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Can Providing Positive Interactions with Snakes Change a Person's Perception of Dangerous Wildlife Interactions?

Bethany Walker
Jacksonville State University, bwalker9@stu.jsu.edu

THESIS APPROVAL

Candidate: Bethany Elaine Walker

Major: Biology

Thesis Title: Can Providing Positive Interactions with Snakes Change a Person's Perception of Dangerous Wildlife Interactions?

Approval:

Dr. Sarah J Wofford
Adjunct Professor, Biology
Major Professor/Advisor

11-9-21
Date

Dr. George Cline
Professor, Biology

11-9-21
Date

Dr. Todd McKercher
Professor, Psychology

11.9.21
Date

Dr. Channing Ford
Dean, Graduate Studies

11/10/2021
Date

Can Providing Positive Interactions with Snakes Change a Person's Perception of Dangerous Wildlife Interactions?

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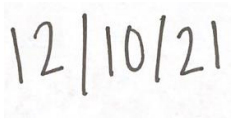
By

Bethany E. Walker

December 10, 2021

Advisor: Dr. Sarah J. Wofford-Mares



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Abstract

Due to a long co-evolutionary history between placental mammals and reptiles, primates demonstrate aversive responses to snakes. In humans, this can result in ophidiophobia, or the fear of snakes which can arise due to cultural backgrounds, traumatic experiences, or fear instilled by others. However, these reptiles fill essential roles in ecosystems. Conservation and outreach efforts are important to help our population understand snakes' role in our lives and the state's broader biodiversity. Negative experiences or preconceptions about snakes can make this message hard to share with the public. Educators can help prevent intentional harm to some of these organisms through targeted education and outreach programs. The goal of the experiment outlined in this thesis was twofold: first, the author wanted to quantify the perception of snakes to individuals based on demographic variables (e.g., sex, age, education level). Second, the author wanted to measure the efficacy of an educational program to change these perceptions. The author surveyed individuals in groups ranging in size from five to 64 individuals in an educational setting. Participants viewed one of two presentations: one with pictures of snakes or one with live snakes. Results revealed educational programs can enhance understanding and appreciation of an organism commonly viewed as threatening to humans. However, these results also reveal that the benefit of this type of education is context dependent as perceptions were influenced by demographic information and presentation location.

Keywords: Conservation, perception, snakes, education

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Introduction

Due to a long co-evolutionary history between placental mammals and reptiles, human and non-human primates have demonstrated aversive responses to snakes (Isbell 2006). In humans, this can result in ophidiophobia, or the fear of snakes. These fears can arise as a result of cultural backgrounds, traumatic experiences, or fear instilled by family or friends (Ceríaco, 2012). Studies have also shown that sociodemographic variables can play a role in fear of snakes, for example locale and education. People who have fewer experiences in higher education are more likely to have a different perception of snakes than people with more experiences in higher education (Ceríaco, 2012). Some of these negative perceptions arise due to fear, negativity, unsureness towards, and ignorance about snakes. These perceptions are likely due to sources of incorrect information or misconceptions about snakes (Pandey et al. 2016). For instance, some people have the idea that all snakes are venomous or harmful and need to be killed because of their danger posed to humans (Ceríaco,2012). Feelings like these have further perpetuated the misconceptions people have about snakes and can lead them to think irrationally about animal behavior and perceived "motives" of these organisms (Ceríaco, 2012). If these attitudes are not changed, some individuals will continue to kill snakes indiscriminately. This poses several issues related to conservation (Hartel et al., 2015) and unintended injuries to the humans that attempt to displace these organisms (Hartel et al., 2015).

One hypothesis used to explain the tight co-evolutionary history between primates and snakes posits that humans are better able to detect snakes than other objects in their habitat. The "Snake Detection Theory" argues that snakes were ultimately responsible for primates' complex vision system and caused vision to become a (Van Strien & Isbell,

2017). This type of selection pressure likely arose due to the cryptic nature of predatory snakes; primates without the visual acuity to detect snakes likely had lower fitness than those with that trait. The Snake Detection Theory is supported by electrophysiological evidence that shows a greater visual sensitivity to snakes by primates, specifically humans (Van Strien & Isbell, 2017). Van Strien & Isbell (2017) conducted a study using early posterior negativity (EPN) to test how people respond to images of creatures. This study showed snakeskin pictures had a larger EPN, or neural response, than pictures of other animals. Likewise, the scale patterns on a snake showed a significant boost in EPN response compared to the skin of other animals. Van Strien & Van der Peijl (2018) found similar results in a follow-up study. Specifically, they found that, for participants who were shown different up-close images of creatures, the image of snakeskin had a larger EPN than other pictures (Van Strien &Van der Peijl, 2018). Likewise, LoBue & DeLoache (2008) found that both adults and young children can detect threat-relevant stimuli (i.e., pictures of snakes) faster than threat-irrelevant stimuli (i.e., pictures of frogs or caterpillars).This study demonstrated that even young children associated limbless, coiled bodies (i.e., identifying properties of snakes) as threat-relevant (LoBue & DeLoache, 2008). Children have a great ability to detect threat-relevant organisms, especially snakes. However, the fear of snakes is often instilled in children's minds by other humans, typically their family. In a study conducted by Ballouard et al. (2013) they found that schoolchildren in France held moderately negative viewpoints about snakes. However, after fieldtrips in which the authors caught and handled a variety of native species in the area, a significant proportion of children agreed they liked and wanted to protect snakes (Ballouard et al.,

2013). Their findings showed suggest that adults with which the children frequently interact may project their own negative perceptions about snakes onto children.

Older individuals can develop a fear of snakes for a variety of reasons. Some of these reasons could be a result of cultural backgrounds, traumatic experiences, or fear instilled by family or friends (Ceríaco, 2012). Although some of these negative perceptions are justified, most of them arise from false information or misconceptions about snakes (Ceríaco, 2012). This false information could be learned from childhood to adulthood. Early adolescents are impressionable to social media or viewpoints of friends and family as they are still trying to figure out who they are and what they believe. According to Bornstein et al. (2010) social competence in children manifests in several ways. Some of these are emotional self-regulation, social cognition, positive communication, and prosocial relationships with family members, peers, and teachers. Based on the results of Vollebergh et al. (2001), parents instill their views and beliefs in their children while raising them. As adolescents begin to develop into young adults, their relationships with their parents change. The older young adults get, the less influence their parents have on what they believe. In this study, the oldest group (21-24 years old) had a small amount of parental influence (Vollebergh et al., 2001). Although the studies outlined above are in relation to broader topics than snakes or conservation, a change in views and beliefs on certain topics (e.g., snakes, conservation) as humans reach different life stages means perceptions of snakes could change with age. However, these initial viewpoints could be tempered by previous experiences with these organisms. Studies have shown that children who were able to view captive snakes or watch an adult handle a snake had significantly

more positive attitudes compared to those who had only experienced a typical education program about snakes (Hartel et al., 2015).

Other demographic variables also appear to influence an individual's perception of snakes. For instance, geographic location (e.g., urban vs rural dwellings) can play a part in this perception and subsequent behavior. An urban area is location surrounded by city. This can refer to towns, cities, and suburbs (Rutledge et al., 2011). Rural areas are often viewed as countryside and are characterized by low population densities and large amounts of undeveloped or agricultural land (Rutledge et al., 2011). A baseline assumption is that rural or agricultural populations should encounter snakes more often as they are closer to the native habitat of most snakes and likely have large rodent populations in range. However, rapidly expanding urban areas could soon change this assumption. A study of urban-dwelling snakes in New Jersey, USA, found that some larger species were extirpated over time while other, smaller species might find valuable resources (Zappalorti & Mitchell, 2008). More human-snake encounters in urban dwellings could ultimately change human perceptions towards snakes. Pinheiro et al. (2016) found that individuals living in an urban area showed a positive attitude towards snakes because there was a greater presence of media and access to information about conservation than in surrounding rural areas (Pinheiro et al., 2016). Other demographic variables that could influence perceptions of snakes are access to education and sex. Ceriaco (2012) suggested individuals with higher levels of education have fewer misinterpretations about herpetofauna. Furthermore, Pinherio et al. (2016) showed that formal education is important in changing the attitude of people perceptions of snakes. Another sociodemographic variable that could influence these perceptions is sex. Women generally have more negative perception and fear of

snakes than men do. One explanation is women are likely to believe more in myths about snakes than men. Women also show more fear than men in relations to different situations. Another possible explanation for gender is hormones influences and genetic factors (Pinherio et al. 2016). However, it should be noted that many of these explanations are under debate and none of them have been tested formally.

