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Assessing the Relationship Between Change Blindness and the Anchoring Effect

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ASSESSING THE RELATIONSHIP BETWEEN CHANGE BLINDNESS AND THE ANCHORING EFFECT

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HONORS PROJECT

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Abstract

A lack of consideration for all aspects of a question prompts fragmented decision making. These decisions, as they leave out fundamental information, repeatedly then lead to a potentially problematic reaction to the target question or stimuli. The anchoring heuristic propels one to make a decision, usually an estimate, based on a presented “fact”, often ignoring additional background and environmental clues. Reducing the rate of occurrence of the anchoring bias is thought to lead to an increase in holistic decision making. To promote this reduction, the purpose of this research was to examine the relationship between the susceptibility to change blindness and anchoring bias, in regards to memory capacity while integrating the use of coding in R to provide supplemental graphs and interpretations of the data. The implementation of a lesson on noticing changes in the external environment was employed to improve awareness to changes and reduce the frequency of the anchoring bias for the experimental group. Two sample groups from the Bowling Green State University undergraduate student population participated. Before and after the lesson, both groups took anchoring surveys, conducted flicker scene tasks, and completed reading span tasks. The data obtained did not yield significant results to support most the hypotheses. A lack of significance suggests these phenomena are not related quite as predicted or that the study performed was flawed.

Key terms: *anchoring effect, change blindness, memory capacity*

Assessing the Relationship Between Change Blindness and the Anchoring Effect

The realm of psychology is vast and is always changing, just like the world does each day. Detecting the change is a skill that requires attention to detail and the ability to remember what preceded the change. Frequently people get caught on one aspect of the world around them that hooks them in and pulls them away from noticing the changes occurring. The amalgamation of these ideas led to the research questions that prompted this project. Are change blindness, the ability to detect changes, and the anchoring effect, the pull of a provided value, correlated? If the concept of change blindness and how to be aware of it is taught, can that teaching reduce someone's susceptibility to the anchoring effect? The ability to detect changes requires memory recall of what a scene used to be to compare it to the present one. On the other hand, the anchoring effect instills people to remember the anchor and base their predictions around that anchor, causing them to be influenced by the anchor. Do these two different uses of memory overlap and thus allow for a connection between the phenomena?

Psychologists are continuously testing out different theories and ideas. An unrelenting effort exists in unveiling correlations and causations between phenomena. As of now, little is known about the relationship between change blindness and the anchoring effect. The key cognitive component appearing to allow for overlap between these two cognitive events though is memory capacity.

Change blindness has long been a source of research in psychology. Simply Googling or searching YouTube can provide hundreds of thousands of changing-scene videos: from big-screen Hollywood movie mistakes to simple, geometric pattern shifts. The ability to notice when an object changes color or appears in a new location seems like an exceptional talent people claim. Everyone has some level of ability to spot these changes though. Changes in position are most easily spotted while color changes are the most demanding (Ball, Elzemann, & Busch, 2014). The level of demand from these tasks when actually measuring change detection skills in research is dependent on not only what type of change is occurring (Gusev, Mikhaylova, & Utochkin, 2014), but also on the participant's working memory (Pailian & Halberda, 2015).

Change detection tasks have thus become measures of working memory. Note that working memory capacity can be defined as, "…an individual differences construct reflecting the limited capacity of a person's working memory," (Wilhelm, Hildebrandt, & Oberauer, 2013). Pailian and Halberda (2015) used one-shot change detection tasks to assess visual working memory, specifically looking at how reliable and consistent such tests are. Though historically an extensive construct to measure, increased interest into its ability to show how the brain works has prompted research to create shortened, but reliable and valid versions of measures for working memory capacity (Oswald, McAbee, Redick, & Hambrick, 2015).

This working memory capacity processing ability of the brain has been suggested as a possible explanation for how the brain partitions and sorts incoming information (Carlson, 1990). Carlson's (1990) work focused on how risks impact people's judgements, specifically those risks involved with gambling. He evaluated how anchors motivate such judgments, and in the process of doing so, he determined that decisions about risks are made by dividing the anchor into various partitions, which he attributes to be a task of working memory (1990).

