

**Viewing Distressed Marine Life and its Impact on Perceptions of  
Environmental Conscientiousness**

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# 1 Introduction

Dr. Lindsay Mehrkam and McKenna Douglass are both interested in how a subject's environmental conscientiousness changes before and after viewing different marine animals in distressed environments. Dr. Lindsay Mehrkam is an assistant psychology professor at Monmouth University. She obtained her M.S. and Ph.D. from the University of Florida. Dr. Mehrkam is an applied animal behaviorist, animal welfare scientist, and doctoral-level board-certified behavior analyst. McKenna Douglass graduated from Monmouth University in 2020. She now works at a clinic for children with autism. Some of her hobbies include research and advocating for disability rights. McKenna's love for animals inspired her to write her thesis project about marine animals with Dr. Mehrkam.

Environmental conscientiousness is said to be the level of concern in which a subject reflects towards the well being of the environment. In this project, we will understand if a person's environmental conscientiousness will improve after being exposed to various conditions. The potential benefits of this study include creating new marketing strategies on animal care, motivating people to be eco-friendly, and helping others understand if this is an effective way of changing a person's environmental conscientiousness.

The participants from Amazon MTurk began the survey by taking fifteen pre-test questions regarding environmental sustainability/eco-friendly behavior. Each participant was then put into one of the five animal conditions: Household items pertaining to water, Ocean, Seal/Sea Lion, Sea Turtle, and Sea Bird. All participants saw four natural images and four distressed images and were asked how impactful they found each photo. Along with these questions, they were also exposed to a fun fact about the animal they saw. Within the animal conditions, participants were exposed to one of the two vignettes: perceived control and perceived helplessness. The perceived control vignette summarized that the participant alone can make a difference on the environment while the perceived helplessness vignette summarized that the participant's effort has no impact on the environment. After the participant read one of the two vignettes, they were asked how empowered it made them feel. The participants answered a memory game as a distraction to then answer the fifteen post-test questions. These questions were reworded and reverse coded from the fifteen pre-test questions. For the behavioral choice measure, participants were asked if they wanted to participate in a beach and waterway cleanup. After the behavioral choice measure, they answered the manipulation check to ensure they were present during the survey. The participants responded to two demographic questions about gender and age. Finally, the participants were debriefed and thanked for their time.

In this project, we are interested to see if environmental conscientiousness changes after viewing marine animals in distress. Our clients have the following hypotheses:

- H1: The person's environmental conscientiousness will increase after viewing the images.

- H2: Participants will increase their level of environmental conscientiousness by the type of animal and vignette they saw.
- H3: There will be a difference in how impactful participants found the distressed and natural images by animal type.

## 2 Methodology

Since the post questions on the survey were reverse coded and rearranged, we matched the pre questions to the post questions in order and made sure all questions were scaled the same. We switched the scale to where a high value was considered a good answer. Thus, one implied strongly disagree and a seven implied strongly agree with the statement. We used these scales as quantitative values when analyzing participants responses. To get a pre-score for each participant, we added the score for each question and divided it by the total possible score which was 105. The same procedure was done for the post questions.

### 2.1 Methods: H1

Using a bootstrapped paired *t*-test we test for the difference in means of pre-scores and post-scores. We used a bootstrapped test since our data did not meet the assumption of normality. Using this method, we tested to see if the difference in scores was statistically significant. An increase in environmental conscientiousness will be evident if we have a negative difference in scores. We used the 95% confidence interval to verify if there was an increase in environmental conscientiousness.

### 2.2 Methods: H2

To test if participants increase their level of environmental conscientiousness by the type of animal and vignette they saw, first we calculated the difference in test scores. This was done by,

$$\text{Score}_{\text{difference}} = \text{Score}_{\text{pre}} - \text{Score}_{\text{post}}$$

Therefore, a negative difference implies an increase test scores. We used a bootstrapped Anova test to test for the difference in difference in scores by the animal and vignette each participant saw. In this test we included the interaction between animal type and vignette type to test if these variables influenced each other. We used a bootstrapped Anova test since our data did not meet the assumptions of normality and equal variance.

### 2.3 Methods: H3

For the picture survey, each participant saw and responded to four images of distress environments and natural environments of one of the four animal types.

