are you to…**	Very Unlikely	Unlikely	Neither Likely nor Unlikely	Likely	Very Likely
do nothing.	◯	◯	◯	◯	◯
tell them to stop.	◯	◯	◯	◯	◯
let them.	◯	◯	◯	◯	◯
tell them the benefits of snakes.	◯	◯	◯	◯	◯

After you read each item, check the option that best describes how you feel about each statement.

Section 6: Snake Conservation	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
Protecting snakes is a waste of time.	◯	◯	◯	◯	◯
Snakes do not need any more habitat (i.e. woods, swamps).	◯	◯	◯	◯	◯
Snakes in the wild need more protection.	◯	◯	◯	◯	◯
I want to help protect snakes.	◯	◯	◯	◯	◯
I would be willing to donate money to protect snakes.	◯	◯	◯	◯	◯
If I gave money to protect snakes, it would be a waste.	◯	◯	◯	◯	◯
There should be more laws that protect snakes.	◯	◯	◯	◯	◯
There should be more laws that protect snake habitat.	◯	◯	◯	◯	◯

Citizen Science is when people who are not scientists take part in scientific research. Generally, it is when people volunteer their time to help collect data for a scientist's research.

After you read each item, check the option that best describes how you feel about each statement.

Section 7: Citizen Science	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
Only scientists should contribute to scientific research.	◯	◯	◯	◯	◯
I cannot contribute to scientific research if I am not a scientist.	◯	◯	◯	◯	◯
Research can only be done by scientists.	◯	◯	◯	◯	◯
Only scientists should be interested in research about snakes.	◯	◯	◯	◯	◯
Only scientists should care about understanding snakes.	◯	◯	◯	◯	◯

Reptiles are the group of animals that include snakes, lizards, and turtles.
Amphibians are the group of animals that include frogs, toads, and salamanders.

After you read each item, check the option that best describes how you feel about each statement.

Section 8: Citizen Science Participation **How likely are you to…**	Very Unlikely	Unlikely	Neither Likely nor Unlikely	Likely	Very Likely
Volunteer your time to help scientists research **snakes**.	◯	◯	◯	◯	◯
Go outdoors to help a scientist look for nonvenomous **snakes**.	◯	◯	◯	◯	◯
Participate in a free citizen science project in my area that involved **snakes**.	◯	◯	◯	◯	◯
Volunteer my time to help scientists research **lizards**.	◯	◯	◯	◯	◯
Volunteer my time to help scientists research **turtles**.	◯	◯	◯	◯	◯
Go outdoors to help a scientists look for **many kinds of reptiles**.	◯	◯	◯	◯	◯
Participate in a free citizen science project in my area that involved **many kinds of reptiles**.	◯	◯	◯	◯	◯
Volunteer my time to help a scientists look for **frogs and toads**.	◯	◯	◯	◯	◯
Volunteer my time to help a scientist look for **salamanders**.	◯	◯	◯	◯	◯
Go outdoors to help a scientist research **many kinds of amphibians**.	◯	◯	◯	◯	◯
Participate in a free citizen science project in my area that involved **many kinds of amphibians.**	◯	◯	◯	◯	◯

Please circle the response, True or False, that best describes each statement below.

Section 9: Beliefs

All snakes are venomous:	TRUE	FALSE
There are venomous snakes in the United States:	TRUE	FALSE
All snakes rattle their tail when they are in danger:	TRUE	FALSE
Snakes hypnotize their prey:	TRUE	FALSE
Snakes have slimy skin:	TRUE	FALSE

Section 10: Demographic Information

1. Gender: ◯ *Male* ◯ *Female*

2. Age:_____

3. I live in a: ◯ *Rural* ◯ *Suburban* ◯ *Urban* area.

4. Race: ◯ *Asian/Pacific Islander* ◯ *Black or African American* ◯ *Hispanic/Latino*
◯ *Native American* ◯ *White* ◯ *Other*

5. Education: What is the highest level you have completed? (check one)

_____ No schooling completed
_____ High school graduate, diploma or the equivalent (for example: GED)
_____ Some college credit, no degree
_____ College Degree
_____ Graduate/ Professional Degree or beyond

APPENDIX B

The University of Georgia
WARNELL
SCHOOL OF FORESTRY & NATURAL RESOURCES

This survey will examine your attitudes and behavior concerning snakes and snake conservation. Your responses will help Sandy Creek Nature Center better understand visitor needs in their educational programming centered on snakes. Please answer all questions. There are no right or wrong answers. Thank you for participating in this survey.