The anchoring effect is a cognitive heuristic often measured, but to a lesser extent than change blindness by psychology researchers. Anchors are often conceptualized as provided values cueing people to answer similarly to the value. Epley and Gilovich (2006) found that people essentially give up trying to adjust from the anchor when their answer is in a range of plausible values. Providing a completely random anchor in relation to a question though will not create high occurrences of the anchoring effect, nor will it if the anchor is higher or lower than the real value. Neither of these have a profound effect on peoples' susceptibility to be pulled in by the anchor.

From the above knowledge, there appears to be a common variable playing a key part in both the ability to detect changes and resisting the anchoring effect: memory capacity. The evidence that partitioning and sorting memories plays a key role in anchoring resistance (Carlson (1990) connects with the research that started with change detection tasks for pigeons and led to an advancement in the understanding that humans bind the different aspects of an object together when perceived and consequently stored (Lazareva, 2016). When objects are encountered, working memory binds and sorts the objects in certain ways. Memory, therefore, has much evidence to suggest that it is involved in both change blindness and the anchoring heuristic.

With memory serving as a tie between these two cognitive phenomena, there are many parallels that seem to emerge throughout the research when compared. The common element of how objects are perceived and stored allows for these seemingly unrelated studies to overlap. This connection can be seen in the work of Smith and Windschitl (2015). They delved into how people can resist the pull of the anchoring effect based on what kind of knowledge the brain is using to code the given data. Metric knowledge and mapping knowledge were studied as the main two types of knowledge: mapping relies on comparisons between objects, while metric "…refers to the general statistical properties that items tend to have" (Smith & Windschitl, 2015). Participants using metric knowledge better resisted the pull of anchors than mapping knowledge participants (Smith & Windschitl, 2015). By definition then, people that compared items were more likely to have their estimates influenced by the anchor than people who used facts about the item. Using the idea that a certain type of knowledge coding reduces the anchoring effect, it prompts an interest as to how change blindness is coded and if change blindness is metric knowledge, does it correspond to the results of Smith and Windschitl (2015).

Another tie between anchoring and change blindness arises from what form of stimuli these two phenomena are typically tested with. The anchoring effect has often been regarded as a semantic knowledge heuristic. But through the research of Langeborg and Eriksson (2016), the anchoring effect has been shown to occur with presented visual stimuli. As change blindness is generally a visual concept, this research can help close another gap between how these two cognitive processes are more similar than previously thought.

The above concepts were the basis of the expectation that there will be a correlation between the ability to detect changes and the ability to resist the anchoring effect. However, this correlation was not the only relationship of interest. There have been studies uncovering how the teaching of change blindness with regard to particular scenes can transfer to scenes not subjected to training (Gaspar, Neider, Simons, McCarley, & Kramer, 2013). These studies inspired the question; if change blindness and the anchoring effect are correlated as prompted by the literature stated above, are they also causally related? When searching through a scene for a change, only four items can be monitored at a time (Rensink, 2008) which is consistent with the relationship of working memory. If a lesson is given about change blindness, can that teaching then furnish for a greater number of items to be searched and a quicker searching time? If more objects can be searched, or if they can be searched more quickly, can those skills transfer to resisting the provided anchors?

Change blindness and the anchoring effect each have been the subject of various types of studies with different goals in mind. Memory appears to have been a key factor in both however. Thus, memory is a factor that may then connect the two phenomena. In the initial proposal of this project, the background of participants was also thought to influence change detection skills; specifically, someone who grew up in a larger city would be more skilled at detecting changes because in large cities, change is always occurring. While on the other hand, someone who grew up in a rural community would not be as adept at detecting changes and thus would perform worse on such tasks.

This Honors Project strived to collect data on participants' ability to detect changes and their susceptibility to the anchor effect, as well as, their working memory capacity. This data was then analyzed in R to test for any relationships that may exist.

