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The Role of Metacognition and Anxiety in College Students' Performance on a General-
Knowledge Test

A Senior Honors Thesis

Submitted in Partial Fulfillment of the Requirements
for Graduation in the Honors College

By
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Educational use of this paper is permitted for the purpose of providing future students a model example of an Honors senior thesis project.

Abstract

This study was interested in the role of metacognition, confidence, and question type in student's likelihoods of changing responses to general-knowledge questions. Participants were given two tasks, a general-knowledge multiple-choice test that contained both tricky and non-tricky questions accompanied by confidence judgments and indications for why they chose their answers and a second task which consisted of a test review packet for an opportunity to change and re-assess confidence in questions. Students opted to change very few answers when given the opportunity to do so and when they changed they were more likely to change tricky questions than non-tricky questions. Students were significantly more confident in answers for non-tricky questions and the younger a student was corresponded with higher ratings of confidence. Overall, results suggest that future research should force participants to change answers and to analyze shifts in confidence and reasons for changing answers for both initial and changed responses.

Introduction:

Testing students is a consistent part of education. Students are commonly given assessments to decide whether or not they have learned required information. During these assessments, students read each question and the provided answers and try to determine the answer. Next, a student may be left with an underlying worry about whether or not their chosen answer was correct. She may begin to wonder if the piece of information she extracted from her knowledge bank is in fact what she needs or is accurate. What should the student do? Should she change her answer or stick with her initial response? Should she re-examine the answer choices and maybe choose another one? Metacognition can assist a student in this process.

Metacognition is defined as the ability to evaluate and regulate the success of cognitive processes (Dunlosky & Metcalfe, 2009). It is important for students to have the ability to monitor learning processes as well as control these processes especially in educational settings that involve test taking (Hacker, Dunlosky, & Graesser, 2009).

An individual's metacognitive awareness is directly linked to his/her ability to adapt or modify their cognitive activity across time (Forrest-Pressley, MacKinnon & Waller, 1985). For instance, if a student is unable to differentiate between the material that they know and the material that they do not know, they will not be able to determine what information they should be focusing on versus the material they can skim or come back to at a later time (Hacker et al., 2009). Research has found that individuals who have a lesser metacognitive awareness, spend more of their time reviewing material that they already have a grasp of instead of focusing on yet to be learned information (Hacker et al., 2009). Having less metacognitive awareness creates a greater likelihood that these students will not display, or attempt to use, more advanced learning or metacognitive strategies like evaluation of their own knowledge or skills and they will most

likely not implement different learning or studying strategies (Hacker et al., 2009). Commonly, metacognition is assessed using measures like judgments of knowledge (J.O.L) and feelings of knowing (F.O.K). Judgments of learning are the estimates that people provide for how well they have learned something (Van Overschelde, 2008). In other words, are they able to retrieve the information and do they feel that they understand what they were presented. Many times, this is affected by delay. If someone is asked how well they may have learned something an hour ago versus five minutes ago, they would be more likely to say they knew it better in the five minute delay and they could thus retrieve it faster. Feelings of knowing are related to judgments of learning and are defined through the feeling that the needed information is known and that this information can correctly be identified later on when needed (Widner & Smith, 1996).

Confidence is “the state of believing that a particular piece of information has been correctly retrieved from memory” (Metcalf & Shimamura, 1994). Historically, confidence has been measured using Likert Scales in which high numbers correspond to high confidence and low numbers correspond to low confidence. Confidence measures provide information about how students assess their accuracy of their own-knowledge. Confidence ratings may influence students’ performance predictions on tests of their own knowledge (Pressley, Ghatala, Woloshyn, & Pirie, 1990). Asking students to make confidence judgments about the accuracy of their answers may help students because the judgments require students to metacognitively monitor themselves. Thus, they need to assess the amount of and accuracy of knowledge which they are employing when answering the questions. It can also reinforce that action as well as help them identify limits of their own knowledge and how they can diminish the gaps in knowledge that they have. (Curtis, Lind, Boscardin, & Dellinges, 2013).