Circle one response, yes or no, to the statements below.

I have had a snake as a pet: Yes No

I have worked with snakes at my job: Yes No

I have previously seen the snakes that are permanently on display at Sandy Creek Nature Center: Yes No

I have previously attended Sandy Creek Nature Center's Snake Day: Yes No

I have previously volunteered to help a scientist research snakes in the wild (also known as citizen science): Yes No

After you read each item, there will be five choices: Strongly Disagree, Disagree, Neither Disagree nor Agree, Agree, and Strongly Agree. Check the one that best describes how you feel about each statement.

Section 1: Attitudes about snakes	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
I am afraid of snakes.	○	○	○	○	○
I think all snakes are dangerous.	○	○	○	○	○
I would be willing to hold a snake.	○	○	○	○	○
I would be willing to touch a snake to see how it feels.	○	○	○	○	○
I am scared by the thought of touching a snake.	○	○	○	○	○
I would like to see some snakes in nature.	○	○	○	○	○
If I see any snake, I tense.	○	○	○	○	○
I am scared more by snakes than any other animal.	○	○	○	○	○
I would like to learn more about snakes.	○	○	○	○	○
I would avoid places where I know there could be snakes (e.g. woods).	○	○	○	○	○
When I walk through the woods, I do not want to see snakes.	○	○	○	○	○

Section 2: Attitudes about snake education	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
I would like to know how snakes eat, smell, and hear.	○	○	○	○	○
I would like to read about snakes.	○	○	○	○	○
I would like to learn about where snakes live.	○	○	○	○	○
I would like to learn about different types of snakes.	○	○	○	○	○
I would like to study snakes in nature.	○	○	○	○	○
I would like to know more about how snakes live.	○	○	○	○	○
I think snakes are interesting animals.	○	○	○	○	○
I would like to learn more about snakes in my education.	○	○	○	○	○

Section 3: Attitudes about snake conservation	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
Snakes are an important part of nature.	○	○	○	○	○
I care if some snake species go extinct.	○	○	○	○	○
Snakes are important, as they kill mice and other rodents	○	○	○	○	○
I would like to have a snake living in my yard.	○	○	○	○	○
Snakes have the same right to live as any other animal.	○	○	○	○	○
All snakes should be killed.	○	○	○	○	○
Killing snakes is wrong.	○	○	○	○	○
I think a person should be punished if they harm snakes.	○	○	○	○	○

Section 4: Attitudes about Snake Protection	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
I want to help protect snakes.	○	○	○	○	○
I would be willing to donate money to protect snakes.	○	○	○	○	○
I think if I gave money to protect snakes, it would be a waste.	○	○	○	○	○
There are enough snakes in nature.	○	○	○	○	○
Snakes do not need any more protection.	○	○	○	○	○
Snakes do not need any more habitat (i.e. woods, swamps, etc.) than they already have.	○	○	○	○	○

Citizen Science is when people who are not scientists contribute to scientific research. Generally, it is when people volunteer their time to help collect data for a scientist's research.

Section 5: Attitudes about Citizen Science and Snakes	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
Only scientists can contribute to scientific research.	○	○	○	○	○
I cannot contribute to scientific research, as I am not a scientist.	○	○	○	○	○
Research can only be done by scientists.	○	○	○	○	○
I would like to know how scientists research snakes.	○	○	○	○	○
Only scientists are interested in research about snakes.	○	○	○	○	○
Only scientists care about understanding snakes.	○	○	○	○	○
I am interested in how scientists discover things about snakes.	○	○	○	○	○

Non-venomous snakes are snakes that cannot inject venom (poison) with their bite.
Habitat is the land that an animal needs to survive.

