

Running Head: THE ROLE OF METACOGNITION AND ANXIETY

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

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students a model example of an Honors senior thesis project.*

**Abstract**

Previous research has demonstrated that college students do not consistently make accurate metacognitive judgments (e.g. Dunlosky & Lipko, 2007). Such inaccuracy can be a concern because students' metacognitive judgments affect their academic performance. For example, after selecting answers on an exam, students may reflect on their confidence in those selected answers and if they are not confident, they may consider making changes. Previous research has investigated reasons for why students opt to change answers as well as general beliefs about answer-changing (e.g. Benjamin, Cavell, & Schallenberger, 1984). Such research has found that students often worry that changing answers will negatively impact their grade and thus they hesitate to make changes (e.g. Mueller & Wasser, 1977). However, the existing empirical research on answer-changing does not support students' beliefs (e.g., Foote & Belinky, 1972). Changing answers can actually be beneficial for students. The current research examines whether students' general anxiety levels may impact their confidence ratings and/or decisions to change answers on an exam. It is expected that students with more reported anxiety will change more answers and have lower confidence ratings.

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

Metacognition, is the ability to make a judgement about one's own cognitive processes (Dunlosky and Metcalfe, 2009). In other words, it is the ability to recognize how well one understands a given topic, or thinking about thinking. This concept is important especially in the context of education where students must accurately monitor their knowledge while studying for and taking tests (Hacker, Dunlosky, & Grasser, 2009). Imagine you are a student studying for a final exam, when do you make the decision to stop studying? This decision is vital for potential success on the exam. Students who do not make accurate judgements about their knowledge have the potential to do worse on evaluative assessments. When students cannot accurately assess their understanding of to-be tested material, they are more likely to stop studying too early, which will result in a lower grade on the assessment. The decision to stop studying for a particular assessment can be anxiety provoking for students. In fact, studying in general often induces anxiety in students. Also, if one stops too early, and the result is a lower grade on a test, they may develop an anxious reaction to future examinations. This paper will investigate the relationship between anxiety, and metacognition. First, the literature on general anxiety, and metacognition will be briefly reviewed. Then the literature on, test anxiety, and its potential links to metacognition will be discussed. Finally, a potential link will be examined between answer changing behaviors, confidence levels, and test anxiety.

### **Anxiety**

Anxiety is broadly defined as “an abnormal and overwhelming sense of apprehension and fear often marked by physical signs (such as tension, sweating, and increased pulse rate), by doubt concerning the reality and nature of the threat, and by self-doubt about one's capacity to

cope with it” (Anxiety. (n.d.)). Thus, anxiety can be a normal and necessary response to dangerous situations. However, when it becomes excessive, it has the potential to have detrimental effects by lessening an individual’s ability to cope with the task at hand. Sarason (1984) stated that there are two major components of anxiety, worry, and emotionality. Worry is defined as the cognitive portion of anxiety, and emotionality is the physiological component of anxiety. In a study conducted by Spada, Nikcevic, Moneta, and Wells (2008), a metacognitive questionnaire, which assessed individual differences in metacognitive beliefs, judgements, and monitoring tendencies, was utilized to assess the relationship between anxiety, and metacognitive thought. The study found that metacognition was positively, and significantly correlated with perceived stress and negative emotions, anxiety, and depression. The Spada study found that metacognition acts as a moderator in the relationship between perceived stress, and negative emotion (anxiety and worry) (2008). Therefore, metacognition acts as a means to maintain negative emotions as well as a means to decrease negative emotions. The results of this study suggest that for the future, metacognitive skills can be taught to individuals in the hopes of alleviating anxiety.

Thielsch, Ehring, Nestler, Wolters, Kopei, Rist, Gerlach, and Andor (2015), examined the relationship between negative metacognitions, thoughts which interfere with a current task or other event, such as over thinking, and other detrimental thought processes, and its relation to GAD (Generalized Anxiety Disorder) patient’s levels of worry. The study administered the Penn State Worry Questionnaire, as well as a metacognitive assessment similar to the Spada et. al study, and finally an ambulatory assessment which contained subscales for worry, uncontrollability, and sleep. The study found that negative metacognitions were related to increased levels of worry for individuals but that increased worry did not appear to strengthen

metacognitions (Thielsch et al., 2015). Although, interesting, the study only involved people who had been diagnosed with Generalized Anxiety Disorder. Thus, the findings may not be applicable to the general population.