Based on the prior research, five key hypotheses were created:

- **H1:** If working memory capacity scores improve, then change detection scores will also improve.
- **H2:** If working memory scores improve, then resistance to the anchoring effect scores will improve.
- **H3:** If change detection scores improve, then resistance to the anchoring effect scores will improve.
- **H4:** To test for the ability of scene detection knowledge being generalizable, it is hypothesized that if a lesson on change blindness is viewed, then scores in change detection and resistance to anchoring effects will both improve while, on the other hand, viewing a lesson on a non-influential topic will yield no changes in scores after the lesson.
- **H5:** If the population size of one's hometown is larger, then the ability to detect changes will be better than someone who grew up in a smaller, rural community.

In this research, scores for change detection are reversely coded so that a participant whom performed well would receive a score close to zero, while poor performance would yield higher scores. Likewise, for resistance to the anchoring effect, a low anchoring score suggests a greater resistance to being pulled by the anchor while high scores indicate a greater influence occurred from the anchor. Working memory capacity scores increase in value as ability also increases. A participant that was skilled at these three phenomena then would have a low score for change blindness, a low score for the anchoring effect, and a high score for memory capacity.

Method

Participants

Thirty-One Bowling Green State University (BGSU) undergraduate psychology students (N= 31; 26 women and 5 men) ranging in age from 18 to 36 years (M= 19.8 years, SD = 3.3 years) participated in this research. This sample was acquired via BGSU's SONA system; an online research scheduler. Participants were given one credit of research participation for being involved.

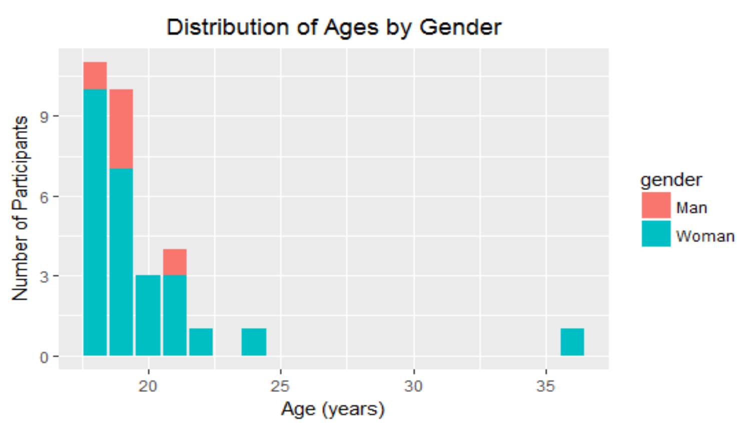

Figure 1: Age range of participants by gender.

Materials and Procedure

Upon entering the lab at a designated timeslot, each participant sat at a desk with a computer in front of them to perform a session. Informed consent was obtained by each participant via their decision to click an arrow button and move forward with the study after reading a screen describing the risks, benefits, and general purpose of the experiment. Each participant was also provided with a five-digit participant ID number to use throughout the study to ensure their data from each part was connected.

After providing consent, several demographic questions were asked. These questions included inquiring about age, gender, education level, and hometown populations. Two questions were aimed at this last demographic, in which, the goal was to divide the sample into groups based on rural or city life backgrounds. The hypothesis was that participants that classify themselves as being from an urban setting, defined as that they are predominately surrounded by people they don't know, will score better on change blindness detection scores than those coming from rural areas of few people. Thus, it would imply that someone who grew up in an urban city location would be used to detecting changes more regularly, on the basis that the city is an always adjusting scene. These demographics were included in the first part of the session.