While snakes can be a fearful presence to some, these reptiles often fill essential roles in their local ecosystems. Snakes are both predators and prey, thus helping maintain a healthy ecosystem and environment (Tsinde, 2008). Snakes' roles in food webs are diverse and extremely important, which makes them crucial to allowing many ecological processes to function properly (Campbell et al. 2001). Snakes also play a role in vital ecosystem services. For example, their general role as secondary or tertiary consumers means they can play a role in population control of other animals. This is especially important since some of their prey can be disease vectors. Rats can over-produce and have a negative impact on humans, structures, and economy. Rats directly and indirectly carry many harmful diseases such as rat bite fever, the plague, and Lyme disease; these can all harm or kill humans (CDC, 2017). Rats can also cause structural damage. For example, they are the number one cause for electrical fires. Along with structural damage, rats can cause economical damage. Rats are also known for spreading deadly diseases to chickens and will feed on crops. This can cost a local farmer a lot of money. Corn snakes can save the farmer up to $32.46 a year depending on the size of the farm and rat infestation. These roles are especially prevalent in the southeastern United States, which also can be a hotspot of human-reptile interactions.

Alabama, a state in the southeastern United States, is known for its high biodiversity due to the mild climate, diverse physiographic regions, and remarkable square mileage of rivers (Guyer et al., 2019). The herpetofauna of Alabama is also notably rich and diverse (Chen & Wang, 2007). For example, Alabama has 40 species of non-venomous and venomous snakes that all play very important roles in their respective ecosystems (Armstrong, 2018). Although Alabama is diverse and rich in many species, it is also ranked fourth in the country for imperiled species (Duncan & Wilson, 2013). As of October 2012, US Fish and Wildlife Service had listed 120 species as threatened or endangered in the state. This rise in listed species is due to a suite of issues such as habitat loss and degradation, invasion of ecosystems by non-native species, over harvesting of species, pollution, and rapid climate change (Duncan & Wilson 2013). One victim of these issues is the federally listed Indigo Snake (*Drymarchon couperi*) which was once located throughout several regions in Alabama. Habitat loss, fragmentation, and degradation remain primary threats to *D. couperi* populations. However, other concerning factors for the Indigo Snake are highway fatalities, spiteful killings, and pesticide usage (Hyslop, 2007).

Conservation and outreach efforts are extremely important to help our population understand snakes' role in our lives and the state's ecosystem and broader biodiversity. Snakes make up a large portion of Alabama's diverse ecosystems. Conservation efforts must focus on the preservation of native species and reduction of ecosystem damaging processes or a suite of stakeholders will lose unique biological features of our state. Unfortunately, negative experiences or preconceptions about certain wildlife can make this message hard to share with the public. Through conservation education and outreach

programs, educators can help prevent intentional harm to some of these organisms with a poor reputation and garner community support for biodiversity preservation efforts. Hartel et al. (2015) showed that encounters with wild or captive animals may create positive perceptions of the species. This evidence could be reason to incorporate animal interaction into outreach efforts for species whose conservation is most critical and most overlooked.

The goal of the experiment outlined in this thesis was twofold: first, the author wanted to quantify the perception of snakes to individuals based on a number of demographic variables (e.g., sex, age, education level). Second, the author wanted to measure the efficacy of an educational program to change these perceptions. The author administered a pre-survey to the participants prior to giving a brief presentation. After the presentation, participants took a short post-survey and then the author answered questions from the members of the audience. Participants viewed one of two presentations: one with only pictures of snakes or one with live and contained, non-venomous snakes. The content of the remainder of the presentation remained the same. There were three hypotheses for this experiment. First, the author hypothesized there would be a difference in initial perception of snakes (pre-survey) based on the demographics of the participants. Specifically, the author predicted that people with fewer years in an education setting will be more averse towards snakes and female participants would have a higher perception of fear than male participants. Additionally, the author predicted that urban residence would have a greater fear of snakes due to the lack of encounters. Second, the author hypothesized that perceptions of the participants would change once they had been exposed to an educational program about local species (e.g., the author will detect changes from the pre-survey to post-survey metrics). Specifically, the author predicted that providing a positive

interaction would show an increase in positive perception towards snakes. Finally, the author hypothesized that individuals who saw an educational program with live snakes would have a significantly greater change in perception than individuals who only saw pictures of snakes. The author predicted participants who observed living snakes rather than pictures of snakes would show a stronger, positive change in perception compared to those participants who only observed pictures of snakes.

Materials and Methods

Experimental Design

The author surveyed individuals in groups ranging in size from five to 64 individuals in an educational setting. For each group, the author gathered demographic data and perceptions of snakes before and after an education presentation using a 2-part survey system (Appendix A). The first survey (from hereon, pre-survey) consisted of demographic information (i.e., sex, age, zip code, urban/rural residence, and education level) as well as an individual's perceived behavior toward snakes using several questions with interval scaling. The participants listened to a 30-45-minute presentation in which they were allowed to see picture packets of snakes or view live snakes contained in clear aquaria. Then participants observed pictures of snakes or viewed live snakes and ask questions. Finally, A follow-up survey (from hereon, post survey) was given with the same perception questions from the pre-survey. Each pre and post survey was assigned a unique code corresponding to place, date, and individual. Organismal representatives were chosen due to their species' likelihood of encounters with humans or due to their conservation significance. The first two species were chosen because individuals residing in the southeastern United States are likely to encounter these two species around their house or

in a local park or walkway (i.e., high likelihood of encounter). The third species was an endangered snake native to the state of Alabama to raise awareness of current conservation concerns in the state (i.e., low likelihood of encounter).

Institutional Review Board of the Protection of Human Subjects in Research (IRB)

The author applied for and was approved for exempt status IRB. The author provided an informed consent and informed assent document to state that no data would be taken from any individual under 14 years of age. The author provided consent from institutions whom agreed to host the presentation. The author's IRB protocol number was 03312021-1. The IRB requested information on details about how snakes will be kept during the presentation, if participants would be in danger, and how participants' identities would be kept private.

To collect demographic data, the author has asked questions in a particular way. All participants were asked to state their age so the author could bin participants' data based on the age groups. The reason for asking participants to state their age instead of having age ranges was that age was a better representation for the data collected and this format allowed the author to make a more accurate bin system. Participants were also asked to self-report their zip codes and report whether they lived in an urban or rural area based on the definitions provided by the United States Census Bureau (census.gov). By having participants report their zip code and urban/rural categorization using a recognized definition, the author hoped to eliminate issues of interpretation from the participants.

Snake Species Used

Grey Rat Snake (Pantherophis spiloides)

Grey Rat snakes are commonly found in Alabama and throughout the southeastern United States, therefore its conservation status is lowest conservation concern (see Figure 2.A). This species is non-venomous (Dunn, n.d.). Gray Rat snakes mainly eat small rodents and other small mammals; consequently, this species is important for rodent population control (Behler, 2000). Because rodents can cause significant damage to agriculture and electrical wiring Grey Rat snakes are beneficial to humans. The author chose this snake because they are common in Alabama and likely to be encountered in both rural and urban settings.

Midland Watersnake (Nerodia sipedon pleuralis)

This species of nonvenomous aquatic snake can be found in the southeastern part of the United States in nearly all freshwater habitats such as ponds, lakes, streams, rivers, and marshes (Powell et al., 2016) (see Figure 2.B). Consequently, this snake is quite abundant, and its conservation level is of least concern (Himes, 2002). This species is sometimes killed due to its superficial resemblance to two venomous species: Cottonmouth (*Agkistrondon piscivorus*) or Copperhead (*Agkistrodon contortrix*) (Shupe,2011).

Eastern Indigo snake (Drymarchon couperi)

The third species is the Eastern Indigo snake (*Drymarchon couperi)* (see Figure 2.C). This species is nonvenomous. Previously, Eastern Indigo snakes lived throughout Florida, southern Georgia, Alabama, and Mississippi in the Longleaf Pine (*Pinus palustris*) ecosystem. Today, this snake is rarely found in Alabama. Specifically, they are found in the Conecuh National Forest in south Alabama. The conservation status is federally endangered. The loss, fragmentation, and alteration of longleaf pine ecosystems are most likely the main cause for the disappearance of the Eastern Indigo snake in Alabama.