Both metacognition and judgements of one's own confidence can contribute to an individual's success in educational settings, more importantly, test-taking. Taking a test requires a lot of effortful processing. Students must read and try to comprehend the questions, search their memory for answers, and evaluate the accuracy of the answers they generate. Sometimes students will be unsure of the accuracy of their answers and may decide to change their initial answer. Research has consistently supported that changing an initial response or "first impression" to an answer is believed to be a faulty tactic, one that results in a decrease in scores (Mueller & Wasser, 1977; McMorris & Weideman, 1986; Foote & Belinky, 1972). Mueller & Wasser, (1977) indicated that in a pinnacle study conducted by Mathews (1929), nearly 86% of students believed if they changed an answer from their initial response that their test score would be lowered. This is especially intriguing because research about answer-changing has found the opposite. In fact, research finds that changing answers can increase test scores because answer changes are often from an incorrect response to a correct response (e.g. McMorris & Weideman, 1986; Linden, Jeon, & Ferrara, 2011; Higham & Gerrard, 2005; Benjamin, Cavell & Shallenberger, 1984; Schwarz, McMorris & DeMers, 1991; Foote & Belinkey, 1972). For example, Linden et al. (2011) asked participants to answer questions and then review their responses. During the review process, participants could keep their initial answers or change them. If they chose to change their answer, they were asked to provide a reason for why they made this choice. Based on the results, it was concluded that participants' scores improved due to answer changes. Specifically, 11,543 responses (across all participants) were changed from incorrect to correct (7%) increasing their overall score as compared to only 1,454 answers being changed from correct to incorrect (0.8%).

Despite these types of findings, students tend to believe that changing answers will have negative consequences, so only a small portion of answers on tests tend to be changed (Higham & Gerrard, 2005). Why do students change answers? Researchers have investigated the reasons for these revisions when they occur. In studies by McMorris & Weideman (1986) and Schwarz et al. (1991), participants were surveyed and questioned about their test taking strategies and reasons for choosing answers. Based on these collections of responses, the following general reasons for changing answers were recorded: re-thinking and conceptualizing a new response, re-reading the question, correcting a clerical error, finding a clue or learning from a later item, and remembering more information upon review. Schwarz et al. (1991)'s study was especially intriguing because all of their participants were informed about answer-changing myths prior to being given multiple choice tests. Participants were presented with consistencies in literature regarding how changing answers can result in gains and presented the opposite opinion of those changes causing decreases in scores. The students were given three multiple choice tests and then were asked to voluntarily participate in an interview that was set up to evaluate the participant's reasons for changing answers and to address the erasures on their tests. Although research has found a variety of reasons for answers changing, students do also engage in random guessing especially on questions they find more difficult. However, students do seem to often have a reason for why they change their answers on certain questions.

Question type can also influence a student's likelihood of answer changing. Questions that are created to be more challenging or tricky can cause students to extract pieces of information they feel are correct when in fact they are not. Students are usually overconfident in their self-assessments: they tend to think they have more knowledge than they actually do (Curtis et al. 2013). There may be times when students are presented with material that they either did

not take the time to study, or that may not be in their knowledge base. In regard to answer changing, those items that students did not study enough for or that are too difficult for them, are more likely to be changed (Benjamin, Cavell, & Shallenberger, 1984; Higham & Gerrard, 2005).

A related question is when presented with questions of greater difficulty, how will students' confidence influence their metacognition and accuracy? This is expanded on further in Higham & Gerrard's (2005) research about metacognition and changing answers on multiple choice tests. They asked participants to answer a series of general knowledge questions that were either deceptive in nature or non-deceptive (this was unknown to the participants). The participants were asked to provide confidence ratings (that were unanalyzed) and were instructed to go back and change 1/3 of their initial response. Changing of initial responses indicated that deceptive questions still remained harder for participants even when their scores resulted in increase. Overall, this supports the idea that question type does influence a student's answer changing habits and can still cause issues in student abilities even if an increase upon review is found.

Based on previous research, it appears that question type, metacognition and confidence can influence students' likelihood of changing answers on multiple choice tests. There are some gaps in the literature that need to be addressed. Some of these gaps include confidence judgments for given responses to questions and reasons as to why participants choose their answers. Therefore, further investigation on how confidence and answer changing factor into metacognition directly is needed. In other words, how does confidence reflect an individual's metacognitive awareness and judgement of their knowledge and how do reasons participants choose reflect that awareness. Higham & Gerrard (2005), executed a methodology that included two different types of tests, a paper and pencil test and a computer test. The tests contained either

deceptive questions or non-deceptive questions (depending on condition given). During the computer test, students were given time limits of either five seconds or ten seconds to choose an answer. For the paper and pencil test this was not the case. However, in both conditions, after they had provided their answers, participants were asked to give a confidence judgment and then the tests were scored and given back to the participant. In the case of the computer, participants could change any responses they wanted to whereas in the paper and pencil test, they were asked to change ten out of their thirty responses (they had to take part in this changing process). And again, in both cases after each question they chose to change, they had to indicate their confidence. Although Higham & Gerrard (2005) had participants provide confidence judgments, they did not analyze these data and therefore did not try and analyze a connection between metacognition and confidence. They also forced their participants to change answers, which is not naturalistic in comparison to regular test settings. Linden et al. (2011) also neglected a crucial piece of information in regard to metacognition and test taking. They asked participants about the reasons they chose their initial responses but they did not analyze these and therefore this piece is also missing.