Section 6: Behaviors concerning snakes	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
I would be willing to hold a non-venomous snake in my hands.	○	○	○	○	○
I would be willing to touch a live, non- venomous snake's skin.	○	○	○	○	○
Given the opportunity, I would stand near someone holding a non-venomous snake.	○	○	○	○	○
Next time I'm outdoors, I would look for non-venomous snakes.	○	○	○	○	○
Next time I'm in my yard, I would look for a non-venomous snake.	○	○	○	○	○
Next time I'm outside, I would avoid places that any snake might live.	○	○	○	○	○
If I saw someone trying to kill a snake, I would tell them to stop.	○	○	○	○	○
If I saw someone trying to kill a snake, I would do nothing.	○	○	○	○	○
I would tell other people why killing snakes is wrong.	○	○	○	○	○
I would tell someone to stop if I saw them destroying a snake's home.	○	○	○	○	○
I would tell someone why snakes need land to live on.	○	○	○	○	○

Section 7: Behaviors concerning snake conservation	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
I would be willing to donate money to help protect snake habitat.	○	○	○	○	○
I would be willing to volunteer my time to protect snake habitat.	○	○	○	○	○
I would not protect snake habitat if it kept me from making money	○	○	○	○	○
I would buy things made of snake skin.	○	○	○	○	○
I would not buy something if it meant a snake was killed to make it.	○	○	○	○	○
I would tell someone not to buy something if it was made from a snake.	○	○	○	○	○
I would vote for a law that protects snakes.	○	○	○	○	○
I would vote for a law that protects land that snakes live on.	○	○	○	○	○

Reptiles are the group of animals that include snakes, lizards, and turtles.
Amphibians are the group of animals that include frogs, toads, and salamanders.

Section 8: Behaviors concerning reptile and amphibian citizen science	Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
I would volunteer my time to help scientists research **snakes**.	○	○	○	○	○
I would volunteer my time to help scientists research **lizards**.	○	○	○	○	○
I would volunteer my time to help scientists research **turtles**.	○	○	○	○	○

I would go outdoors to help a scientist look for **snakes**.	○	○	○	○	○
I would go outdoors to help a scientists look for **reptiles**.	○	○	○	○	○
I would volunteer my time to help a scientist research **amphibians**.	○	○	○	○	○
I would go outdoors to help a scientists look for **frogs and toads**.	○	○	○	○	○
I would go outdoors to help a scientists look for **salamanders**.	○	○	○	○	○
If there were a free citizen science project in my area that involved **snakes**, I would participate.	○	○	○	○	○
If there were a free citizen science project in my area that involved **many kinds of reptiles**, I would participate.	○	○	○	○	○
If there were a free citizen science project in my area that involved **many kinds of amphibians**, I would participate.	○	○	○	○	○

Please circle the response, True or False, that best describes each statement below.

Section 9: Beliefs about snakes

All snakes are venomous: TRUE FALSE

There are venomous snakes in the United States: TRUE FALSE

All snakes rattle their tale when they are in danger: TRUE FALSE

Snakes hypnotize their prey: TRUE FALSE

Snakes have slimy skin: TRUE FALSE

Section 10: Demographic Information

1. Gender: *Male* *Female* (circle one)
2. Age:_____
3. I live in a: *Rural* *Suburban* *Urban* area. (circle one)
4. Race: *Asian/Pacific Islander* *Black or African American* *Hispanic/Latino*

Native American *White* *Other* (circle one)

5. Education: What is the highest level you have completed? (check one)

_____ No schooling completed
_____ High school graduate, diploma or the equivalent (for example: GED)
_____ Some college credit, no degree
_____ College Degree
_____ Graduate/ Professional Degree or beyond

Thank you for your time and help with this research.