For this hypothesis we excluded household items in the animal type category because participants only saw images of household items in their natural environment. We found each participants average distressed impact score and average natural impact score. Since each participant saw and responded to both natural and distressed images, the participant is a repeated factor. Thus, we will not use a standard Two-way Anova, we will use a Linear Mixed-Effects model using the function lme in the package nlme. The Linear Mixed-Effects Model tests for the difference in impact score by the type of image each participant saw (Distressed / Natural) and by the animal each participant viewed. We also considered the interaction between image type and animal type. We created contrasts to test which animal type and image type was different from the control, which was ocean in a natural state.

## 2.4 Reliability Analysis

To ensure the survey used in this study provided reliable response we used Cronbach's alpha. We used reliability analysis to measure the consistency in the survey responses. In theory a participant who takes the survey early in the day should receive the same score if taken later than night. In other words, participants are allowed to obtain different scores but the individual participant should receive the same score no matter the time of day. It is important to note that for survey with subsections of questions will get their own alpha. Since there was a pre and post test and within each test there were three subsections of questions such as attitudes toward recycling, opinion of responsibility, and Sacrifice of convenience there will be a total of six Cronbach alpha values. A reliable Cronbach alpha is defined to be anything above 0.7. Cronbach's alpha is defined as:

$$\alpha = \frac{N^2 \bar{Cov}}{\sum s_{item}^2 + \sum Cov_{item}} \quad (1)$$

where  $N$  is the number of questions,  $\bar{Cov}$  is the average covariance between the questions,  $s^2$  is the variance between the questions, and  $Cov_{item}$  is the covariance between the questions. Since this equation depends on the number of questions in the survey, when we calculate Cronbach's alpha for subsections of smaller number of questions we will in theory obtain a smaller alpha. Thus, a value smaller than 0.7 is acceptable.

## 2.5 Behavioral Choice Measure

Participants were shown a flyer relating to beach and waterway cleanups. They were then asked if they would like to find out about cleanups in their area. We tested to see if the animal type or vignette they were exposed to depended on their response. Using a Chi-square test, we tested if participants answered yes(1) as opposed to no(2) in the behavioral choice measure question.

## 3 Results

### 3.1 Descriptives

In our sample we had a total of 391 participants, where 138 were female, 249 were male, and 2 did not identify. Participants' ages ranged from 19 to 77 years old. There were at least 40 participants in each condition. There was a total of 10 conditions that included one of the five animal types and either a perceived control vignette or a perceived helplessness vignette.

### 3.2 Results: H1

From Figure 1 we can see that our pre-scores and post-scores do not meet the normality assumption.