The current study expands on the afore mentioned gaps in literature in providing a more naturalistic approach to answer changing with trying to replicate what it would be like for a student to take test in a non-laboratory setting. This study also analyzes confidence judgments provided by participants for initial responses as well as revised responses and takes into consideration the reasons indicated by students for choosing answers in comparison to these confidence ratings and the question type of tricky or non-tricky it is identified for. These are components of both Higham & Gerrard (2005) and Linden et al. (2011) that were not analyzed. The current study intends to address the gaps in the literature. Specifically, the goals of the

current study are: (1) to investigate the metacognitive processes student's engage in when answering multiple-choice questions on a general knowledge test, (2) to investigate student's answer-changing behaviors, specifically the types of questions, for which they choose to change their answers and (3) to investigate students' confidence in their initial responses and changed responses.

It is expected that students will be more likely to change answers for tricky questions compared to non-tricky questions and for responses for which they provide lower confidence ratings initially. To test and expand on the ideas mentioned, a general knowledge multiple choice test was given with opportunities for revision and indications of both confidence and reasons for choosing answers.

Method

Participants:

80 college students were involved in this study (22 males and 58 females). The mean age was 18 and ranged from 18 to 27. The mean year in school was first year, freshman (48 out of 80 participants) and the mean GPA was 3.26 and ranged from 1.50 to 4.00. Participants were from Principles of Psychology using the Human Subject Pool recruitment system SONA.

Procedure:

Five students participated at a time in a 60 minute session. Students worked independently on the tasks during this session. Upon arrival to the research lab, students were asked to give their informed consent. Next instructions were read aloud by an experimenter (see appendix E). The instructions were: "Hello! Thank you for coming to participate in our study! Soon we will be passing out a test for you to complete. When you receive your packet please write your participant number that you were assigned on the top of each page. Do not write your name on any of the materials given. We ask that you please answer the general knowledge questions in the packet you will receive. Please circle your answer clearly. Should you decide to change an answer, cross out the previous one and write your new answer in the margin. After each question, please indicate your confidence in your answer, 1 being the least confident and 5 being the most confident, as well as your reasoning for choosing that particular answer. You may check multiple reasons for your answer. Once you have completed this section, please turn your paper over and raise your hand and a researcher will come over to give you further instructions. The top four scorers on this general knowledge test will receive a gift card, so please take your time and try your best. Please wait to be dismissed before you leave unless you would like to

stop participating in the test. Once you receive your test, you may begin! Any questions? Okay, we will now hand out the materials.”

During the first task, each participant was asked to complete a 26-question general-knowledge test (National Geographic 2015) (see appendix A). Questions were assigned to a category of either tricky or non-tricky (13 questions were tricky, 13 were non-tricky) (see appendix B). A small group of college students (who did not participate in the current study) were polled about the trickiness of the test questions. Their responses were used to determine the designation of each question as either tricky or non-tricky.

Participants in the current study were asked to answer each question on the general knowledge test by selecting 1 answer from a list of possible four possible answers, three incorrect and one correct. After answering each question, the participants were asked to provide a confidence judgment for their selected answer in the form of a Likert Scale. The scale was numbered one through five with five representing the greatest confidence and one representing the least confidence. The participants were also asked to select possible reasons for why they selected their answer. They were able to choose as many reasons as they wanted from the following choices: educated guess, process of elimination, random guess/selection and I knew the answer.

Upon completion of the main test questions, participants were asked to complete another task; the review task. For this task, students were given instructions individually based upon when they completed the test. The instructions were as follows: “This is your chance for a review process of your answers. Please read the instructions on this packet carefully. You do not have to change any answers but if you decide to please indicate them on this packet by following the steps. You do not have to re-write all of the answers you have chosen, just the ones you

decide to change. Your changed answers will be considered your final answers and will be factored in for the gift card final score. Please write your participant number on the top of every page you use. Please raise your hand when you are done and if you have any questions!”

Students were given a packet which consisted of 26 spaces (for each possible question to be changed) (see appendix D). The participant was asked to indicate the question number being changed, the initial response, the revised response, and their confidence judgement in the new answer they were providing.