APPENDIX C

The Snake Attitude Questionnaire*

Negativistic (Cronbach's alpha = 0.89)

I would like to camp near the ruin of an old castle where snakes are present	P
Snakes are sympathetic animals	P
I would like to catch a snake with my hands	P
Capturing snakes would make for an exciting story	P
Even the thought of touching a snake scares me	N
I would rather watch snakes on TV than encounter them in nature	N
I would like to encounter some species of snakes in nature	P
If I see a snake, I feel tense	N
Snakes scare me more than other animals	N
I would like to participate in an expedition to investigate snakes	P
It makes me feel sick when I see a snake	N
I feel like I would be able to catch a snake if I had gloves on my hands	P
I would like to have snakes in the loft of my home	P

Scientistic (Cronbach's alpha = 0.87)

I would like to read a book about snakes	P
Greater resources should be dedicated to snake protection	P
I would like to know more about the life histories of snakes	P
I would like to watch snakes at night using a night-vision camera	P
Whenever I see a snake on television I close my eyes	N
I would like to know more about large species of tropical snakes	P
I do not like pictures of snakes	N
I like watching natural history films about snakes	P
I think snakes are quite interesting animals	P
We should learn more about snakes at school	P
Woods are just for tourists, not for snakes	N
I would like to know how scientists investigate snakes	P
I do not see how someone might be interested in research on snakes	N

Naturalistic (Cronbach's alpha = 0.81)

I would rather avoid places where snakes are present	N
If there were a snake under my window, I would be unable to sleep	N
If somebody tells me that there are snakes somewhere around me, I get nervous	N
I would never go to a cellar if I knew that snakes were there	N
I would rather stay away from countries where there are a lot of snakes	N
I would rather avoid going to the cellar of my house if snakes were present there	N
If I happened to find a snake in my cellar, I would probably run away	N

Knowledge (Cronbach's alpha = 0.58)

Some snakes occur in the sea	N
Poisonous snakes are able to spit their poison up to several centimeters away	N

Snakes are able to consume prey up to 3 times larger than their own mouth	P
Snakes spend the winter in abandoned holes	N
Snakes are able to discriminate between the temperature of their prey and that of colder environments	N
Myths (Cronbach's alpha = 0.65)	
Snakes are able to hypnotize their prey	N
Poisonous snakes have triangular heads	N
The rattle of the rattlesnake grows one new segment per year	N
All snakes are more or less poisonous	N
Injured snakes die only after sunset	N
Injured snakes die more slowly in comparison to other animals	N
Female snakes swallow their young when confronted with danger, and then spit them out again	N
The skin of snakes is slimy	N
The breath of snakes is also poisonous	N
Some species of snakes live in Antarctica	N
Some snakes have poisonous glands in the ends of their body, like some scorpions	N
A snake can only strike from a coiled position	N
Some snakes suck milk from livestock and sheep	N
Snakes chew their prey at first, and then swallow it	N
Snakes travel in pairs	N
Ecologistic (excluded) (Cronbach's alpha = 0.51)	
Snakes have great importance in nature	P
Some snakes are 10 meters long	P
I am not interested in whether snakes in Slovakia/Turkey are endangered or not	N
Snakes are not important in nature	N
People should not be prejudiced against snakes; they could then both coexist without violence	P

Notes: P - positive wording, N - negative wording

Authors are grateful to Warren Greig for his kind improvement of the English.

APPENDIX D

QUESTIONNAIRE

School: _____

Age: _____ Gender: M ( ) F ( ) Grade: _____

Dwelling-place: urban area ( ) rural area ( )

1. What is a snake?

_____

_____

2. Are you afraid of snakes?

( ) yes ( ) no

If so, why?

_____

_____

3. Do you consider all snakes as venomous?

( ) yes ( ) no

If not, how do you differentiate a poisonous snake from a non-poisonous one?

_____

_____

4. Which of the following actions you would take in an eventual encounter with a snake:

a) ( ) let the snake go away.

b) ( ) scare off the snake to the bush

c) ( ) tries to capture it

d) ( ) asks someone to kill it

e) ( ) you kill the snake.

5. Have you ever suffered a snakebite?

( ) yes ( ) no

If so, what was the injured body part?

_____

Do you know someone who has ever been bitten by snakes? What happened to that person?

_____

Thank you!