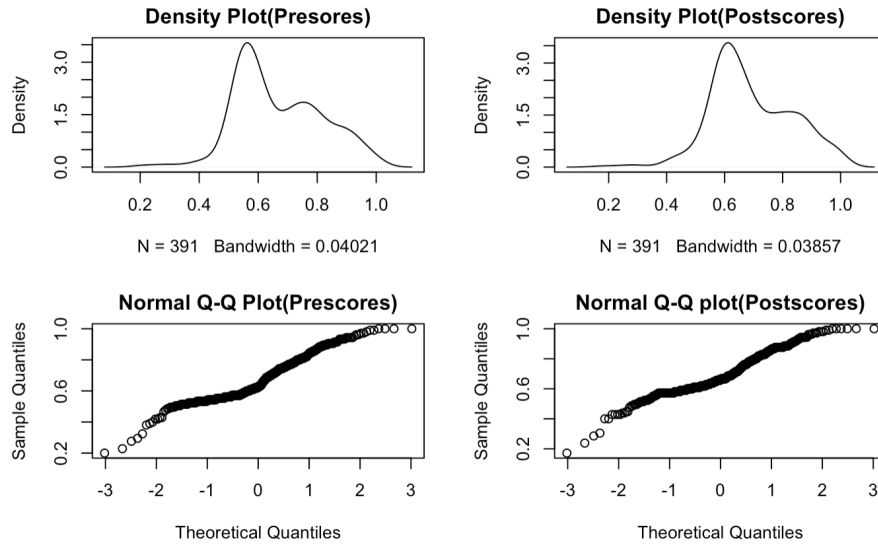


Figure 1: Density and Q-Q plots for Prescores and Postscores

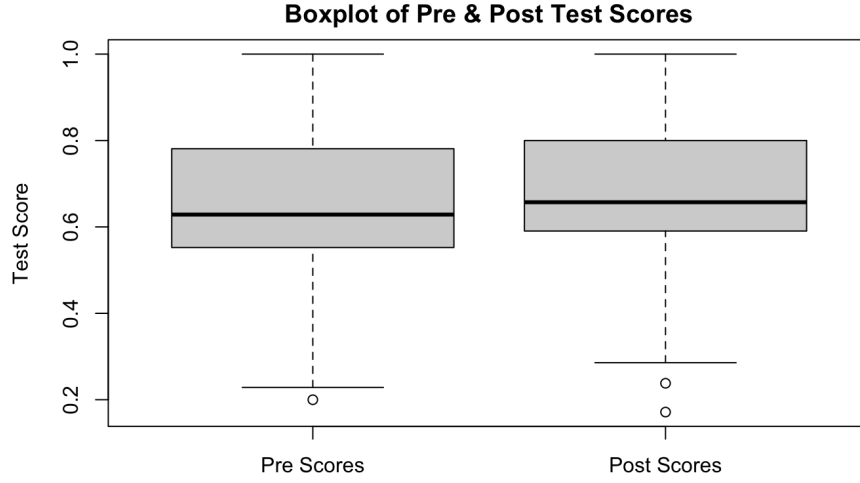


Figure 2: Boxplot for Prescores and Postscores

We cannot use a standard paired  $t$ -test. To compare pre-scores to post-scores, we used a bootstrapped paired  $t$ -test to test if there was a difference in scores. We obtained a statistically significant difference ( $p < 0.001$ ). Therefore, we have sufficient evidence that there is a difference in pre-scores and post-scores. To verify there was an increase in environmental conscientiousness, we will use the 95% confidence interval of the difference in scores. Since our 95% confidence interval is  $(-0.030, -0.013)$ , and we are looking for a negative difference in scores, we can verify that 95% of the time participants had an increase in tests score, as shown in Figure 2.

### 3.3 Results: H2

In hypothesis two, we are looking to see if there is a difference in the difference of test scores by the animal and vignette participants were exposed to.

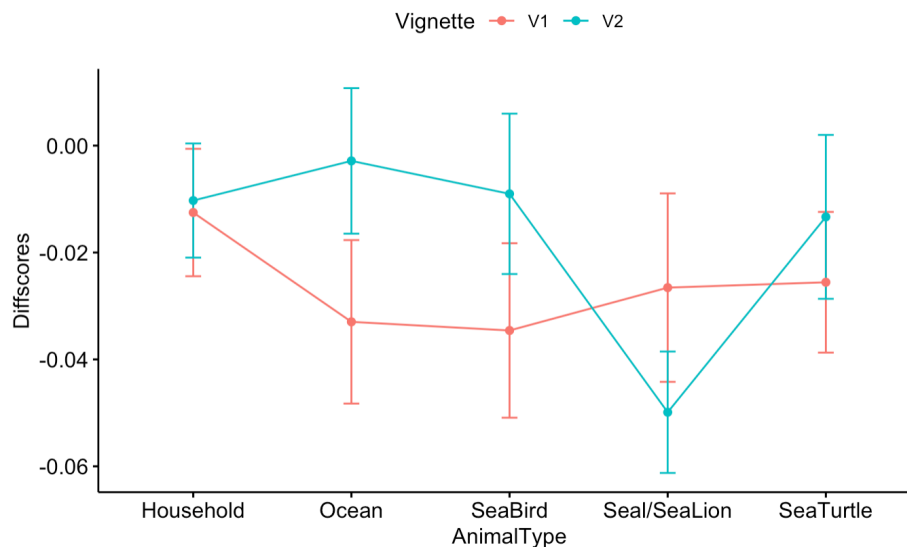


Figure 3: Interaction plot between Animal Type and Vignette for Difference in Scores

From Figure 3, we can see the differences in scores by the five animal types and vignette 1 and vignette two. By first glance we can see that the lines cross telling us there is a possibility of an interaction between vignette and animal type however it is important to notice that these differences are very small. The vertical axis ranges from -0.06 to 0, thus every value in between would be small difference.