Results

Mean total score on the general knowledge test (26 possible questions) was 13.37 with range of 7-21. Participants were significantly more likely to accurately answer non-tricky questions compared to tricky questions, $t(79) = -30.71, p < .001$. For non-tricky questions, the most common reason for answer selection was option D: I knew the answer. After option D, the most common reasons were: educated guess, random guess/selection and process of elimination (see Table 1). A similar trend was found with reasons for tricky questions. The most common reason for answer selection for tricky questions was option D: I knew the answer and was followed by educated guess, random guess/selection and process of elimination (see Table 2). Such a pattern suggests that participants were overconfident in their knowledge on tricky questions.

Overall, participants did not opt to change many of their answers. In fact, the mean number of questions on which answers were changed was 1.5. The mean total score after participants had the opportunity to change their answers was 13.51. Thus, changing answers did not significantly increase scores on the general knowledge test. As mentioned above, participants did not opt to change many answers. The maximum number of answer changes

participants opted to make was six. The majority of participants, 24, opted to change zero responses, 20 changed one response, 14 changed two, 13 changed three, 4 changed four, one participant changed five, and one changed a total of six responses. 76 changes were made to tricky questions and 49 changes were made to non-tricky questions (see Table 3). Participants were significantly more likely to change the answers to tricky questions compared to non-tricky questions, $t(79) = 2.86, p < .01$ thus supporting hypothesis 1.

Students rated their confidence for each answer on a Likert Scale from 1-5 (one being the least confident and five being the most confident). The mean confidence rating across all 26 questions was 3.98. Confidence ratings ranged from 1.69 to 4.81. Age was significantly correlated with confidence ratings, $r = -.27, p < .05$, in that younger participants rated their answers more confidently. Relatedly, year in school was significantly correlated with confidence ratings, $r = -.33, p < .01$. Again, participants who were earlier in their college career rather their answers more confidently. Confidence ratings were significantly correlated with overall accuracy on non-tricky questions, $r = .33, p < .01$. Confidence was not significantly correlated with accuracy on tricky questions.

Participants were significantly more confident in their answers for non-tricky questions compared to tricky questions, $t(75) = -10.99, p < .01$. Confidence was not significantly correlated with the number of questions participants chose to change. However, as discussed above participants only chose to change one question on average and many participants did not change any of their answers. Thus, we were not able to statistically evaluate hypothesis 2.

Discussion

The current study was designed to indicate relationships between metacognition, question type, and confidence on a general-knowledge multiple choice test. The current study replicates Higham & Gerrard's (2005) findings that tricky questions (or deceptive questions) were more likely to be changed by participants compared to non-tricky questions. However, unlike the majority of the research literature, the current study did not replicate the finding that changing answers increases test scores. This lack of replication is likely due to the fact that very few answer changes were observed in the current study. However, it is important to note that some scores did improve as a result of answer changes. Twenty-three participants improved their score by at least one point after changing at least one answer. More specifically, sixteen participants increased their scores by one point, four participants increased their scores by two points, and three participants increased their scores by three points (see Table 4). Unlike Higham & Gerrard (2005), this study did not force participants to go back and change answers. Therefore, the intended naturalistic design of the current study may have been an unexpected limitation.

Perhaps more participants would have changed answers if they had been required to do so. The fact that many participants did not voluntarily opt to change answers in the current study may reflect the myth of answer-changing leading to negative consequences such that participants may have purposively decided not to change answers because they thought it would lower their score.

Unlike Linden et al. (2011) the current study analyzed the reasons provide by participants for choosing their initial responses. Overall, participants identified two top reasons for their initial answer responses. The top reason selected was "I knew the answer" and the second top reason selected was "educated guess." For tricky questions, both "I knew the answer" and "educated guess" were selected the most by participants. For tricky questions, the top reason

selected was “I knew the answer” (see Table 4). This is especially interesting because most of the responses provided by participants for tricky questions were incorrect. Therefore, it seems participants over-estimated their knowledge and there is a discrepancy between what they think they know and what they actually know. These reasons provided for tricky questions were similar to those provided for non-tricky questions. In the case of non-tricky questions, the top two reasons provided were again “I knew the answer” and “educated guess” Again, the top reason provide was “I knew the answer” (see Table 4).

The current study also found that question-type influences student’s accuracy and metacognition. Participants answered non-tricky questions with greater accuracy in comparison to tricky questions. However, participants rated their confidence high on many tricky questions and claimed they knew the answers when they chose the incorrect response. This not only shows that participants were overconfident in their knowledge of the tricky questions but that they have a discrepancy between information they know and information they do not know. Reporting they knew the answers to the questions they actually got incorrect indicates that their metacognitive awareness is lower than what they think it is. This is also supported by the confidence judgements given. Since confidence is an assessment of knowledge, indicating higher confidence for questions they got incorrect also supports a lower metacognitive awareness.