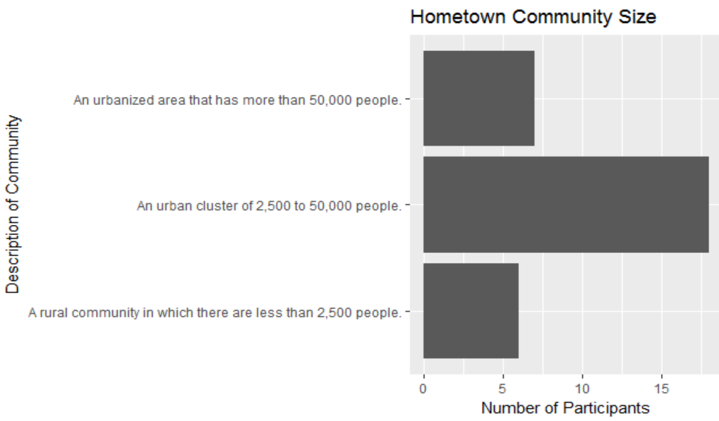

Figure 2: Frequency of participants by hometown type.

Each session was composed of seven parts, that occurred in sequential order. The first and fourth parts were surveys created by the online software, Qualtrics. These assessments measured the susceptibility to the anchoring effect. General knowledge questions were accompanied by a prompt that included an anchor asking whether the true value was greater or

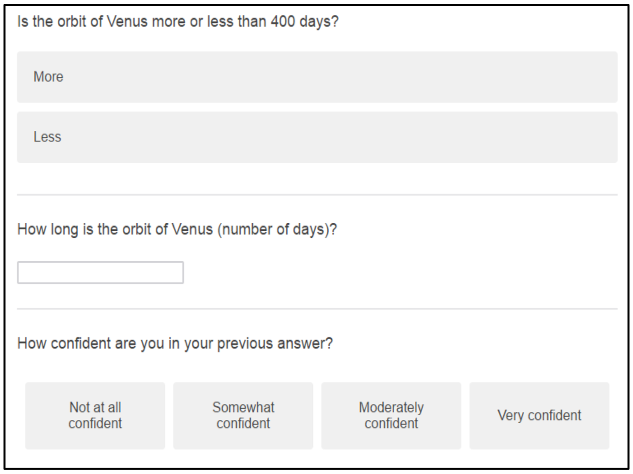

Figure 3: Example of an anchoring set of 3 question created using Qualtrics.

less than the anchor. A second question followed asking the participant to estimate the true value. A confidence rating question ended the set, as can be seen in Figure 3.

Some of these questions were adaptations of those used by Jacowitz and Kahneman (1995). Several were also replicated stimulus material from Epley and Gilovich (2006). There were eight anchoring sets of the three questions for each part 1 and part 4 of the session.

Parts 2 and 5 were assessments taken to measure the ability to detect changes. The flicker change detection test used was obtained from the University of Idaho’s cognitive neuroscience demonstration page (Werner, 2017). For each scene, the original picture would appear for one second and then would rapidly change to a solid grey blank that lasted two-hundred milliseconds. Then the picture would return but with something in the picture having changed, an adapted picture. The adapted picture would appear for one second and then switch to the solid grey blank again for two-hundred milliseconds. The original picture would then be shown again. These alterations would continue until the mouse correctly clicked on the area of the picture where the change was

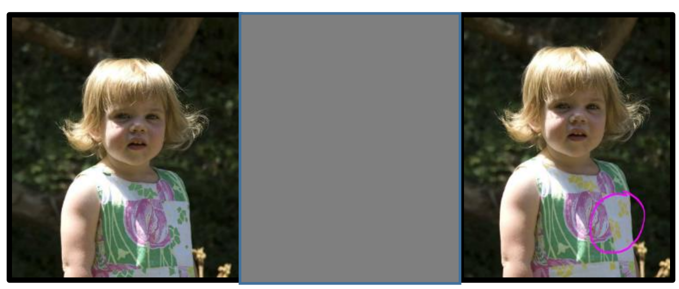

Figure 4: Example of change blindness scene. From left to right: Original picture, grey blank, adapted picture. The pink circle on the right image is only shown here to indicate what part of the picture was changing; there was no pink circle during the actual testing.

occurring. For each part 2 and part 6, three different scenes were shown.