### **Test Anxiety and Metacognition**

A specific form of anxiety, test anxiety is defined as feelings of over arousal and worry (including fear of failure) before, during, and/or following an examination (e.g. Benjamin, McKeachie, Lin, and Holinger, 1981, Culler and Holahan, 1980, Morris and Liebert, 1970, Sarason, 1984). Sarason (1984) found that worry was related to decreased performance on evaluative assessments more so than emotionality suggesting that worry is the component of anxiety that interferes most with evaluative assessments, and test anxiety. Culler and Holahan (1980) investigated the relationship between test anxiety, and academic performance in college students, and found that increased test anxiety levels were correlated with academic performance. Specifically, lower GPAs were related to higher levels of test anxiety. They also found that students who experienced high levels of test anxiety spent more time studying, but they did not improve the quality of their study time, suggesting a deficit in metacognitive judgments. Benjamin, Mckeachie, Lin, and Holinger (1981) also investigated the relationship between GPA, and anxiety. They also found that increased anxiety is related to lower GPA.

In 1999, Minnaert conducted a study of college freshmen, which investigated the relationship between self-referenced cognitions/feelings and regulatory activities invariant of gender and of ability differences. Self-referenced cognitions are thoughts that are directed at oneself. The study consisted of college freshmen, who were given two written examinations at two points in their college career, in the first week of classes, and after three months. One of the domains of self-referenced cognitions was fear of failure. Minnaert (1999) found that, in

particular for women, an increased level of fear of failure, which is an anxious response, was detrimental to metacognitive judgments. A high level of fear of failure was not found to be detrimental to male students. For women fear of failure, led to an inability to make an appropriate judgement about their knowledge in a specific content area, whereas this did not happen for men.

Morris and Liebert (1970), found that anxiety was negatively correlated to exam grades, where an increase in anxiety was correlated with lower exam grades. Therefore, if an individual feels more anxious they are more likely to get a lower grade on their exam. Currently, numerous and various tests are administered to children at younger and younger ages, which may lead to an earlier onset of test anxiety (Yeo, Goh, and Liem, 2016). Yeo, Goh and Liem (2016) examined the effect of a CBT intervention for test anxiety on elementary students. The study contained two groups, one that received treatment and one that was a control group. An important result showed that in the control group which included average students without treatment showed the greatest increase in test anxiety over time. Furthermore, if the increased anxiety was allowed to go untreated or unmanaged, children's grades began to falter. Therefore, for younger age groups unchecked test anxiety can result in further increased anxiety and lower grades as they grow older. Thus, the result that students perform worse when they have high anxiety when compared to those who have lower anxiety has been found time and again (Mavilidi, Hoogerheide, and Paas, 2014).

Another study conducted by Everson, Smoldaka, and Tobias (1994) with a college aged sample examined the cognitive component of test anxiety, worry, and its interaction with metacognition on a reading comprehension tasks that varied in difficulty. They found that the complexity of problems were more of a detriment for individuals with higher anxiety when

compared to those with lower anxiety. Therefore, when the difficulty of problems increases, individuals with higher anxiety struggled more than individuals with lower anxiety. Thus, individuals with increased levels of anxiety performed more poorly on the examination with different levels of question difficulty. Accordingly, this research has found that anxiety takes away from a participant's ability to perform on a task.

### **Answer Changing**

A common myth that many students have heard is that changing answers on a test is detrimental, and they should always go with their gut instinct. Therefore, answer changing on an assessment/exam can be an anxiety inducing task for some students as they must make a decision to either keep their original answer or change it to a new one. However, Muller, and Wasser (1977) conducted a review of the literature of answer changing behaviors and found that those who change answers gain more points than individuals who do not change answers. Higham and Gerrad (2005), attempted to understand the disconnection between the myth, and the research literature by investigating the role of metacognition in students' answer changing behaviors on a multiple-choice test. Two experiments were conducted in which students were asked to complete a computerized general knowledge test. In the first experiment, participants took the exam, and once they had completed it they were given a chance to change their answers without mention of a point value or deadline for completion. In experiment two the participants were given a pre-test which was either positive or negative. The positive pre-test consisted of questions that were designed to be deceptive, and the negative pre-test consisted of questions that were of medium difficulty and considered to be non-deceptive. Deceptive questions were defined as questions with potentially confusing answer choices. Following completion, the participants were given a distractor task and then asked to choose to change 10 of their 20 answers in a set time limit. The

result of experiment two was that giving participants an opportunity to change their answers resulted in a higher overall test score. However, the study also found that some changes did not prove to be beneficial when the participants were given a time limit or if they were given an opportunity to change harder answers (Higham and Gerrad, 2005). The lack of beneficial outcome for harder questions may be the root of the false belief that answer changing is not beneficial to students.