The study does have limitations that should be addressed by future research. Again, not having many answer changes resulted in findings that not analyzable in the way that was initially intended or hoped. Forcing participants to change answers may have allowed for more analyses and findings. Not having students indicate reasons for changing the answers they did opt to change, could also have limited the amount of data collected on metacognitive judgement. It was decided an indication of reason for why participants chose to change answers was not to be

included because it would have increased the length of the test and it was not what we were looking for in the hypotheses. The small sample size and majority of the sample being first year students was also a limitation. The small sample size did not allow for a great amount of answer variance or answer changing. Having first year students may also have been an issue because they students are not yet fully exposed to college testing which means their confidence could still be greater than it would be if they had experience with college test settings. Having a broader, more diverse sample size could diminish this limitation and result in greater findings and more data that can be analyzed. One of the most impactful limitations was that the set-up of the tasks in the study did not allow for all changes made by participants to be captured. When participants were completing the initial test task, a lot of the time they would go back through their tests and review or revise them on their own. Meaning they would change answers or decide to keep their initial responses while taking the test initially. This made it so that when the review task was administered they either did not change any answers or said that they had already gone through and were complete with their tests. Not accounting for these changes and decisions by participants resulted in a loss of data and if this was analyzed it could account for some more data about participants metacognitive assessments and how they take and review tests.

Future research should try and account for these limitations upon replication or expansion on the subject of metacognition and test taking. Asking students why they chose to change any of their initial responses could be valuable in helping to identify if participants are using their confidence judgements to monitor themselves and assess their accuracy. This is because if participants chose to change answers they had indicated lower confidence ratings for initially, it could indicate a re-assessment of their knowledge with an attempt to try and increase the confidence they have in their new answers. It would be expected that students use their

confidence to decide if they are going to change answers and the lower this confidence is the greater the likelihood it would be for them to change that answer. Using a broader sample size could help support this idea and could further provide some more interesting results. Future research may want to take into consideration forcing participants to change a certain amount of answers, like Higham & Gerrard (2005), in order to gain the data necessary for a meaningful analysis of answer changing tendencies and the metacognitive assessments like confidence and reasons for choosing or changing answers that occur.

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Table 1

Non-Tricky Question Most Common Reasons

| Non-Tricky Question Number | Response A “Educated Guess” | Response B “Process of Elimination” | Response C “Random Guess/Selection” | Response D “I Knew the Answer” |
|----------------------------|-----------------------------|-------------------------------------|-------------------------------------|--------------------------------|
| Question #1 | 49 | 41 | 16 | 7 |
| Question #3 | 49 | 29 | 17 | 8 |
| Question #4 | 24 | 13 | 21 | 40 |
| Question #6 | 43 | 9 | 21 | 27 |
| Question #8 | 27 | 12 | 32 | 27 |
| Question #10 | 29 | 10 | 25 | 30 |
| Question #12 | 20 | 11 | 9 | 56 |
| Question #14 | 3 | 3 | 0 | 78 |
| Question #17 | 7 | 3 | 1 | 75 |
| Question #19 | 9 | 6 | 2 | 72 |
| Question #22 | 4 | 1 | 0 | 78 |
| Question #24 | 19 | 3 | 6 | 59 |
| Question #26 | 49 | 41 | 16 | 7 |

Most common response throughout is option D “I knew the answer”

Table 2

Tricky Questions Common Reasons

| Tricky Question Number | Response A “Educated Guess” | Response B “Process of Elimination” | Response C “Random Guess/Selection” | Response D “I Knew the Answer” |
|------------------------|-----------------------------|-------------------------------------|-------------------------------------|--------------------------------|
| Question #2 | 42 | 23 | 40 | 1 |
| Question #5 | 41 | 30 | 20 | 16 |
| Question #7 | 40 | 22 | 41 | 5 |
| Question #9 | 35 | 13 | 16 | 31 |
| Question #11 | 32 | 8 | 19 | 33 |
| Question #13 | 37 | 13 | 10 | 39 |
| Question #15 | 11 | 3 | 0 | 71 |
| Question #16 | 38 | 7 | 36 | 17 |
| Question #18 | 18 | 6 | 14 | 56 |
| Question #20 | 33 | 4 | 12 | 41 |
| Question #21 | 9 | 3 | 5 | 68 |
| Question #23 | 40 | 11 | 48 | 1 |
| Question #25 | 35 | 5 | 9 | 38 |