Parts 3 and 7 assessed working memory capacity using a reading span task acquired from Stone and Towse (2015). On the first trial of this task, a number would flash onto the screen and then quickly disappear. Promptly a sentence was presented. A button click response was needed to indicate whether the sentence was logical or not. After responding to the logic sentence question, a new number would be flashed on the screen, followed by another sentence. After the second sentence, the participant was asked to enter in the first number, and then to enter in the second number. This process repeated two more times with two new numbers and sentences, for a total of three sets of recalling two numbers. Then a third number and sentence was added and the above process was repeated, yielding three sets of three number recalls. After three trials of three numbers, a fourth number was added. This process then repeated. Once five and then six numbers were added, there are only two trials each time. A total of thirteen trials were performed during part three and then thirteen again in part seven.

Part 4 did not repeat itself like the previous three assessments, nor was part four an assessment. This portion featured a short PowerPoint lesson. Upon receiving a random ID number, participants were randomly assigned into either a “control” or “experimental” group. The study was blind, in that, participants were unaware which group they were in. The difference between these groups was the lesson the participant watched. The control lesson presented facts and general knowledge about vision (group 1). The experimental lesson taught about change blindness and how to become better at detecting changes (group 2).

Upon completion of the seven parts in consecutive order, the participant was provided with a debriefing slip with a paragraph that aimed to explain the purpose of the study in further detail.

Results

The results of this experiment were analyzed using code written in R to assess correlations, causations, and produce graphs to demonstrate them.

Hypothesis 1

Performing a Pearson's product-moment correlation, in testing whether memory capacity and change blindness were related generated non-significant results, indicating that there is not a strong relationship between these two phenomena overall across all participants, r(29) = -0.08, p =0.66. There were also no significant results between these measures for the control group, r(14) = 0.17, p=0.95 nor the experimental group, r(13) = -0.30, p= 0.29. Therefore, hypothesis one is not supported and a null hypothesis of no relationship existing should be accepted.

Hypothesis 2

Pearson's product-moment correlation was used to test the relationship between working memory capacity and the resistance to the anchoring effect. The test returned significant results