Additionally, as a result of the changes in these ecosystems, the gopher tortoise population was been reduced greatly. Therefore, the number of gopher tortoise burrows decreased significantly. This is problematic for the Eastern Indigo snake because they depend on those burrows for survival. The Eastern Indigo snake has been advertently killed by the practice of gassing gopher tortoise burrows with the intention of driving out rattlesnakes because they also reside in the burrows (Godwin, n.d)

Experimental Protocol

Partnering with local institutions such as Mt. Cheaha State Park, Anniston Museum of Natural History, Jacksonville State University, and the Little River Canyon Center was important for this study to give surveys and presentations in an educational area. The study took place in June through August. Participants were invited to attend on an entirely voluntary basis and the event was advertised within the parks and institutions as well as on social media. Only participants aged 15 or older were allowed to participate in the survey process due to the regulations of the IRB proposal. All participants that chose to participate in both the survey and the presentation were first given informed consent or informed assent (if under 18) documents and were asked if they still wished to participate. If they agreed, each participant was given a pre-survey (Appendix A) and had 10 minutes to complete it. The pre-survey had 13 questions, which consisted of demographic information (e.g., sex, age, education level) as well as a series of ordinal questions about perception of snakes (Appendix A).

Pre-surveys, post-surveys, and a number 2 pencil were packaged in a manila envelope. Each envelop was labeled 1-100. When participants arrived to listen to the presentation, the author approved them one by one and asked if they were interested in participating in the research project by filling out a pre and post survey. Participants who

acknowledged and agreed to partake in the surveys were asked to read the informed consent document. If the participant looked younger than 18, the author asked for their age. If they were younger than 18 but older than 14, the author asked the parent or guardian to read the minor consent form and sign in the designated spot. Once the participants finished reading the informed or minor assent form, the author handed them the envelope containing the survey. If the participants still agreed they were asked to remove the pre-survey from the envelope and start filling it out. The author allowed participants 10 minutes to complete the pre-survey. If the participant did not agree to the informal or minor consent document, the author instructed them that were allowed to stay and listen to the presentation even if they chose not to participate in the survey. Once all the pre-surveys were completed the 30-minute presentation began. The presentation, using a poster as visual guidance, provided biological and ecological information about snakes, the diversity of Alabama snakes, and current threats posed to snakes by humans (Figure 3). During the presentation, individuals were invited to observe pictures of the three snakes or to view live representatives of each species group. Live representatives were located in a transparent container and were not removed during the presentation. Individuals were allowed 15 minutes for these interactions and were then presented with a post-survey and were given 10 minutes to complete the document. Post surveys were collected and then participants were invited to ask questions (Appendix A). The pre- and post-survey for each group was stored in a separate file folder. Pre- and post-surveys had corresponding 8-digit numbers for matching surveys because no personal identifiers were collected. Data was transferred to a digital repository using Excel and a digitally locked hard drive. Data was analyzed in

R statistical software to ascertain differences in initial perceptions of snakes due to demographic variables and changes in perceptions between pre- and post-survey answers.

Statistical Analysis

For statistical analysis, all data collected was kept in an Excel spreadsheet. The total data recorded was organized by several metrics including location, treatment group, date, number of participants, number of surveys collected, and notes. There are also several other sheets containing more in-depth information including composition, which is a list of every survey collected, a final composition which is a list of usable surveys, and breakdowns of each individual presentation. Microsoft Excel was used to calculate the mean and standard deviation for all pre and post survey questions across several categories. Categories were determined based on variables of interest (e.g., treatment group, demographic information). Data was later loaded into R Statistical Software. R and RStudio were used to perform statistical tests to assess the author's hypotheses. For hypothesis 1, the author used a generalized (non-parametric) linear model with a Poisson distribution and log link to assess the impact of demographic variables and variable interaction on pre-survey data. A model was performed for each question individually. For hypothesis 2, the author used a Wilcoxon Sign Ranked test (paired, non-parametric) for each question to assess the change in survey data rank from the pre survey to the post survey. For hypothesis 3, the author again used a generalized linear model with a Poisson distribution and log link. In this case, the author assessed whether demographic variables, location of the survey, and treatment type influenced changes in pre survey and post survey responses.

Results

Exploratory Data

The total number of surveys collected was 164, but fourteen surveys were removed from analyses due to participants not completing the entire survey, filling out the survey incorrectly, or not being in the correct age range. After checking surveys for inclusion criteria, 150 usable surveys were used. The author amassed 86 surveys for the picture treatment and 64 surveys for the snake treatment (Figure 4.A). The author examined the demographic variables for all of the surveys combined (regardless of treatment) and revealed the following about the 150 individuals who participated in this study. In regard to sex, 55 participants were male, 91 participants were females, and 1 participant identified as non-binary (Figure 4.B). Across the urban/rural gradient, the majority of participants self-identified as residing in a rural area (77 individuals). The author had 37 individuals who self-identified with an urban residence and 28 who self-identified with a suburban residence (Figure 4.C). The age of the participants ranged from 14 years of age to 88 years of age with an average participant age of 43. Participants demonstrated a range of education levels with the majority falling in the "Some College" category (Figure 4.D)

The final nine questions on the surveys asked participants about their perception of snakes. Questions such as "I like snakes" or "Most snakes are venomous" and an ordinal scaling system were used to measure feelings about snakes under different situations. Questions 1, 2, 8, and 9 were used as standard metrics for expected increases in responses from pre to post survey. All 150 participants showed an increase in agreement with many of these statements. For example, the statement "I like snakes" (Question 1; pre survey mean ± SD = 4.8 ± 3.1; post survey mean ± SD = 5.8 ± 3.1), and the statement "I'm comfortable around live snakes" (Question 2; pre survey mean ± SD= 4.6 ± 3.1; post survey

mean ± SD=5.6 ± 3.0 (Table 1) both demonstrated positive net changes from pre to post survey. This same trend was demonstrated in Question 8, "Snakes have economic importance to humans" (pre survey mean ± SD = 8.1 ± 2.4; post survey mean ± SD = 9.1 ± 1.7), and in Question 9, "Snakes are an important part of the environment where they live" (pre survey mean ± SD = 8.1 ± 2.4; post survey mean ± SD = 9.1 ± 1.7). Questions 3 and 7 were used as standard metrics for expected decreases in responses from pre to post survey. All 150 participants showed a decrease between surveys for these questions. Specifically, the statement "I hate snakes" (Question 3; pre survey mean ± SD = 4.4 ± 3.1; post survey mean ± SD = 3.6 ± 3.1) and the statement "Most snakes are venomous" (Question 7; pre survey mean ± SD = 3.5 ± 2.3; post survey mean ± SD = 2.2 ± 1.9) demonstrated a decrease in agreement from the pre-survey to the post survey.

Quantitative Data:

Hypothesis 1: Initial Perceptions

In order to assess hypothesis one (demographics influence perceptions of snakes), the data were separated into pre and post survey data. Only pre-survey data was considered for this analysis as the author was interested in initial (pre-presentation) perceptions. Pre-survey question responses were divided by gender, living area (urban/rural gradient), age groups, and educational level. fourteen surveys were excluded from these analyses as some individuals failed to properly fill one or more demographic questions. Categories for some pre-survey response data were excluded or re-binned prior to analyses. The non-binary category for gender was removed as only one participant identified with that category. Ages were binned by three categories: younger (15-20 years of age), mid-range (21-29 years of age), older (≥ 30 years of age). Education categories were also re-binned due to

low response numbers in some categories: primary (K-12, High School/GED); post-secondary (Some College, Associate's Degree, Bachelor's Degree); and Advanced (Master's Degree, Specialization/Higher than a Master's).

The authors ran a generalized linear model with a Poisson distribution as ordinal data is not normally distributed. This modeling technique was run for each individual demographic question (response variable) for the pre-survey data.

Gender:

Every question on the pre-survey was significantly influenced by gender with the exception of Question 8, "Snakes have economic importance to humans", and Question 9, "Snakes are an important part of the environment where they live" (Table 2). Specifically, for questions in which gender differences were significant, males ranked higher (i.e., greater agreement) every question. Overall, responses indicate that males have a decreased fear of snakes compared to females (Figure 5).

Age:

The majority of questions on the pre-survey had significance with age, excluding Question 4 ("If I found a live snake in my yard or driveway, I would leave it alone"), Question 5 ("If I found a snake on a hiking trail in the woods, I would leave it alone"), and Question 6 ("If I saw a snake while driving, I would leave it alone") (Table 3). Participants in the mid-range and older categories ranked higher than younger aged participants for four questions ranked higher for "I like snakes", "I am comfortable around live snakes", "I hate snakes", and "If I saw a snake on a hiking trail in the woods, I would leave it alone." Younger participants ranked higher than older and mid-range participants for "Most snakes are venomous." Younger and older aged participants ranked higher than mid-range

participants for “Snakes are an important part of the environment where they live” (Table 3). Overall, responses indicate that participants in the mid-range and older categories have a decreased fear of snakes compared to individuals in the younger category (Figure 6).