In a related study conducted by Foote and Belinky (1972), answer changing in a college sample was examined, without forcing the participants to change answers. In this study two classes were given two examinations, and each examination was graded, with the researcher tabulating the amount of changed answers, while grading the exam. The results of the study were that over half the answer changes were positive, or from incorrect answers to correct answers, and less than 22% of changes were negative. This result replicates what Higham and Gerrad (2005) found, except in a naturalistic setting, without forcing answer changing behaviors.

Muller and Wasser (1977) critiqued one of the methods used in the Foote and Belinky study specifically the tabulation of answer changing, through the examination of erasures and crossed out responses. They believed that such a method was troublesome as it does not account for all of the potential answer changes that an individual considers before committing to come to a final answer. Additionally, the viewing of erasures is subjective, and some people may view erasures differently or an individual may have made an unintentional mark. Also, Muller, and Wasser (1977) found that both males and females benefit equally from answer changing. This is an important finding, as gender differences exist in anxiety as previously discussed but do not appear to have any bearing on benefits of answer changing.

### **Students' Confidence Levels**

Sarason (1984) found that individuals became less confident in their answers when their anxiety increased. Deffenbacher (1978) also found a similar result. Specially, he asked college students who had been split into two groups based on their levels of test anxiety, to complete difficult anagrams to solve in either a high stress evaluative scenario or a low stress non-evaluative scenario. The high stress testing scenario involved instructions that emphasized the intelligence evaluation that the anagram represented. The low stress testing scenario involved more reassuring instructions, including sentences that recognized the difficulty of the problems and encouraged the participant to take their time. Those who had high test anxiety and who were in the high stress scenario reported more anxiety during testing and that they rated themselves, their abilities, and the task itself more negatively. Therefore, high anxiety coupled with high stress evaluation leads to a decrease in confidence in their abilities in relation to a task.

### **Current Study**

The current study hopes to add to the previous research by examining anxiety and metacognition as well as gender differences. The goals of this research are (1) To examine the relationship between gender and anxiety (2) To examine the relationship between anxiety and number of questions changed (3) To examine the relationship between confidence and anxiety on a general knowledge test. It was suspected that participants would change more answers when their anxiety was higher, as well as have lower confidence in their answers. It was hypothesized that gender would be correlated with anxiety, where women would have higher anxiety scores compared to men. It was also hypothesized that anxiety would be positively correlated with number of questions changed, where as anxiety increases more questions would be changed, and vice versa. Finally, it was hypothesized that confidence and anxiety would be negatively correlated, with confidence decreasing as anxiety increases.

### Method

Eighty college students ( $M = 18.75$ , Range = 18-27 years old) from The College at Brockport participated. Participants ranged in terms of their year in school ranging from 1st year college students to 4th year college students. 22 of the participants were male and 58 were females. Participants had a mean GPA of 3.26.

Participants were recruited through the Brockport Human Subject Pool System. Students were enrolled in PSH 110 and completed the study in groups, ranging from 1-5 individuals based on available dates and timeslots. After arriving at the lab, participants were assigned a participant number and asked to put their name and email next to their participant number on a master list. This master list was kept in the research lab, and used to connect the email of the individual to their final score on their general knowledge test, it was destroyed at the completion of the study. The participants were then asked to read and sign an informed consent form and were told that the top four scores on the general knowledge test they would be taking would receive a 50-dollar gift card to Amazon.com. Finally, the participants were read instructions for the general knowledge test (see Appendix A).

Next, participants were asked to complete a general knowledge test which, contained 26 questions considered either tricky or non-tricky (See Appendix B and C). The categorization of questions as tricky or non-tricky was based on pilot testing involving a small group of college students. Initially, the questions were chosen by the researchers to have a wide range of difficulties for the questions. Next, the questions were given to a group of people close to the researchers, they answered the questions and commented on how difficult they found each question. Questions that were believed to be too easy or too difficult based on both comments and accuracy of answers. The questions came from two quiz books, National Geographic Kids

Quiz Whiz 4 and 5: 1,000 Super Fun Mind-Bending Totally Awesome Trivia Questions. (National Geographic Society 2014 & 2015). After answering each question participants were asked to rate their confidence in their answer, on a scale of 1 (least confident) to 5 (most confident). They were also asked to choose reasons for why they chose their answer. The potential reasons for making their final choice were as follows, educated guess, process of elimination, random guess/selection, and I knew the answer. Of the four options the participants could pick as many or as few reasons that they felt applied to their decision-making process.