APPENDIX E

Item	**Scientistic**	**Negativistic**	**Willingness**	**Moralistic**
I would like to learn about snake habitats.	0.901			
I would like to know how snakes eat, smell and hear.	0.841			
I would like to learn about different snake species.	0.823			
I would like to study snakes in nature.	0.687			
I like to read about snakes.	0.659			
I am bored when biologists talk about snakes. (R)	0.466			
I am afraid of snakes. (R)		0.786		
Snakes are disgusting. (R)		0.773		
Snakes are ugly. (R)		0.720		
I would rather watch a movie about snakes than observe them in nature. (R)		0.694		
When I walk through the woods, I do not particularly wish to stumble upon a snake. (R)		0.669		
I would like to hold a snake in my hands.			0.629	
I would report it to the authorities if I was aware that someone was destroying snake habitats.			0.806	
I would be willing to inform the public about people destroying snake habitats.			0.719	
I would notify the authorities if I saw someone killing snakes.			0.618	
Keeping snakes in captivity is cruel.			0.484	
I would be willing to donate some money to protect certain snake species.			0.466	
I would be willing to inform the public about the wrong treatment of snakes.			0.448	
I would not buy snake products, because I would like to protect snakes.				0.627
Snakes are of value as they kill mice and other rodents.				0.583
Snakes should have rights too.				0.491
It would be for the best if all snakes were killed. (R)				0.486
Killing snakes for fun is cruel.				0.473
We should not legally protect snakes because there are a lot of snakes elsewhere. (R)	-	-	-	-
Cronbach α	0.86	0.83	0.71	0.58

APPENDIX F

Table 5.1

Citizen Science Projects/Groups Represented and Count (more than one answer per respondent accepted)

Group/Project	Count	Group/Project	Count
AZ Fish & Game	1	Monarch Watch	1
Audobon Society	1	Mushroom Observer	1
Balcones Canyonlands Preserve	1	NA Field Herping Association	1
BAMONA	1	NA Herp Education & Research Project	1
Bug Guide	1	NAAMP	3
Cape Fear River Watch	1	National History Museum of LA County	1
Caswell Beach Turtle Watch	1	National Park Service	1
Center for Snake Conservation	3	Natural History Museum	1
Coastal Water Watch	1	NC Herp Atlas	1
CO Parks & Wildlife	3	NC Museum of Natural Sciences	1
Community Project	1	NC Wildlife	1
COPARC	4	Obow Meadows, Columbus, GA	1
Cornell Ornithology Lab	1	OK City Zoo	1
DAPTF	1	ON Nature	4
Denver Zoo	1	ON Reptile & Amphibian Atlas	1
Duke University	1	Piedmont Wildlife Center	7
Earth Watch	1	Roadkill Garneau	1
eBird	3	Sedgewick County Zoo	1
eButterfly	1	South TX Herpetological Association	1
Elon University	1	Southwestern Center for Herp Research	1
Fort Hays State University	1	Southwestern Herpetologists Society	3
Froglog	1	Survey for NM Ridgenose Rattlesnake	1
FrogWatch USA	2	SWPARC	1
GA DNR	1	The Orianne Society	18
HerpMapper	1	The Urban Ecology Project	1
Horned Lizard Conservation Society	1	TN Aquarium	1
iNaturalist	1	TNC	2
International Iguana Foundation	1	Toronto Zoo	1
KS Biologic Survey	1	TX Herpetological Society	1
KS Dept. of Wildlife & Parks	3	TX Parks & Wildlife	2
KS Herp Society	4	University of NC-W Sea & Coffee Program	1
Local Government	4	University of GA Herpetological Society	11
MAAMP	1	University of KS Natural History Museum	1
MN DNR	1	Zoological Discovery Center	1
MO Herpetological Society	1		