Home:

Participants’ home dwelling only showed significance for Question 1 (“I like snakes”) and Question 2 (“I am comfortable around live snakes”) (Table 4). For both of these statements, rural and suburban dwelling participants ranked higher than urban dwelling participants. This proposes that rural and suburban residents have a decreased fear perception of snakes compared to urban residents (Table 4) (Figure 7).

Education:

Education alone did not significantly affect pre-survey responses.

Interactions: Gender and Age

The interaction of gender and age significantly impacted the response of 4 questions (Table 5). For question 1 and 2, males in every age group ranked higher than females. However, for question 3, responses were equal among all gender and age groups. For question 4, younger and mid-range females ranked higher than younger and mid-range males. Older participants had the same ranking regardless of gender (Figure 8).

Interaction with Age and Home

Interaction with age and home was significant with Question 1 (“I like snakes”), Question 2 (“I am comfortable around live snakes”), and Question 3 (“I hate snakes”) (Table 6). For question 1, younger participants did not differ in perception based on living area; however, older individuals’ answers did vary based on living area. Specifically, rural and suburban participants in the older age category tended to rank higher in agreement on Question 1 (“I like snakes”) than those who lived in urban areas. No individuals from the

mid-range category identified themselves as living in urban areas so the author did not have a complete comparison for mid-range data across residence types. Data from question 2 revealed older and mid-range participants living in a rural area ranked higher than younger participants that lived in a rural area. This same trend was true for participants living in suburban areas. Because no mid-range age individuals identified themselves as living in an urban area, these data were not considered. Question 3 showed younger participants did not really differ in rating across rural, urban, or suburban residences. In older participants, rural and suburban individuals ranked higher than urban individuals. Older individuals also tended to rank higher than younger individuals across all residence types. Mid-range data was lacking for rural and urban dwelling individuals for this question (Figure 9).

Interaction with Age and Education:

The Interaction of age and education was significant with question 1 ("I like snakes") and question 2 ("I am comfortable around live snakes") (Table 7). Younger aged participants had no individuals in the advanced degree category, likely because it is rare to have someone under twenty with a master's or PhD degree. Consequently, the author did not make education comparisons in the younger age category for these data. For question 1 the mid-range age group participants with advanced degrees (masters/PhD) ranked higher than postsecondary individuals (some college, associates, bachelors) in the mid-range age group. Both of these education groups ranked higher than primary education individuals (K-12 and high school diploma/GED) in the mid-range age group. Within older age participants, primary education ranked the highest for question 1. Postsecondary and advanced degree groups in the older age participants were roughly equivalent in rank. Mid-range age participants ranked higher than older participants for both advanced degree and

postsecondary education groups. However, older participants ranked higher than mid-range age participants in the primary education class.

Other Interactions:

All other interactions were deemed not significant or did not have sufficient data for statistical analyses.

Hypothesis 2: Overall Change in Survey

For the second hypothesis, the author wanted to measure whether there was a difference in perception when comparing the results from pre and post survey. The author did not separate the surveys based on treatment group or any type of demographic data. These data were analyzed using the Wilcoxon Sign Ranked test, a non-parametric test for paired comparisons. Fourteen surveys were excluded from these analyses as some individuals failed to properly complete both pre and post surveys. The majority of participant answers are expected to increase in rank (i.e., statement agreement) from pre to post survey; however, questions 3 and 7 are expected to decrease in rank from pre to post survey.

Every question demonstrated a significant change in pre- and post-survey responses. Every question demonstrated the expected trend (i.e., positive or negative change in response rank) (Table 8).

Hypothesis 3: Treatment Groups

Hypothesis 3 examined if there was a difference in perception when comparing pre and post surveys across the two treatment groups (live snake and pictures of snakes). The author expected presentations with live snakes to be more impactful in changing opinion from pre to post surveys. These data were examined using a generalized linear model (glm) with a Poisson distribution and log link. Fourteen surveys were excluded from these analyses as some individuals failed to properly complete both pre and post surveys. Each

question was analyzed as a response variable for the model and survey type (pre vs post), treatment (snake vs picture), location (where presentation/survey took place), gender and living area (urban, suburban, rural) were used as independent variables of interest.

Survey:

All questions with the exception of question 5 ("If I saw a snake while driving, I would leave it alone.") demonstrated a significant impact of survey type on the response variable (Table 9). These findings further support the statistical test run in the Hypothesis 2 section above.

Survey x Treatment Interaction:

None of the questions demonstrated a significant difference for the interaction of survey type and treatment (Table 10), suggesting that treatment did not play a role in changing participants' pre to post survey responses.

Other Interactions of Note:

Question 1: "I like snakes."

The interaction with location, survey, and gender was important for question 1 (Table 11). Female participants at Anniston Museum of Natural History ranked higher than male participants. Dr. TJ's location showed females had greater increases between pre and post survey than males. The Little River Canyon Center showed female participants increased between pre and post survey, however males decreased. Cheaha State National Park showed males had a greater increase from pre and post survey than females (Figure 10).

Question 3: "I hate snakes."

Pre to post survey rankings decreased (desired result) at all locations with the exception of Little River Canyon Center (Table 12).

Question 7: “Most snakes are venomous.”

All locations showed a decrease between pre and post survey (desired result) (Table 13). For the Cheaha State National Park and Dr. TJ locations females had a greater decrease than males. Whereas Dr. Turgeon location males had a greater decrease than females (Figure 10).

Discussion

According to the results, educational programs can enhance understanding and appreciation of an organism commonly viewed as threatening to humans. However, these results also revealed that the benefit of this type of educational program is context dependent. Specifically, demography of participants matters as well as the location but the materials used do not (i.e., presentation type). The first hypothesis stated that there would be a difference in initial perception of snakes based on demography of participants. Specifically, the author tested whether gender, living area, age groups, and educational level would influence participants' initial perceptions of snakes. The author found significant differences across questions that suggests that all of the explored demographic variables play some role in perception of snakes. However, gender and age seemed to play a much larger role as they significantly impacted almost every question. Hypothesis two predicted that the perceptions of participants would change once they had been exposed to an educational program about snakes. The presentation explained to participants real-life examples of how snakes are beneficial to humans, how to identify venomous and non-venomous snakes, and what to do when they encounter a snake. The Wilcoxon Sign Rank test revealed a significant change in pre- to post-survey responses across every question. This suggests that, after learning more information about snakes and their usefulness to the environment, the participants had a more positive perception of snakes. Finally, hypothesis three predicted that individuals who saw an educational program with live snakes would have a greater change in positive perceptions than those who only saw pictures of snakes. These results suggest that it does not matter if the audience viewed live snakes or pictures of snakes. However, the location of the

presentation and certain demographic variables (mainly gender) influenced pre to post survey responses.

The demographic data are interesting for targeting particular audiences for conservation education. Furthermore, our data align with previous studies and hypotheses about which demographic groups might find more value in these presentations. For example, gender seemed to play the largest role in both initial perceptions and in change in perception from pre- to post-survey. Male and female participants showed an increase between pre and post survey results, but females' initial perceptions had a lower initial score than males. This trend indicates males and females have differences of initial perception of snakes. Past studies have also confirmed this finding. Women generally have more negative perception and fear of snakes than men do (Pinherio et al., 2016). However, no studies yet exist to explain why. One explanation offered is that women are more likely to believe in myths about snakes than men. Women also show more fear than men in different situations. Another possible explanation for gender differences is hormonal influences and genetic factors (Pinherio et al., 2016). It should be noted that these explanations have not been tested or confirmed. Age was also a variable the author predicted would influence perception. The age range of participants varied widely from ages 14 - 88. As a person ages, their perception changes. Younger individuals (20 years old or younger in our study) are still trying to figure out their own viewpoints. During this time, parents or other adults can project their own perceptions onto children (Ballouard et al., 2013). Young adults (21-29 years old) are less influenced by their parents' beliefs. However, the young adult could still believe the negative perception instilled in them by parents and other adults (Vollebergh, 2001). Older individuals (30+

years old) are assumed to be less likely to change their perceptions. The result of hypothesis one showed responses indicates that participants in the mid-range and older categories have a decreased fear of snakes compared to individuals in the younger category. However, the results for hypothesis three showed age doesn't seem to impact with treatment groups. This is mostly because there was not a wide spread of age classes among participants with each location. In some ways, these age categories could also link to formal education, another variable of interest in this study. Ceriaco (2012) suggested individuals with higher levels of education have fewer misinterpretations about herpetofauna. Furthermore, Pinherio (2016) showed that formal education is important in changing people's perceptions of snakes. In this study, education level alone did not significantly affect pre-survey responses. Hypothesis three showed the same result, because there was not a wide array of data to capture other education level among locations. Expanding into participants educational levels with advanced degrees would help this in a future study. The final demographic variable of interest was living area. The author predicted participants' living area could influence their perception of snakes. A baseline assumption is that rural or agricultural populations should encounter snakes more often as they are closer to the native habitat of most snakes and likely have large rodent populations in range. However, rapidly expanding urban areas could soon change this assumption. A study of urban-dwelling snakes in New Jersey, USA, found that some larger species were extirpated over time while other, smaller species might find valuable resources (Zappalorti & Mitchell, 2008). The results from this study found that overall, there was a difference in magnitude of the change across living areas; rural and suburban residents had a decreased fear of snakes compared to urban residents.