Most common response throughout is option D “I knew the answer”

Table 3

Total Number of Changes on Tricky and Non-Tricky Questions

| Tricky Question Number | Number of Changes | Non-Tricky Question Number | Number of Changes |
|-------------------------------|-------------------|-------------------------------|-------------------|
| Question #2 | 8 | Question #1 | 3 |
| Question #5 | 10 | Question #3 | 11 |
| Question #7 | 12 | Question #4 | 10 |
| Question #9 | 8 | Question #6 | 7 |
| Question #11 | 1 | Question #8 | 6 |
| Question #13 | 3 | Question #10 | 4 |
| Question #15 | 4 | Question #12 | 3 |
| Question #16 | 8 | Question #14 | 0 |
| Question #18 | 6 | Question #17 | 0 |
| Question #20 | 8 | Question #19 | 0 |
| Question #21 | 5 | Question #22 | 0 |
| Question #23 | 4 | Question #24 | 2 |
| Question #25 | 1 | Question #26 | 2 |
| Total Tricky Question Changes | 78 | Total Tricky Question Changes | 48 |

Table 4

Information on Revisions and Increased Scores

| Participant | Original Score | # Changed | New Score |
|-------------|----------------|-----------|-----------|
| 1 | 14 | 1 | 14 |
| 2 | 11 | 0 | 11 |
| 3 | 15 | 0 | 15 |
| 4 | 11 | 0 | 11 |
| 5 | 14 | 1 | 13 |
| 6 | 13 | 2 | 13 |
| 7 | 17 | 0 | 17 |
| 8 | 17 | 1 | 18 |
| 9 | 17 | 2 | 17 |
| 10 | 16 | 4 | 16 |
| 11 | 9 | 0 | 9 |
| 12 | 12 | 2 | 13 |
| 13 | 10 | 2 | 12 |
| 14 | 16 | 1 | 17 |
| 15 | 14 | 0 | 14 |
| 16 | 15 | 1 | 16 |

| | | | |
|----|----|---|----|
| 17 | 10 | 6 | 13 |
| 18 | 13 | 0 | 13 |
| 19 | 15 | 2 | 15 |
| 20 | 12 | 0 | 12 |
| 21 | 13 | 3 | 12 |
| 22 | 14 | 0 | 14 |
| 23 | 14 | 0 | 14 |
| 24 | 18 | 1 | 17 |
| 25 | 12 | 4 | 13 |
| 26 | 12 | 0 | 12 |
| 27 | 9 | 4 | 12 |
| 28 | 13 | 1 | 13 |
| 29 | 18 | 1 | 19 |
| 30 | 14 | 0 | 14 |
| 31 | 11 | 1 | 11 |
| 32 | 11 | 0 | 11 |
| 33 | 10 | 4 | 9 |
| 34 | 13 | 3 | 14 |
| 35 | 12 | 2 | 12 |
| 36 | 12 | 3 | 13 |
| 37 | 16 | 1 | 15 |
| 38 | 15 | 3 | 14 |
| 39 | 18 | 3 | 19 |
| 40 | 15 | 3 | 14 |
| 41 | 12 | 2 | 11 |
| 42 | 15 | 4 | 13 |
| 43 | 10 | 1 | 9 |
| 44 | 12 | 2 | 11 |
| 45 | 16 | 0 | 16 |
| 46 | 12 | 3 | 12 |
| 47 | 14 | 0 | 14 |
| 48 | 13 | 1 | 13 |
| 49 | 11 | 2 | 10 |
| 50 | 12 | 1 | 13 |
| 51 | 15 | 4 | 16 |
| 52 | 7 | 3 | 9 |
| 53 | 10 | 0 | 10 |
| 54 | 21 | 0 | 21 |
| 55 | 10 | 2 | 11 |
| 56 | 14 | 2 | 15 |
| 57 | 18 | 1 | 17 |
| 58 | 11 | 1 | 10 |
| 59 | 8 | 5 | 10 |
| 60 | 15 | 0 | 15 |
| 61 | 8 | 2 | 9 |

| | | | |
|----|----|---|----|
| 62 | 11 | 0 | 11 |
| 63 | 14 | 2 | 16 |
| 64 | 18 | 3 | 16 |
| 65 | 16 | 0 | 16 |
| 66 | 13 | 4 | 13 |
| 67 | 13 | 2 | 13 |
| 68 | 14 | 3 | 11 |
| 69 | 16 | 1 | 15 |
| 70 | 13 | 1 | 14 |
| 71 | 19 | 1 | 18 |
| 72 | 12 | 0 | 12 |
| 73 | 14 | 3 | 14 |
| 74 | 13 | 3 | 16 |
| 75 | 12 | 1 | 12 |
| 76 | 17 | 0 | 17 |
| 77 | 12 | 0 | 12 |
| 78 | 9 | 1 | 10 |
| 79 | 15 | 0 | 15 |
| 80 | 14 | 3 | 14 |