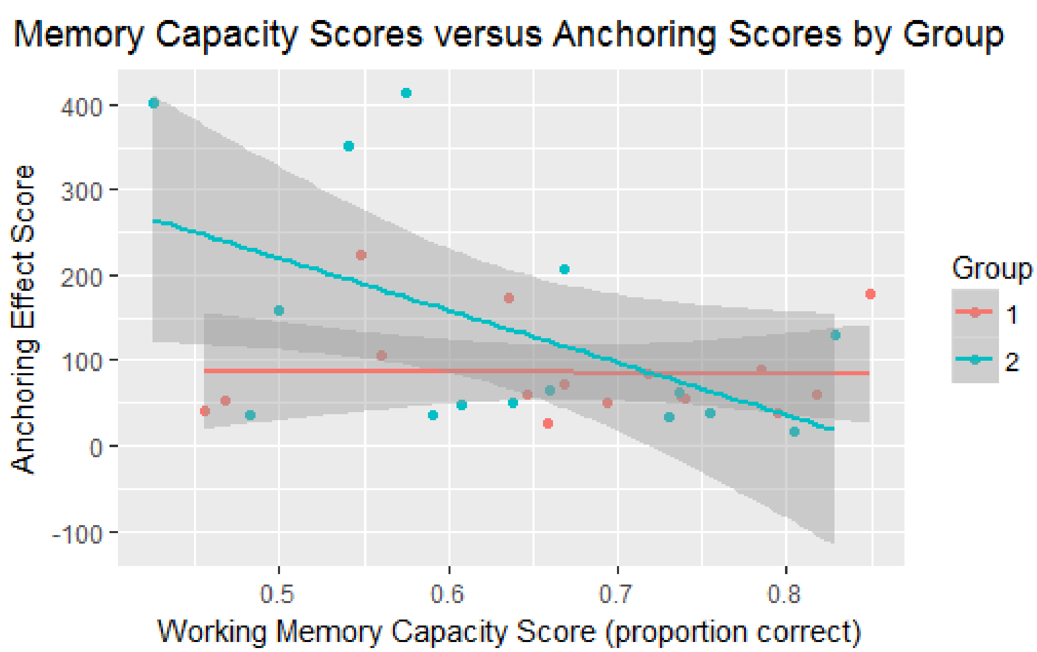

Figure 5: Working memory scores have a significant relationship with anchoring resistance scores for the Experimental group (group 2), while no relationship exists for the Control Group (group 1). Lines of best fit with 95% confidence intervals are shown with the plotted data for each participant (n=31).

across the full group of participants, indicating a relationship does exist between these two cognitive phenomena at the alpha =.05 level, r(29) = -0.37, p=.043. Assessing this relationship for the control versus the experimental group showed that while the overall correlation was significant, only the experimental group itself was significant, r(13) = -0.52, p= .047, while the control group had no relationship between these variables, r(14)= -0.02, p= 0.94. Hypothesis two is supported.

Hypothesis 3

One of the many correlations looked at included comparing the overall change blindness score to the overall anchoring effect scores. It was expected to have a positive relationship, where as one score increased, the other score would also increase. A Pearson's correlational test was used to compare these overall scores and it was found that no significant correlation existed between the data across all participants, r(29) = -0.04, p = 0.83. This expected relationship was a foundation for hypothesis four, but it should be accepted that there is no significant relationship between change blindness and anchoring scores based on this data.

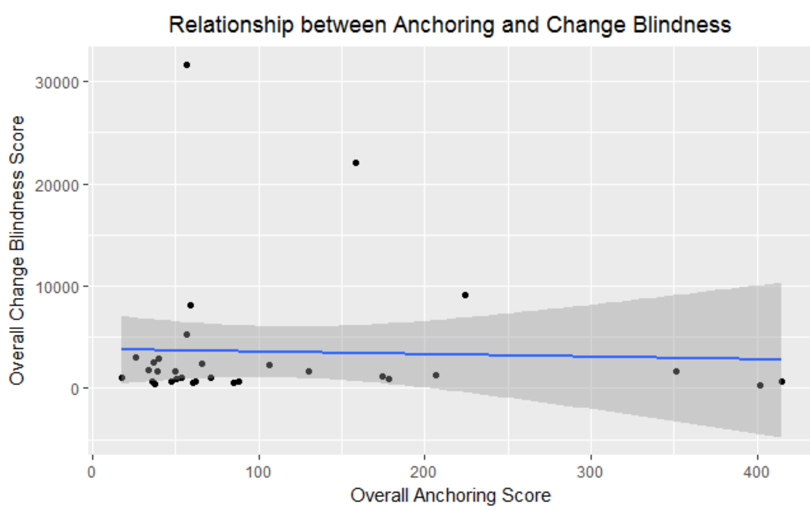

Figure 6: No significant relationship exists between anchoring scores and change blindness scores. A line of best fit with a 95% confidence interval shows the flat, nearly non-existent correlation.

Hypothesis 4

To assess the primary relationship of a difference between the control and experimental group on their change in anchoring effect and change blindness scores from the assessments pre- and post the PowerPoint lesson, a two-sample t-test was performed in R. This test indicated that between groups, there was no significant difference in their score improvements for the change blindness task, $t(29)= -0.047$, $p= 0.96$. However, for the anchoring questionnaire, the results are significant at the alpha=0.1 level, $t(29)= -1.96$, $p= 0.060$. Thus, this causal hypothesis was partially upheld. Change blindness scores were not affected by which lesson participants viewed, but the anchoring scores did differ significantly between group 1 (M=-4.41, SD=36.09) and group 2 (M=59.73, SD=125.83), suggesting which PowerPoint was viewed influenced the ability to resist the anchoring heuristic.