Although there were significant differences in initial perceptions of participants, the data demonstrated a significant, positive increase in perceptions across all questions (Hypothesis 2). However, the data did not demonstrate a difference in the magnitude of the change based on whether participants viewed live snakes or pictures of snakes. This finding is in direct opposition to previous studies in conservation education. Hummel & Randler (2010) demonstrated that both live animals and pictures of animals are both effective in educating the public about the animals, but the live animals gained a slightly better response than the pictures. Moon (2018) found that using live raptors in a presentation allowed participants to form an emotional connection which caused the audience to learn more about the raptors and change their behavior (Moon, 2018). By the program allowing visitors to form emotional connections, the audience members are more likely to leave the program feeling motivated to participate in pro-environmental behavior (Moon, 2018). The same can be said across various age groups. Children who were able to view captive snakes in an aquarium or watched snakes being handled by an adult had drastically more positive attitudes related to those who only experienced a typical educational program about snakes (Hartel et al., 2015). The data from this study did not confirm the findings of these last two studies. The author found that it does not matter if the audience viewed live snakes or pictures of snakes. Based on the results, the author rejects hypothesis three. However, the author did find that it is important for the presenters to go into locations where people are not getting exposed to relevant conservation information. Furthermore, the author also found it is important to present information to individuals from different demographic groups that are not normally exposed to this information. Specifically, the starting point of the pre survey depended on the location of where the program was

conducted. Locations at Jacksonville State University either showed a high ranking or lower ranking and national parks showed a mid-way or higher ranking. Gender also depended on location of the presentation. At Dr. TJ's location, females had a lower ranking in the pre survey compared to females at Anniston Museum of Natural History or Cheaha State National Park. These findings suggest that targeting populations that might not have previous exposure to or interest in conservation topics can produce the biggest gains in positive perceptions of wildlife.

For the future of environmental education, conservation of snakes can be difficult. Individuals have been taught to hate snakes through cultural background, traumatic experiences, untrue stories, lack of knowledge, or fear instilled by family or friends. Individuals need to understand the repercussions of killing snakes. If humans do not stop, then there will be an increase of diseases spread by rats, a decrease in crop production, and a decrease in livestock production. The majority of the locations where the presentations were held were places where people would be interested in learning about snakes and their role in the environment (e.g., Cheaha State Park, the Anniston Museum of Natural History). However, certain areas (e.g., classrooms at JSU) were areas in which participants were not being directly exposed to nature; these locations tended to have the greatest magnitude of change in perception. Furthermore, this study suggests that these same results can be achieved regardless of the use of live snakes or images of snakes. There could be a fear component to showing live snakes. If an institution is doing a program involving live snakes, it might be best when advertising for the event to express to the public that live snakes will be there, so the participants are not shocked or caught off guard when they see

live snakes. Alternatively, institutions without access to live snakes or that are concerned of the fear factor can use images and should achieve some of the same results.

Conservation and outreach efforts are extremely important to help our population understand snakes' role in our lives and the state's ecosystem and broader biodiversity. Snakes make up a large portion of Alabama's diverse ecosystems. Conservation efforts must focus on the preservation of native species and the reduction of ecosystem damaging processes or a suite of stakeholders will lose unique biological features of our state. Unfortunately, negative experiences or preconceptions about certain wildlife can make this message hard to share with the public. Through conservation education and outreach programs, conservationists can help prevent intentional harm to some of these organisms with a poor reputation and garner community support for biodiversity preservation efforts.

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Appendix A: Pre-survey

DATE:_____ **SURVEY ID: 05081001**

PRE-SURVEY

ATTENTION: Please do not put you name on either survey. Please answer all questions to the best of your ability. If you choose not to participate, you may leave the presentation or stop filling out the survey at any time.

1. Please report your age: _____

2. Please circle your gender:
   Male Female Non-binary I prefer not to say

3. Please write your zip code on the line provided: _____

4. Please circle one of the following definitions that best describes where you live.

   City- I live in a town or city area of 50,000 or more people

   Suburban- I live in a suburban area of at least 25,000 and fewer than 50,000

   Rural- I live in a town with fewer than 25,000 people

4. Please report your highest level of education (circle one).

   K-12

   Highschool diploma/GED

   Some college

   Associates degree

   Bachelor's degree

   Master's degree

   Advanced or Terminal Degree (Please note degree here:_____)

Please rate your agreement with the following statements:

5. “I like snakes.”

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

6. “I am comfortable around live snakes.”

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

7. “I hate snakes.”

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

8. “If I found a live snake in my yard or driveway, I would leave it alone.”

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

9. “If I found a live snake on a hiking trail in the woods, I would leave it alone.”

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

10. “If I found a live snake on the road while I was driving, I would not harm it.”

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

11. “Most snake are venomous.”

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

12. “Snakes have economic importance to humans.”

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

13. “Snakes are an important part of the environment where they live.”

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

Appendix B: Post-survey

DATE:_____ **SURVEY ID: 05081002**

POST-SURVEY

ATTENTION: Please do not put you name or any other identifying factors on either survey. Please answer all questions to the best of your ability. If you choose not to participate, you may leave the presentation or stop filling out the survey at any time.

Rate your agreement with the following statements:

1. "I like snakes."

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

2. "I am comfortable around live snakes."

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

3. "I hate snakes."

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

4. "If I found a live snake in my yard or driveway, I would leave it alone."

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

5. If I found a live snake on a hiking trail in the woods, I would leave it alone.".

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

6. “If I found a live snake on the road while I was driving, I would leave it alone.”

Strongly Disagree									Strongly Agree
1	2	3	4	5	6	7	8	9	10

Appendix C: IRB Approval Letter

JSU | INSTITUTIONAL REVIEW BOARD
JACKSONVILLE STATE UNIVERSITY

Institutional Review Board for the Protection of Human Subjects in Research
203 Bibb Graves Hall
700 Pelham Road North
Jacksonville, AL 36265-1602

March 31, 2021

Bethany Walker
Jacksonville State University
Jacksonville, AL 36265

Dear Bethany:

Your protocol for the project titled "Can providing positive interactions with snakes change a person's perception of dangerous wildlife interactions?" protocol number 03312021-1 has been approved by the JSU Intuitional Review Board for the Protection of Human Subjects in Research (IRB).

If your research deviates from that listed in the protocol, please notify me immediately. One year from the date of this approval letter, please send me a progress report of your research project.

Best wishes for a successful research project.