Following completion of the general knowledge test, the participants were asked to review their previous answers. The participants were then given a new packet, and verbal instructions for the completion of the packet (See appendix A and E). The packet contained spaces to change any answers should the participant chose to change an answer. Included was space for the participant to write the number for the question they wanted to change, what their original answer was, the new answer, their new confidence in their answer and finally space to check their reasons for their questions. The confidence judgment and potential reasons followed the same format as previously discussed.

Upon completion of the review process, participants were asked to complete a final packet that contained two questionnaires. The first questionnaire was the State Post Thinking questionnaire (O'Neil, Brown, 1998, Appendix F). The questionnaire contains 4 sub scales, use of a cognitive strategy, level of self-checking, worry felt, and level of effort put into the assessment. The items are measured using a Likert scale, relating to the level of agreement that the individual feels with each statement, 1 (Not at all), 2 (somewhat), 3 (Moderately so), 4 (Very Much so). Six items were dropped due to their lack of applicability to the current test, leaving a total of 18 items left. The second questionnaire was the Penn State Worry Questionnaire (Meyer

et. Al., 1990, Appendix G), which contains 16 items. Each item has a corresponding Likert scale, ranked 1 (Not at all typical of me) to 5 (Very Typical of me). The questionnaire measures the amount of worry the participant experiences. The total possible scores ranges from 16 to 80. A score of 62 or higher has been found to predict Generalized Anxiety Disorder status. Lastly, participants were asked to complete a demographics questionnaire, the demographics questionnaire asked participants their age, gender, class level, and finally their major (See Appendix H).

## Results

The average score on the general knowledge test was 13.51, with a range of scores from 9 to 21. The maximum score was 26 points. The average scores for males and females were different, the average for males was 14.5 and the average for females was 13.14. This difference was significant,  $t(78) = 2.12$ ,  $p = .037$ . The total possible score on non-tricky questions was 13, the average score was 9.55. The smallest number of non-tricky questions correct was 6 and the highest was 12 (Table 1). The average score for males on non-tricky questions was 9.77 and the average score for females on non-tricky questions 9.47. The total possible score for the tricky questions was 13, and the average score was 3.59. The minimum number correct was 0 and the maximum was 8 (Table 2). The average score for males on tricky questions was 4.23, and the average female score was 3.34. Furthermore, the total score for tricky questions was found to be correlated to non-tricky questions,  $r = .25$   $p = .027$ . Many students were not engaging in answer changing behaviors, the average number of questions changed was 1.6. The frequency of answer changes ranged from 0-6 (See Table 3). Therefore, in this sample very little answer changing occurred.

The average score on the State Post Thinking Questionnaire Worry Subscale was 7.86 with a range of scores, 5-19. The maximum possible score was 20. The means differed based on gender. Specifically, males scored an average of 6.05, while females had an average score of 8.52. Males scored significantly lower on the State Post Thinking Questionnaire than women,  $t(77) = -3.26, p = .002$ . The average score on the Penn State Worry Questionnaire was 57.04, with a range of scores 21-79. The maximum score was 80. The means once again differed based on gender. Specifically, males scored an average of 50.14 and females' score was 59.66. There was a significant difference between the male and female scores on the Penn State Worry Questionnaire,  $t(78) = -3.06, p = .003$ .

It was hypothesized that a significant correlation would exist between gender and anxiety. Based on the previous literature, it was specifically hypothesized that women would score higher than men on the anxiety measures. A significant correlation was found between the Penn State Worry Questionnaire and the State Post Thinking Questionnaire Worry Subscale,  $r = .32, p = .004$ . This positive correlation is important as it shows that the two measures are significantly related to one and other, thus the items on the measure are tapping into one construct and not separate constructs. Additionally, a significant correlation was found between gender and the State Post Thinking Questionnaire Worry Subscale,  $r = .35, p = .002$ . there was also a significant correlation between gender and the Penn State Worry Questionnaire,  $r = .33, p = .003$ .