Using ANOVA.boot we looked to see if there was a significant difference in the difference of scores by animal type, vignette, and their interaction. We use ANOVA.boot since our data did not meet the assumption of normality. From ANOVA.boot we did not obtain statistically significant results when holding  $\alpha = 0.05$ . Thus, we do not have sufficient evidence that there is a difference in the difference of scores by animal type and vignette.

### 3.4 Results: H3

To assess hypothesis three we first used a series of Q-Q plots and density plots to test for normality. From Figure 4, we can see that when impact level is split by image type those that fall under the natural images seem to meet the assumption of normality. However, when looking at those that fall under the distressed images these are skewed left with a heavy left tail. We will proceed to use lme with contrasts.

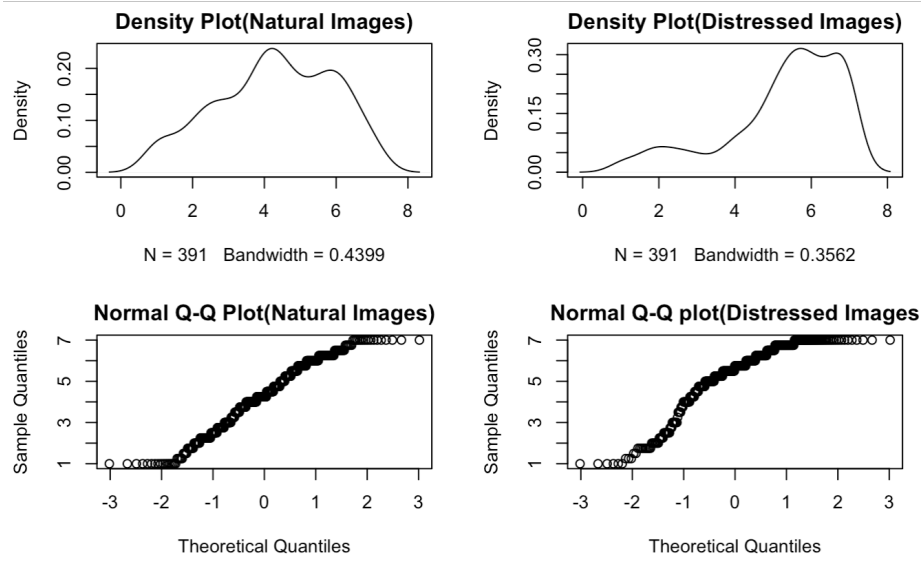


Figure 4: Q-Q Plots and Density Plots for Distressed and Natural Images

Using the interaction plot in Figure 5, we can see that there is a difference in impact level when using ocean in the natural state as the control. There seems to be larger difference in impact level when compared to sea bird in the distressed state.