Sincerely,

Jennifer Mead
Assistant Human Protections Administrator, Institutional Review Board

List of Tables

Table 1

Mean Rank +/-Standard Deviation for Pre- and Post -Survey

Question #	Question	Pre-Survey Mean ± SD	Post Survey Mean ± SD	Net Change
1	"I like snakes"	4.8 ± 3.1	5.8 ± 3.1	+1.0
2	"I am comfortable around live snakes"	4.6 ± 3.1	5.6 ± 3.0	+1.0
3	"I hate snake."	4.4 ± 3.3	3.6 ±2.9	-0.8
4	"If I found a live snake in my yard or driveways, I would leave it alone."	7.5 ±2.7	8.3±2.9	+0.8
5	"If I sound a live snake on a hiking trail in the woods, I would leave it alone."	8.8 ± 2.8	9.2 ± 1.6	+0.4
6	If I found a live snake on the road while I was driving, I would not harm it."	8.0 ± 2.8	9.0 ± 2	+1.0
7	"Most snakes are venomous."	3.5 ± 2.3	2.2 ± 1.9	-1.3
8	"Snakes have economic importance to humans."	6.7 ± 2.7	8.6 ± 1.9	+1.9
9	"Snakes are an important part of the environment where they live."	8.1 ± 2.4	9.1 ± 1.7	+1.0

Table 2

Statistical Report for Pre-Survey Data for Gender Differences

	Question	DF	Resid. DF	RD	P VALUE
1	"I like snakes."	1	141	308.39	5.8E-4
2	"I am comfortable around live snakes"	1	141	312.49	9.96E-09
3	"I hate snakes"	1	141	299.35	9.26E-09
4	"If I found a live snake in my yard or driveway, I would leave it alone."	1	141	170.85	0.003

5	"If I found a snake on a hiking trail in the woods, I would leave it alone."	1	141	98.63	0.075
6	"If I saw a snake while driving, I would leave it alone."	1	140	174.75	1.83E-3
7	"Most snakes are venomous"	1	141	217.06	0.023

Table 3

Statistical Report for Pre-Survey Data for Age Category Differences

	Question	DF	DF	RD	P VALUE
1	"I like snakes."	2	139	266.07	6.49E-10
2	"I am comfortable around live snakes."	2	139	275.64	9.96E-09
3	"I hate snakes."	2	139	299.35	2.40E-03
7	"Most snakes are venomous."	2	139	217.06	8.79E-13
8	"Snakes have economic importance to humans."	2	138	160.53	1.36E-04
9	"Snakes are an important part of the environment where they live."	2	137	121.12	2.179E-5

Table 4

Statistical Report for Pre- Survey Data for Residence

	Question	DF	DF	RD	P VALUE
1	"I like snakes."	2	137	256.71	9.2687E-4
2	"I am comfortable around live snakes."	2	137	263.71	2.56E-3

Table 5

Statistical report for Pre-Survey Data for Gender x Age Interaction

	Question	DF	DF	RD	P VALUE
1	"I like snakes."	2	133	247.01	0.0386
2	"I am comfortable around live snake."	2	133	256.14	0.04192
3	" I hate snake."	2	133	254.52	0.0807
4	"If I found a live snake in my yard or driveway, I would leave it alone."	2	133	155.05	0.0057

Table 6

Statistical Report for Pre-Survey Data for Age Category x Residence Interaction

	Question	DF	DF	RD	P VALUE
1	"I like snakes."	4	127	233.9	0.0337
2	"I am comfortable around live snakes."	4	127	245.57	0.0682
3	"I hate snakes."	4	127	238.35	0.0161

Table 7

Statistical Report for Pre-Survey Data for Age Category x Education Interaction

	Question	DF	DF	RD	P VALUE
1	"I like snake"	3	122	224.92	0.0346
2	"I am comfortable around snakes."	3	122	221.53	3.10E-05

Table 8

Statistical Report for Pre- to Post-Survey Comparison (Wilcoxon)

	QUESTION	Pre Survey Mean ± SD	Post Survey Mean ± SD	V- VALUE	P-VALUE
1	"I like snakes.'	4.85 ± 3.14	5.77 ± 3.13	179.5	1.863E-11
2	"I am comfortable around live snakes"	4.52 ± 3.10	5.69 ± 3.02	218.5	4.489E-13
3	"I hate snakes"	4.45 ± 3.35	3.65 ± 2.93	2360.5	2.856E-06
4	"If I found a live snake in my yard or driveway, I would leave it alone."	7.55 ± 2.76	8.39 ± 2.29	532.5	4.104E-07
5	If I saw a snake while driving, I would leave it alone."	8.89 ± 2.09	9.30 ± 1.65	185.5	1E-4
6	"If I found a live snake on a hiking trail in the woods, I would leave it alone."	8.00 ± 2.87	9.05 ± 2.01	215.5	1.616E-08
7	"Most snakes are venomous."	3.65 ± 2.48	2.27 ± 1.93	4043	6.726E-12
8	"Snakes have economic importance to humans."	6.71 ± 2.84	8.58 ± 1.99	142.5	8.783E-15
9	"Snakes are an important part of the environment where they live."	8.06 ± 2.65	9.06 ± 2.06	120.5	1.58E-09

Table 9

Statistical Report for Pre- vs Post- Survey Differences

	QUESTION	DF	DF	RD	P VALUE
1	"I like snakes."	1	284	606.9	7.04E-3
2	"I am comfortable around snakes."	1	284	598.4	2.57E-05
3	"I hate snakes."	1	284	679	3.29E-4
4	"If I found a live snake in my yard or driveway, I would leave it alone."	1	284	298.5	0.0125
6	"If I found a live snake on a hiking trail in the woods, I would leave it alone."	1	283	272.2	5.73E-4
7	"Most snakes are venomous."	1	283	394.23	1.49E-11
8	"Snakes have economic importance to humans."	1	283	261.5	7.23E-08
9	"Snakes are an important part of the environment where they live."	1	280	194.5	1.98E-03

Table 10

Statistical Report for Pre- vs Post- Survey x Treatment Interaction

	QUESTION	DF	DF	RD	P VALUE
1	"I like snakes."	1	274	489.9	0.770515
2	"I am comfortable around snakes."	1	274	460.93	0.765247
3	"I hate snakes."	1	274	569.3	0.587687
4	"If I found a live snake in my yard or driveway, I would leave it alone."	1	274	275.11	0.76248
5	"If I saw a snake while driving, I would leave it alone."	1	274	150.01	0.81162
6	"If I found a live snake on a hiking trail in the woods, I would leave it alone."	1	273	245.57	0.172234
7	"Most snakes are venomous."	1	273	305.13	0.587383
8	"Snakes have economic importance to humans."	1	273	239.2	0.359424

9	"Snakes are an important part of the environment where they live."	1	270	170.65	0.2939899

Table 11

Statistical Report for Interactions Influencing Question 1

	DF	**DF**	**RD**	**P VALUE**
Survey	1	284	606.93	7.04E-4
Survey: Location: Gender	5	242	423.1	0.018

Table 12

Statistical Report for Interactions Influencing Question 3

	DF	**DF**	**RD**	**P VALUE**
Survey	1	284	679	3.29E-4
Survey: Location	5	269	549.33	1.26E-3

Table 13

Statistical Report for Interactions Influencing Question 7

	DF	**DF**	**RD**	**P VALUE**
Survey	1	283	394.23	1.49E-11
Survey: Location: Gender	5	241	241.37	0.028

List of Figures

Figure 1.A

Treatment 1: This is the schematic for the timing of presentations that fall under the designation of "Treatment 1". Individuals were presented with pictures of snakes during the educational program presentation.

Figure 1.B

Treatment 2: This is the schematic for the timing of presentation that fall under the designation of "Treatment 2". Individuals were presented with live snakes (contained in transparent holding boxes) during the educational program presentation.

Figure 2.A

Grey Rat Snake

Figure 2.B

Midland Water Snake

Figure 2.C

Eastern Indigo Snake

Figure 3

Poster used for Educational Presentation

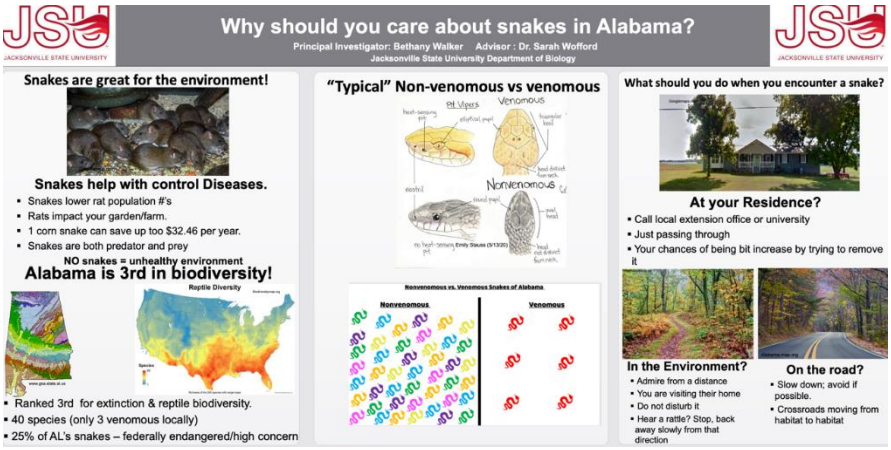

Figure 4.A

Treatment groups: The author collected 150 total surveys, 86 picture surveys and 64 snake surveys.