Appendix A

Test Questions

1. Which animal can communicate with sounds that are too low-pitched for humans to hear?
- a. Frog
 - b. Parrot
 - c. Rhinoceros
 - d. Mouse

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

2. *Daxiongmao*, the Chinese name for panda, translates to _____?
- a. Bamboo-eater
 - b. Large bear cat
 - c. Cuddly Fuzzball
 - d. Black-and-white beast

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

3. Which of the following does NOT cause an avalanche?
- a. Skiing down a mountain
 - b. Shouting
 - c. Heavy wind
 - d. A sudden change in temperature

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection

___I knew the answer

4. What do you call a group of lions?
- a. A pride
 - b. A meeting
 - c. An army
 - d. A circus

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

___Educated Guess
___Process of Elimination
___Random Guess/Selection
___I knew the answer

5. Who was the 1st president to live in the White house?
- a. George Washington
 - b. John Adams
 - c. James Monroe
 - d. John F. Kennedy

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

___Educated Guess
___Process of Elimination
___Random Guess/Selection
___I knew the answer

6. If you walk toward Polaris, the Pole star, what direction are you going?
- a. North
 - b. East
 - c. South
 - d. In circles

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

___Educated Guess
___Process of Elimination
___Random Guess/Selection
___I knew the answer

7. Between about 1250 and 1500, Easter Islanders in the South Pacific Ocean built giant statues to honor their people and watch over the island. What is their name for these statues?
- Tuff
 - Tiki
 - Moai
 - Rushmore

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

Educated Guess
 Process of Elimination
 Random Guess/Selection
 I knew the answer

8. From where did teddy bears get their name?
- President Teddy Roosevelt, who enjoyed hunting
 - Young Ted, son of the teddy bear store's owner
 - The name of the breed of small, gentle bears
 - Tedi, Austria, where the first one was made

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

Educated Guess
 Process of Elimination
 Random Guess/Selection
 I knew the answer

9. What is the capital of Florida?
- Tallahassee
 - Miami
 - Orlando
 - Tampa

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

Educated Guess
 Process of Elimination
 Random Guess/Selection
 I knew the answer

10. What is the last name of the man who began the Reformation in Germany?

- a. Hitler
- b. Luther
- c. Mendelssohn
- d. Habsburg

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

11. What is the capital of Australia

- a. Perth
- b. Sydney
- c. Canberra
- d. Melbourne

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

12. What is the proper name for a badminton bird?

- a. Shuttlecock
- b. Birdie
- c. Ball
- d. Feather

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

13. What is the name of the largest desert on earth?

- a. Antarctic
- b. Sahara
- c. Arabian
- d. Kalahari

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

14. What is the name of the horse-like animal with black and white stripes?

- a. Zebra
- b. Donkey
- c. Hippopotamus
- d. Llama

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

15. If you were running a race and passed the person in second place, what place are you in now?

- a. Second
- b. First
- c. Third
- d. All of the above

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection

___I knew the answer

16. What was the highest mountain in the world before Mount Everest was discovered?

- a. K2
- b. Makalu
- c. Lhotse
- d. Everest

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- ___Educated Guess
- ___Process of Elimination
- ___Random Guess/Selection
- ___I knew the answer

17. What is the name of the long sleep some animals go through during the entire winter?

- a. Hypersomnia
- b. Slumber
- c. Hibernation
- d. None of the above

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- ___Educated Guess
- ___Process of Elimination
- ___Random Guess/Selection
- ___I knew the answer

18. How many of each type of animal did Moses take onto the Ark?

- a. 0
- b. 1
- c. 2
- d. 4

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- ___Educated Guess
- ___Process of Elimination
- ___Random Guess/Selection
- ___I knew the answer