Hypothesis 5

In analyzing the results to test the hypothesis of the hometown population's effect on change detection scores, a one-way between subjects ANOVA was conducted to compare the effect of change blindness scores between the three community descriptor groups. No significant effects were shown, $F(2, 28)= 0.553$, $p=.58$. Hypothesis 5, suggesting a difference exists between hometown types and their effect on the ability to detect changes, should therefore be rejected.

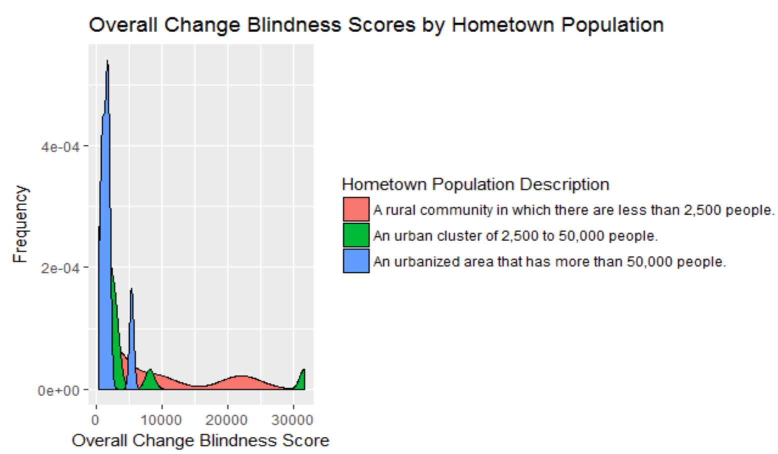

Figure 7: Frequency of hometown types for overall change blindness scores.

General

The process of using R code to create graphs and run tests for significance prompted this project to have a unique insight and understanding of the data, rather than just using programs that perform the work and create well-developed graphs for the user. R is not as frequently used as a method to analyze data, but in doing so, it has allowed for a more ameliorated understanding of what the data truly means and what it represents. Additionally, R has given more independence in creating graphs tailored to fit the desires of what is being displayed. An interdisciplinary component such as this has generated a better understanding and appreciation for obtaining and analyzing the results of data.

Taking all the analyses into consideration, the results of this experiment did not support the majority of the hypotheses. The limitations experienced throughout the experiment are potential confounds that led to these results.

Discussion

As a first attempt at an individualized research project, there was a grand rollercoaster of successes and failures experienced along the way, all leading to a greater level of understanding and appreciation for the process of performing research. Although only one of the five hypotheses was fully supported, the results have led to a series of questions on why significance was not reached in more of the tests and what could be potential confounds.

The significant result of hypothesis two suggests that memory capacity and the anchoring effect are correlated. As the score for working memory increased, indicating better memory recall, the anchoring effect score decreased, showing that the anchors were not influencing responses as much. There is much interest in the fact that this relationship did not hold true for the control group, as this correlation was not expected to be affected by the lesson. However, as seen with the results from hypothesis four, the lesson did have an impact on the anchoring scores. Perhaps those that were better able to recall items from working memory were better able to take the points discussed in the experimental PowerPoint and generalize them to the anchoring questions, delivering improved scores. This interesting relationship would be one worth addressing in future studies.

The non-significant results could perhaps suggest the idea that, as discussed by Smith & Windschitl (2015), mapping versus metric knowledge is a key factor. Perhaps change detection abilities exist differ in type based on the stimulus presented in the picture. Some scenes could be detected much more quickly than others. Even though it has already been shown that color is a more difficult construct (Ball, Elzemann, & Busch, 2014), an experiment could aim to uncover whether color is a mapped versus metrically coded piece of knowledge. This could better help in understanding what the prime memory and knowledge based systems are for identifying things in the environment around us.

One key factor appeared to create a chain reaction of limitations that aroused a variety of difficulties. Implementation of the project was to be carried out within one semester after a semester of creating a proposal with a timeline and annotated bibliography. The single semester to formulate ideas and create the proposal for the project was plenty sufficient. However, a single semester to recruit participants, analyze the data, and prepare a final paper came to be an arduous task. The principal reason for the time not being sufficient is the obstacle of recruiting participants.