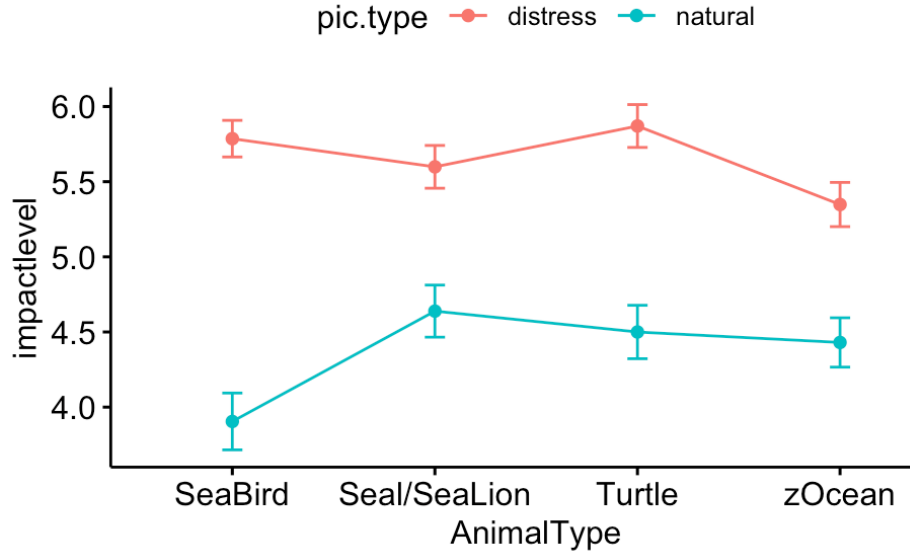


Figure 5: Interaction between Animal Type and Picture Type for Impact Level

Figure 5 indicates there is a possibility of an interaction in our analysis. Using Anova we obtained a p-value less than our significance level of 0.05 for the interaction between animal type and image type ( $p = 0.003$ ). It no longer makes sense to look at animal type and image type as two individual factors since we know one factor influences the other. We created contrast to break the interaction apart. Using lme we obtained a statistically significant p-value for sea bird in a distressed state when compared to ocean in the natural state ( $p = 0.001$ ).

To test that our model meet the normality and equal variance assumptions we plotted the residual as shown in Figure 6.

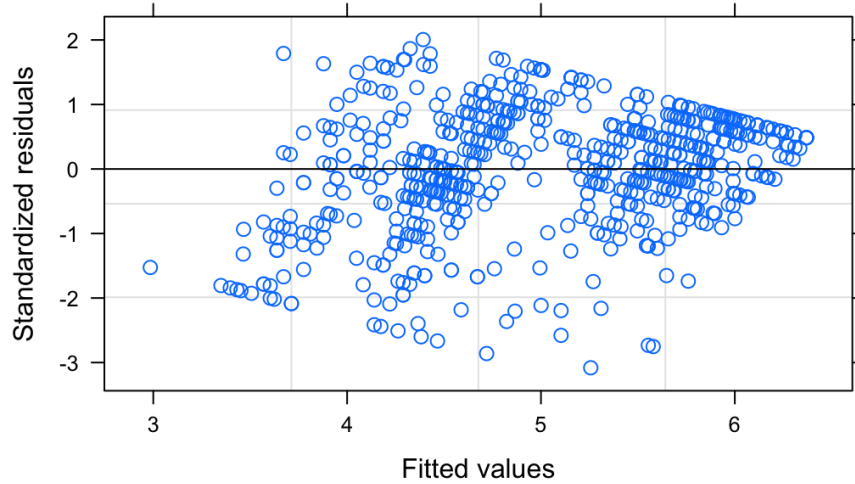


Figure 6: Residuals for Mixed Effects model

From Figure 6, we can see that our residuals seem to follow the pattern of a rhombus. This means our data does not meet the assumption of equal variance. To improve our model we can use `robustlmm` which is the robust version of `lme`. Using `robustlmm` we do not have to assume normality or equal variance.

### 3.5 Reliability Analysis

To ensure the responses to the survey are reliable we are looking to obtain a Cronbach alpha greater than 0.07.

Pre Test	Cronbach's $\alpha$
Attitudes Toward Recycling	0.82
Opinion of Responsibility	0.84
Sacrifice of Convenience	0.70

Table 1: Reliability Scores for Pre-Test subsections

Post Test	Cronbach's $\alpha$
Attitudes Toward Recycling	0.59
Opinion of Responsibility	0.86
Sacrifice of Convenience	0.67

Table 2: Reliability Scores for Post-Test subsections

From Table 1 and Table 2, we can see that majority of the alphas are greater than 0.7. Since there are only three to four questions per subsection having an alpha less than 0.7 is acceptable. Thus, the alpha for post test subsection attitude toward recycling is 0.59 is okay. One might assume the Cronbach alphas for the pre and post surveys would match but it is important to remember that the post questions are originally reverse coded and rearranged. Since our client asked for the overall Cronbach alpha, we obtained an overall value of 0.9.

### 3.6 Behavioral Choice Measure

Using a `xchisq.test`, we tested to see if participants answered yes as opposed to no in the behavioral choice measure question. We obtained a  $p$  value of ( $p=.903$ ) when testing to see if the behavioral choice measure depended on animal type. We obtained a  $p$  value of ( $p=.778$ ) when testing to see if the behavioral choice measure depended on vignette.