19. Which precious gem is red?

- a. Ruby
- b. Emerald
- c. Topaz
- d. Amethyst

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

20. If an electric train is travelling south, in which direction is the smoke going?

- a. North
- b. South
- c. East
- d. None of the above

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

21. What month has 28 days

- a. February
- b. March
- c. June
- d. All of the above

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

22. Who wrote "Romeo and Juliet?"

- a. Shakespeare
- b. Chaucer
- c. Tennyson
- d. Williams

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

23. What gym-class exercise was an Olympic sport in 1896?

- a. Sit-ups
- b. Push-ups
- c. Rope climbing
- d. Jump rope

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

24. What is the name given to a giant ocean wave caused by an earthquake?

- a. Tsunami
- b. Swell
- c. Undercurrent
- d. Billow

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

25. From where does the narwhal's long spiral horn grow?

- a. Tail
- b. Forehead
- c. Mouth
- d. Flippers

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

26. Which animal changes color to show off its fighting ability?

- a. Tiger
- b. Tarantula
- c. Chameleon
- d. Shark

How would you rate your confidence on the question you just answered (one being the least confident and five being the most):

1 2 3 4 5

Which of the following most resemble(s) how you chose your answer? (Check all that apply)

- Educated Guess
- Process of Elimination
- Random Guess/Selection
- I knew the answer

Appendix B

Test Question Tricky or Non-Tricky Designations

1. Non-tricky
2. Tricky
3. Non-tricky
4. Non-tricky
5. Tricky
6. Non-tricky
7. Tricky
8. Non-tricky
9. Tricky
10. Non-tricky
11. Tricky
12. Non-tricky
13. Tricky
14. Non-tricky
15. Tricky
16. Tricky
17. Non-tricky
18. Tricky
19. Non-tricky
20. Tricky
21. Tricky
22. Non-tricky
23. Tricky
24. Non-tricky
25. Tricky
26. Non-tricky

Appendix C

Test Question Answers

1. C
2. B
3. B
4. A
5. B
6. A
7. C
8. A
9. A
10. B
11. C
12. A
13. A
14. A
15. A
16. D
17. C
18. A
19. A
20. D
21. D
22. A
23. C
24. A
25. C
26. C

Appendix D

Review Packet

Now that you have completed the multiple-choice test, you are encouraged to go back and review your answers. Although you are not required to change any of your initial responses, you may wish to and you may change any answers that you want. As a reminder the top four scores on the exam will receive gift cards. If you decide to change any of your answers, you may do so with the sheet attached. Please provide the question number, the changed response, and your confidence level in your new answer (as organized on the sheet).

Participant # _____

If you have chosen to change any of your initial responses from the multiple-choice exam, please do so on this page. Indicate the question number you are changing, your new choice of answer, and your confidence level in the new answer you have chosen (1 being the least confident and 5 being the most).

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Question #: _____

Initial Response: _____

New Response: _____

How would you rate your confidence in your new answer (one being the least confident and five being the most):

1 2 3 4 5

Appendix E

Instructions Read to Participants

Introductory Instructions:

Hello! Thank you for coming to participate in our study! Soon we will be passing out a test for you to complete. When you receive your packet please write your participant number that you were assigned on the top of each page. Do not write your name on any of the materials given. We ask that you please answer the general knowledge questions in the packet you will receive. Please circle your answer clearly. Should you decide to change an answer, cross out the previous one and write your new answer in the margin. After each question, please indicate your confidence in your answer, 1 being the least confident and 5 being the most confident, as well as your reasoning for choosing that particular answer. You may check multiple reasons for your answer. Once you have completed this section, please turn your paper over and raise your hand and a researcher will come over to give you further instructions. The top four scorers on this general knowledge test will receive a gift card, so please take your time and try your best. Please wait to be dismissed before you leave unless you would like to stop participating in the test. Once you receive your test, you may begin! Any questions?

Okay, we will now hand out the materials.

Verbal Instructions for Review Packet:

This is your chance for a review process of your answers. Please read the instructions on this packet carefully. You do not have to change any answers but if you decide to please indicate them on this packet by following the steps. You do not have to re-write all of the answers you have chosen, just the ones you decide to change. Your changed answers will be considered your final answers and will be factored in for the gift card final score. Please write your participant

number on the top of every page you use. Please raise your hand when you are done and if you have any questions!

Verbal Instructions for Questionnaires:

Now we would like you to complete a few questionnaires. Please write your participant number on the top of every page. Please try and answer every question to the best of your ability. Raise your hand when you are done or if you have any questions.

Dismissal Instructions:

Everyone has now completed the materials. You can expect to receive credit for your class within the next few days! We will be in touch with you regarding whether or not you have qualified for the gift card at the end of the study. If you would like to look at the answers to the questions you may do so now or you can email us with the contacts provided on your consent form and we can send you the answers after the study is complete. It is important that you do not reveal any of the questions you have been asked today to others in case they are going to be participating in our study. You can grab your belongings and exit the room, thank you for your time and participation! Thank you again!