Using the SONA system produced an expectation that students would sign up for the study, come during their timeslot, and complete the study. This held true for very few participants. The study was published on the SONA system for 12 weeks, with 71% of the participants signing up the last three weeks. More than the 31 participants whose data was used originally signed up using the SONA system, but cancelled or simply failed to appear for their timeslot. Even with several hundred psychology students enrolled in courses that require SONA involvement, so few sign up to attend lab studies, while the majority opt for the online surveys that can be taken from home. The difficulty of obtaining participants in this research was seen from other research occurring in the psychology labs. As a result, however, a powerful discussion has begun on how, not only as individual researchers, but as a department, this hurdle can be overcome.

Another potential limitation that was created from the time constraint was the use of various internet based and downloaded programs to collect data. These programs all had different internal data collection methods. After participant trials were completed, merging this data all together into one clean, organized data file become a more difficult task than expected. The raw data from the change blindness task came in a less than ideal form which caused scores with large ranges across participants. Creating a better scoring method could have decreased the variability in this measure. The hypotheses (1, 3, and 5) that investigated relationships with change blindness could have benefited from such a better scoring method. More preparation in knowing the way the data would be collected and then subsequently analyzed would have been beneficial to speed up the process. Critical thinking skills overcame the obstacle though and have left a lasting imprint on the importance of being very knowledgeable of how the raw data will appear.

Not only did the use of previously made tests and assessments make it difficult to analyze the data, perhaps they did not measure exactly what was intended. It can be hard to control and ensure that a test is measuring what is desired when the researcher using the test was not the one to create the test. On the other hand, even the use of handmade tests by the researcher can be flawed themselves. This research did not have a pilot study to ensure that the measures and tasks were performing as expected. Hypothesis four could have failed due to the lessons not having enough variation in topic or not enough information to create an impact. The lack of a pilot study or some previous affirmation of the construct validity of these lessons and other measures should be taken into consideration.

Conclusion

Although the results of the study primarily did not yield significance as hoped, the project performed served many other purposes and provided numerous benefits that will persist through future work. A success in accomplishing the goals set forth by the honors college in the completion of the project was undoubtedly achieved, as was, ideas for how to ameliorate this study in the future to overcome as many of the previously mentioned obstacles as possible.

Taking the skills that were learned in a single course using R greatly increased the appreciation for the process and analyzing of data. Using R to analyze real, personal data collected made graphing and finding relationships more efficient, understandable, and worthwhile. Prior work with R used data that did not have the same meaning as data collected by oneself. It took a strong level of integrative learning, incorporating knowledge of statistics from multiple classes to bring it together with the knowledge of coding in R to create the graphs and run the analyses performed for this study.

A variety of methods could be explored to replicate this study and uncover any hidden truths that may occur with these variables that did not manifest themselves in the present research. One future expansion on this project could be to recreate the three tests and combine them all into one survey or software that people can use from home. This would decrease the time spent waiting for participants to sign up and come to the lab. An online survey would potentially decrease the lack of interest because since it would be on the internet, completing the task would be easily accessible from a participant's own home computer.

Through the personal struggle of obtaining participants, a move forward to successful and lasting participant recruitment is in the works. Oral communication about the flaws of the current system and the sharing of ideas for potential new ways to improve the involvement of participants was impacted by this project. The written communication in transcribing the methods, results, and analyses of the study at hand was successfully achieved and led to a personal strive in ensuring clarity in such writing.

Lastly, a new personal understanding arose for all the minute details that need to occur for research to be most successful. Although a great deal of this project was planned, or so it was thought, many bumps in the road caused for continued editing of the timeline. To withstand these many obstacles, a great level of critical thinking was employed. Without the persistent strive to assess all the potential outcomes and find the best solutions to move forward, this project would probably not have been completed as it had been. Overall, this project has demonstrated not only the learning outcomes set forth, but also the culmination of experiences learned from various courses, readings, projects, and many other aspects of the time spent as an honors student at this university.

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