It was hypothesized that increased anxiety would be correlated with the total number of questions changed. More specifically, a significant positive correlation would be found between total number of questions changed and anxiety. No significant correlation was found between number of questions changed and scores on the Penn State Worry Questionnaire,  $r = .03, p =$

.746 Also no significant correlation was found between number of questions changed and the State Post Thinking Questionnaire Worry Subscale  $r = -.038, p = .742$ . As mentioned earlier, many students did not opt to change their answers when given the opportunity. The restricted variability in answer changing makes it unlikely that there would be a significant correlation between answer changing and any other construct.

For the final research question, it was hypothesized that anxiety would be negatively correlated with the average level of reported confidence. Each participant rated their confidence on their chosen answer for each question. Next, these confidence ratings were summed and averaged for each participant. Please note that each participant's average confidence score did not include the participant's confidence ratings for changed answers but only for their answer on their original attempt on the general knowledge test. This decision was driven by the low number of answer changes made by participants. The mean confidence rating participants provided for their answers on the general knowledge test questions was 3.83. Confidence scores had a possible range from 1 to 5, the lowest mean score was 1.5 and the highest was 4.65. A non-significant correlation was found between confidence and gender; however, the relationship was approaching significance. A non-significant correlation was found between total confidence and score on the Penn State Worry Questionnaire,  $r = -.099, p = .395$ . However, a significant correlation was found between the State Post Thinking Questionnaire Worry Subscale and average confidence,  $r = -.28 p = .015$

### **General Discussion**

The first hypothesis that females would score significantly higher than males on anxiety the measures was supported. However, the current sample contained far more females than males. This is not surprising as convenience sampling was used and there are more females in

the psychology program at The College at Brockport than there are males. However, a significant result is encouraging, as it adds to the previous literature, in particular to Minneart (1999), where females exhibited a detrimental level of fear of failure. Although, worry and fear of failure are two different variables they are related in that worry is the cognitive portion of anxiety, and fear of failure is a form of worry. Future studies should attempt to replicate this finding with an evenly gendered sample.

The second hypothesis that the number of questions changed would be related to anxiety was not supported. This finding was unsurprising as people only changed an average of 1.5 answers. As previously discussed participants were given the opportunity to change answers after completing the exam the first time. Therefore, they could have changed answers before they were given the opportunity to do so. In the current study, answer changing was optional. After answering all of the questions participants were given the opportunity to change any answers they wished to but they were not required to change any at all. In the previous research, answer changing was required, such as in Higham and Gerrad's (2005), study the participants were forced to change half of their answers after completing the exam. The participants in the current study may have fallen victim to the common myth that answer changing is detrimental and that they should stick with their gut instinct. Therefore, they, did not choose to change many answers or any at all. Participants may also have opted not to change any answers because they were afraid of receiving a lower grade, and thus thought it was best to keep their original answers.

It is also possible that some students, even with the potential monetary incentive to do well on the exam, did not take the examination very seriously. Therefore, they chose to answer the questions but opted to not participate in the answer changing. Perhaps participants did not want to take the extra time or expend any more thought and energy on the research study. It is

very possible that participants did not take this experience nearly as seriously or view it as important as other tests they had previously taken. Interestingly, the scores on the tricky and the non-tricky questions were positively correlated. Thus, people who did well on the tricky questions were also likely to do well on non-tricky questions, as well as those who did poorly on the tricky questions also did poorly on the non-tricky questions. This result suggests that people performed consistently across questions. It seems that individuals varied in the amount of effort they expended on the test. Those who did not care as much are likely those who performed poorly on all question types while those who did put a reasonable amount of effort did better on all questions.

Another consideration is the timing of the answer changing. Participants were not given the opportunity to change answers until they had already finished the test and notified the researcher that they were ready to proceed to the next part of the study. There is a possibility that the participants may have already changed their answers while going through the test initially. Some participants read through the exam multiple times before notifying the researchers that they were done. Therefore, answer changing could have occurred before the answer changing packet was given, and these preliminary answer changes could not be reliably coded by the researchers. As previously mentioned coding of on the spot answer changing of on the spot answer changes can be problematic (Muller and Wasser, 1977).