Behavior	Household Items	Ocean	Sea Bird	Sea Turtle	Seal/Sea Lion
Yes	63.01%	59.49%	63.16%	66.27%	60.00%
No	36.99%	40.51%	36.84%	33.73%	40.00%

Table 3: Percent of those that said Yes as opposed to No by Animal Type

Behavior	Vignette 1	Vignette 2
Yes	64.36%	60.59%
No	35.64%	39.41%

Table 4: Percent of those that said Yes as opposed to No by Vignette

From Table 3 and Table 4, we can see that the majority of participants answered yes to the behavioral choice measure no matter which animal or vignette they saw. Since this seems to be a consistent pattern we do not have enough evidence that the type of animal or vignette they saw influenced their answer to the behavioral choice measure.

## 4 Conclusion

From our analysis, we now understand that environmental conscientiousness improved from pre to post tests. However, when looking at this improvement by different conditions, we do not have sufficient evidence that one condition improved more than the others. For impact level, because there was an interaction between image type and animal type, we had to break these differences apart. Meaning different animals in distressed or natural states influenced a participant's impact level. Since we are using ocean in a natural state as the control, there seems to be a statistically significant difference in impact level

when compared to sea bird in a distressed state. Therefore, those who saw sea bird in natural and distressed environments found those images more impactful than those who saw ocean in natural and distressed environments. From this study, there's evidence that this survey did impact the participant's environmental contentiousness.

## 5 Personal Reflections

### 5.1 Abby

In the beginning of the project, I was very nervous because I felt like I was inexperienced since I only took MA 220. Before coming into this class, the only R code I could do without looking it up was favstats, but after working with Odalys on this project, I have a lot more knowledge in how R works and how to troubleshoot when I run into problems. Dr.Mehrkam and McKenna's project was very overwhelming when presented to us, but after learning about how the survey was set up, it was easier to understand what the explanatory and response variables were. I learned that sometimes data presented to you can look like one thing, but then when analyzed, is something way different.

For the content of this project, I learned about the Likert scale and how data is measured in Psychology. It was cool to see how the layout of the survey affected participants' responses to certain questions. Seeing the difference in pre test scores and post test scores by animal type was interesting because participants who viewed the seal scored better than the other animal types. Our analysis of the data made me learn about different survey strategies and how certain strategies worked better for this type of project than others. I really enjoyed this topic because in most of my statistics classes I have worked with experiments or data that is not based on a survey, so I was able to work with a new type of data.

For me personally, I feel so much more confident in public speaking and my R skills.. When class started and Dr. B said that most of the class consisted of presenting what we found each week. I was very nervous because public speaking is not my greatest strength. After a couple classes, presenting each week became easier because I had worked so much on the data that it was easy to remember what I did that week. The more comfortable I became with the data, the easier it was to stand up in front of the class and talk about it to my other classmates. Along with public speaking, R was also not my greatest strength. Only having MA 220 before this class was scary because I felt helpless in our project since Odalys is a senior and has taken way more statistics classes than I have. Working with Odalys was the best thing I could have asked for this semester. I learned so much from her and I would not have been able to do it without her.

## 5.2 Odalys

This project came with a couple of challenges. In the beginning I was a little skeptical since the design was very complicated. After understanding all the steps taken in the survey and the reasoning behind it, it became a lot easier to think about the possible analyses to run. In this semester I learn about linear mixed effects models (before we learned about it in MA421). It was challenging and also rewarding being able to learn new topics on our own. We learned about reliability analysis which I never heard of before and a couple of topics from MA460 came back.

This semester I learn why and how surveys are reverse coded and rearranged in order. I learned to pay attention to detail because if we didn't figure this out from the beginning we would have had to start from scratch. I also learned a little bit about the psychology behind environmental consciousness. It was great working with Dr. Mehrkam and McKenna. They always had questions for us and were curious to understand our analysis in depth.

Statistical consulting is always a great time. I know I will always learned something new and face new challenges in this class. Hopefully I can take it one last time. I am very proud of the work we accomplished this semester. It was awesome working with Abby. I think Abby and I worked really well together. We both learned a lot from each other. Overall, I am happy with the outcome of this project.