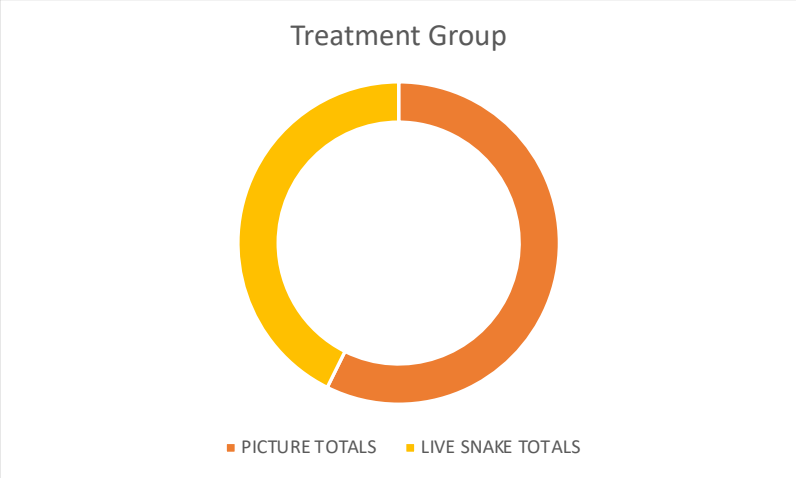

Figure 4.B

Gender of Participants: 150 individuals participated in this survey. The majority of participants were female (91) and the rest were male (55) or non-binary (1).

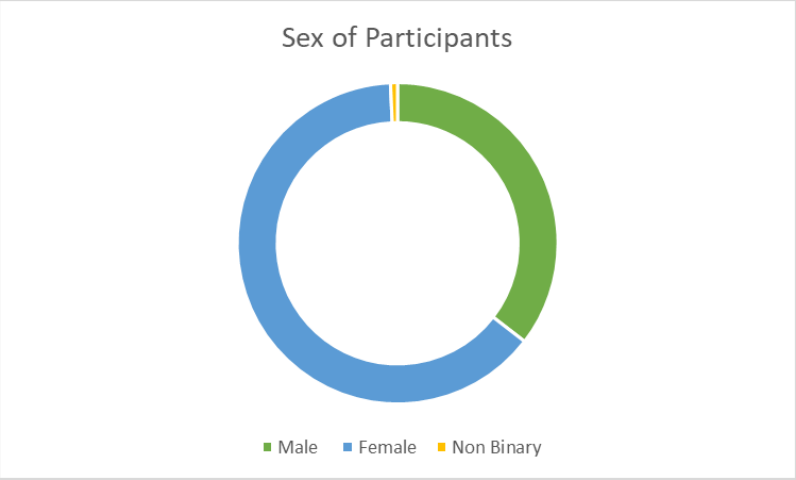

Figure 4.C

Residence of Participants: 150 individuals participated in this survey. The majority of participants were from rural areas (77) and the rest were divided between urban (37) and suburban areas (28).

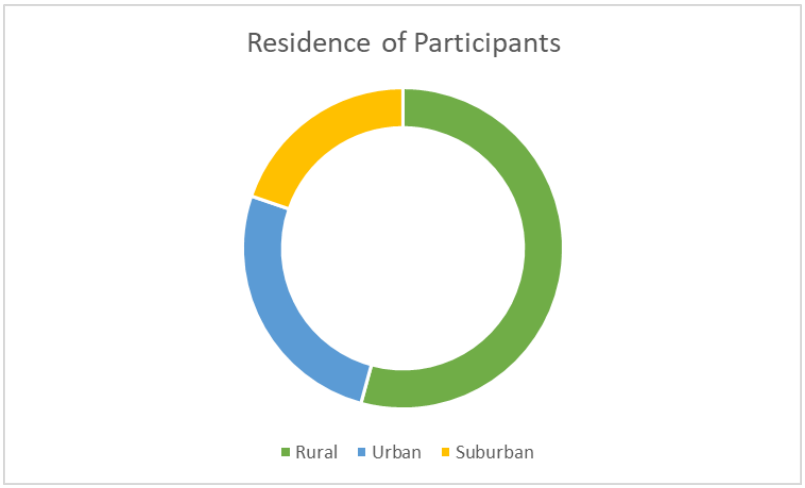

Figure 4.D

Education Level of Participants: 150 individual participated in this survey. The majority of participants identified their education level as "Some College." The rest of the participants were spread across an array of educational statuses from K-12 education to advanced degrees.