APPENDIX G

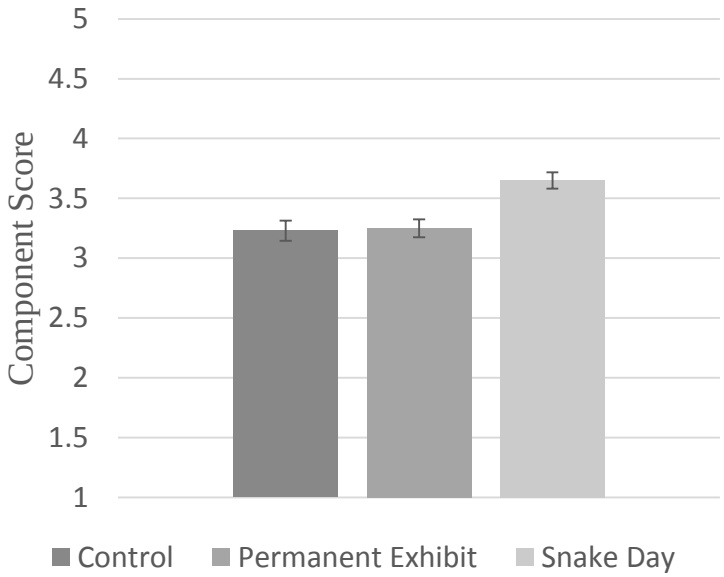

Figure 5.1: Pairwise comparison of estimated Moralistic-Ecologistic means of post-test groups.

Significant Differences ($p > 0.05$):

Snake Day > Control

Permanent Exhibit > Cont

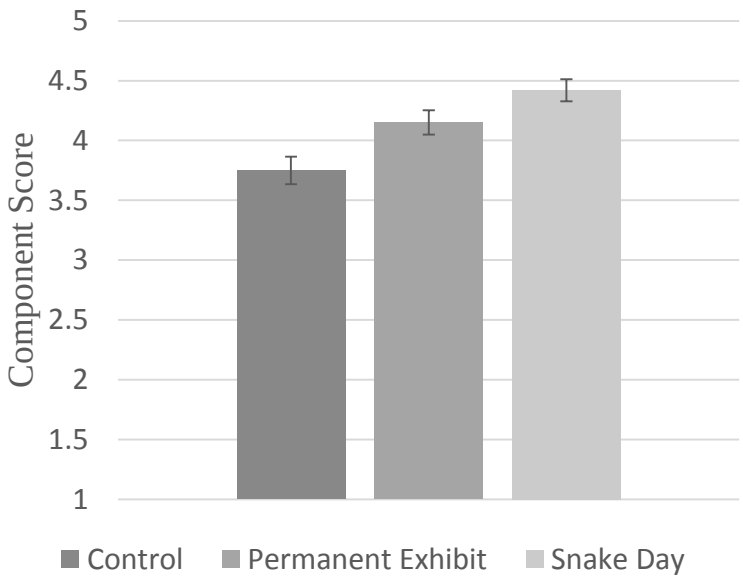

Figure 5.2: Pairwise comparison of estimated Scientistic means of post-test groups.

Significant Differences ($p > 0.05$):

Snake Day > Control

Snake Day > Permanent Exhibit

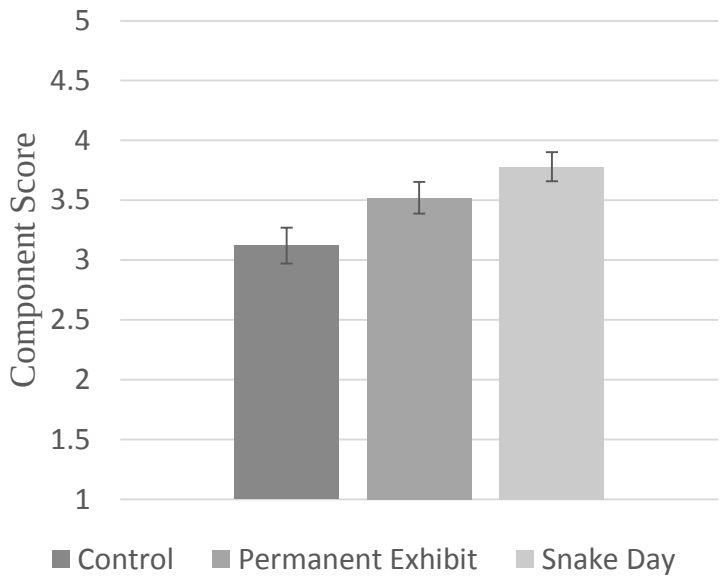

Figure 5.3: Pairwise comparison of estimated Protection Advocacy means of post-test groups.

Significant Differences ($p > 0.05$):

Snake Day > Control