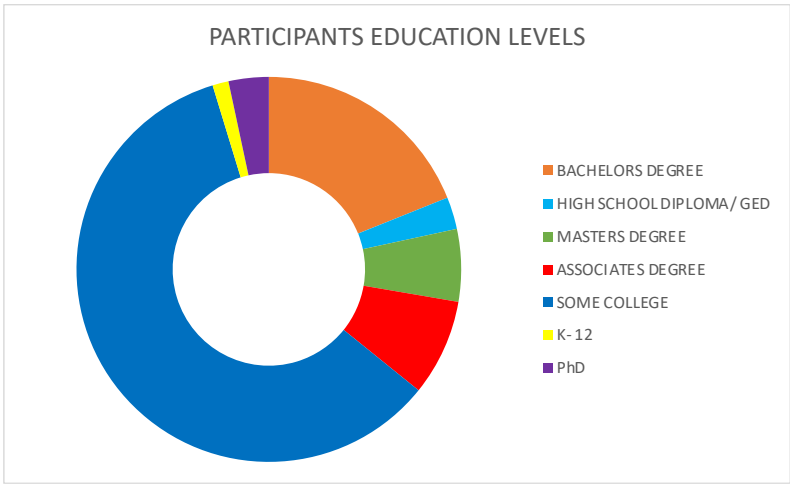

Figure 5

Pre-survey responses by gender

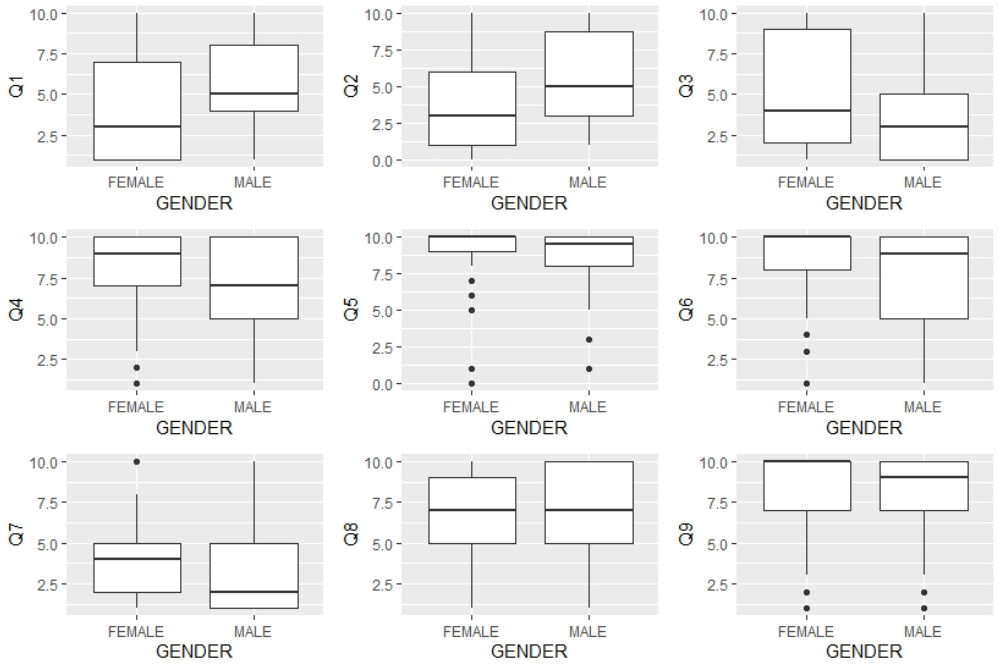

Figure 6

Pre-Survey Responses by Age Category

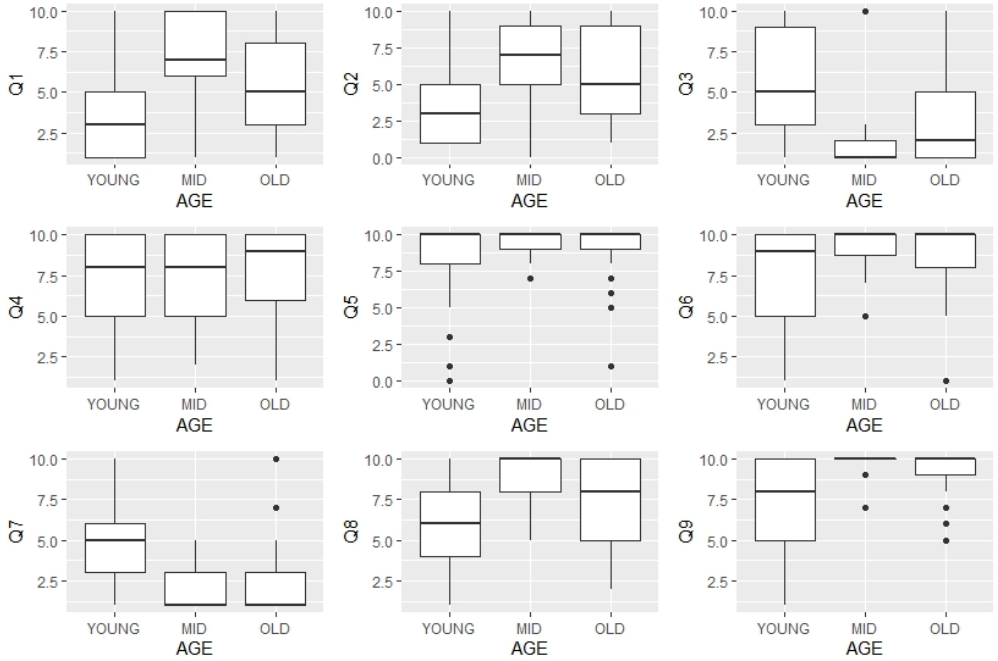

Figure 7

Pre-Survey Responses by Residence Type

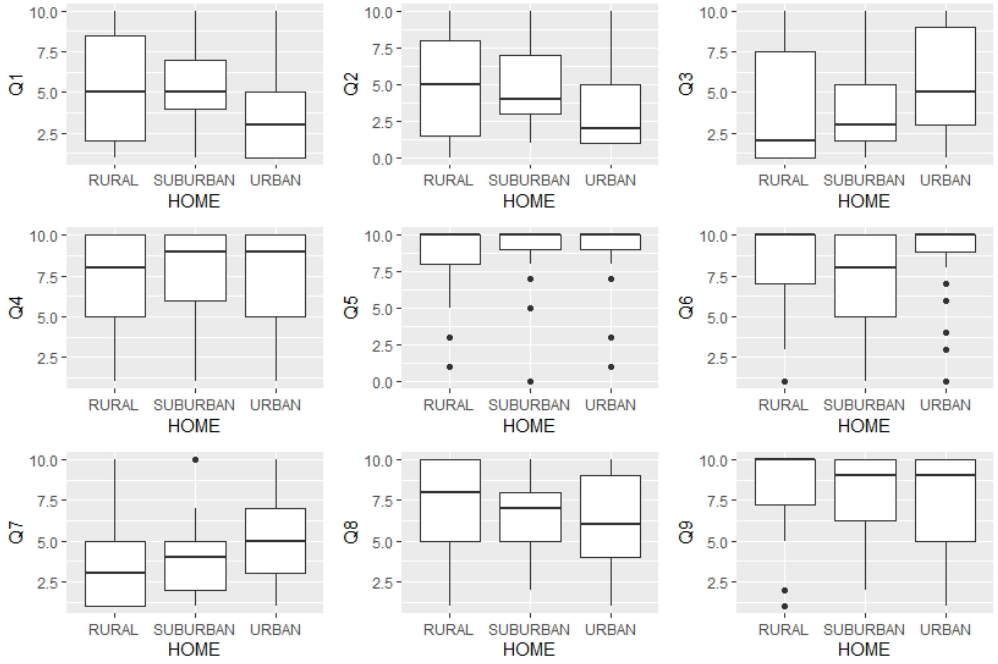

Figure 8

Pre-Survey Responses by Gender x Age Category Interaction

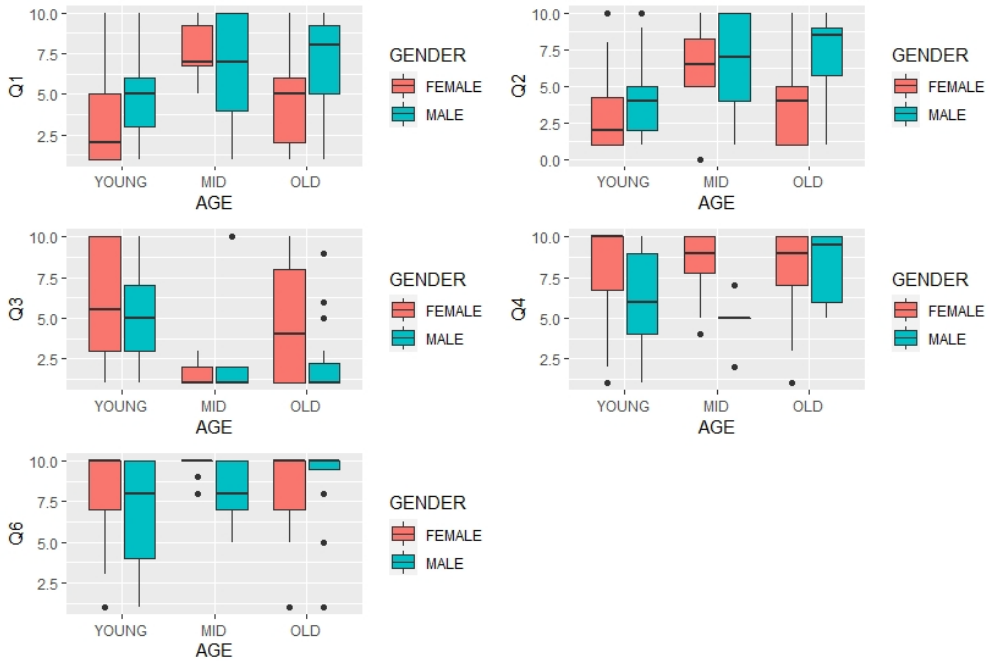

Figure 9

Pre-Survey Data by Age Category x Residence Interaction

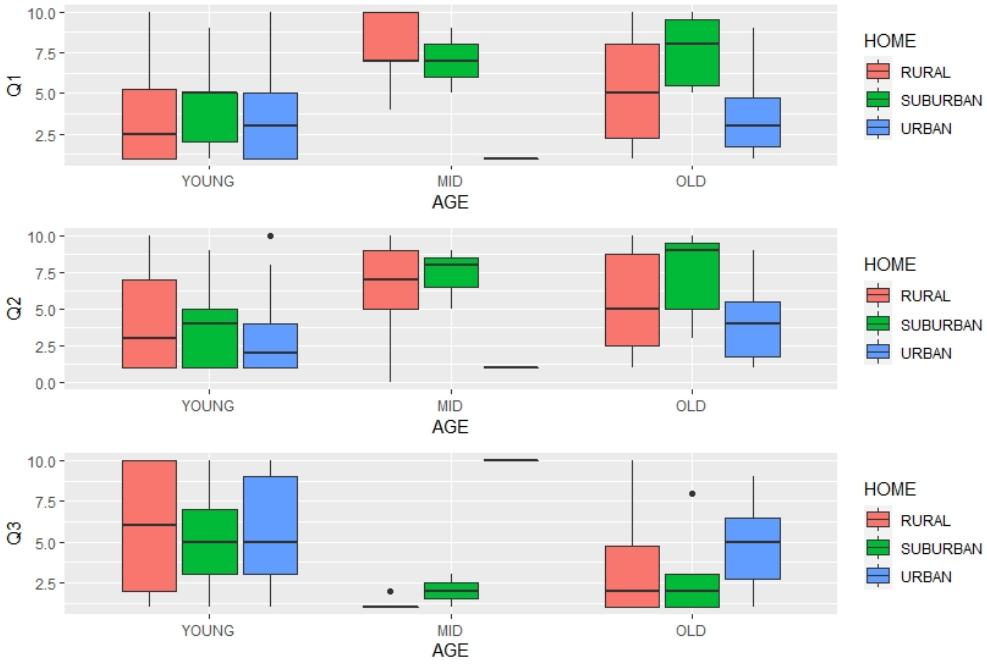

Figure 10

Pre vs Post Survey Comparisons by Location x Gender Interaction