The third and final research question hypothesized that the anxiety measures would be correlated with participants' average confidence scores. A non-significant result was found for average confidence levels and the Penn State Worry Questionnaire, but a significant result was found between average confidence and the State Post Thinking Questionnaire Worry Subscale. The relationship between the State Post Thinking Questionnaire Worry Subscale and confidence

is a negative one, as worry increases confidence decreases and vice versa. The fact that different correlations were discovered between confidence and each of the anxiety measures may be due to the fact that the Penn State Worry Questionnaire measures general anxiety whereas the State Post Thinking Questionnaire Worry Subscale measures the amount of worry specifically felt about the current assessment or test. Participants' general anxiety about life may not influence their confidence ratings on the evaluative assessment.

In conclusion, although the first and third hypotheses were found to be supported, both of these findings should be replicated in future studies. A more even spread of gender should be utilized, to give greater weight to the results previously discussed. Additionally, the second hypothesis could not really be meaningfully tested because, so few participants changed answers. Future studies could use prompting techniques to explain the benefits of answer changing to participants to see if such knowledge would influence their rate of answer changing. This could be done by either giving the participants a sheet with an overview of a few research studies or by reading a short explanation from the literature to the participants before they begin the examination. Further, to gain more data and give true incentive to do well, it might be beneficial to replicate the study but in a class room setting. Students could be asked to clearly mark any changed answers on their exams, and complete anxiety measures following each exam. Therefore, data from across a semester could be collected and utilized to better understand the relationship between anxiety and metacognitive judgements.

In the current study, convenience sampling was used, all of the participants were students in an introductory psychology class who were required to participate in research as part of their course requirement. As a result, the findings may not general to a broader sample. It would be interesting to see if any differences occur across majors. Furthermore, the general knowledge test

only had multiple choice questions, it would be interesting in future studies to see if any differences in results occur across question types. For example, multiple choice and short answer questions or essay questions. These two types of questions tap into different types of knowledge which would be interesting to examine in relation to anxiety.

Future research, could potential use different anxiety measures. The current research utilized two anxiety measures that were short and accessible at the time. However, future research should consider utilizing different anxiety measures, that focus on test anxiety. Some test anxiety measures might be useful or a new measure could be created to tap into the exact feelings during the test.

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Table 1

*Scores for non-tricky questions*

	Frequency	Percent
6	1	1.3
7	3	3.8
8	12	15
9	17	21.3
10	33	41.3
11	10	12.5
12	4	5.0
Total	80	100

Table 2

*Scores for tricky questions*

	Frequency	Percent
0	2	2.5
1	11	13.8
2	11	13.8
3	16	20.0
4	18	22.5
5	8	10.0
6	7	8.8
7	4	5.0
8	3	3.8
Total	80	100

Table 3

*Total Number of Questions Changed*

	Frequency	Percent
0	24	30.0
1	20	24.0
2	14	17.5
3	13	16.3
4	7	8.8
5	1	1.3
6	1	1.3
Total	80	100

## Appendix A

## 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!

## Appendix B

## 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?
- Skiing down a mountain
  - Shouting
  - Heavy wind
  - 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 pride
  - A meeting
  - An army
  - 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 1<sup>st</sup> president to live in the White house?
- 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?
- a. Tuff
  - b. Tiki
  - c. Moai
  - d. 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?

- a. President Teddy Roosevelt, who enjoyed hunting
- b. Young Ted, son of the teddy bear store's owner
- c. The name of the breed of small, gentle bears
- d. 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?

- a. Tallahassee
- b. Miami
- c. Orlando
- d. 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?

- Sit-ups
- Push-ups
- Rope climbing
- 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?

- Tsunami
- Swell
- Undercurrent
- 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 C

## Tricky vs Non-Tricky Question Type

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 D

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 E

## 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 F

## State Post Thinking Questionnaire

**Instructions: Rate your level of agreement with each of the following statements on a scale of 1 (Not at all like me) to 4 (Very much so like me). Please do not leave any items blank.**

	Not at All	Somewhat	Moderately so	Very Much So
I concentrated as hard as I could when taking the assessment.	1	2	3	4
I thought my score was bad, so everyone, including myself, would be disappointed.	1	2	3	4
I went over my answers.	1	2	3	4
I worked hard on the assessment even though it did not count.	1	2	3	4
I reworded the assessment problems so I could understand them better.	1	2	3	4
I judged the correctness of my work.	1	2	3	4
I put forth my best effort.	1	2	3	4
I thought through the meaning of the assessment problems before I began to answer them.	1	2	3	4
I felt regretful about my performance on the assessment.	1	2	3	4
I asked myself, how well was I doing, as I proceeded through the assessment.	1	2	3	4
On difficult problems, I spent more time trying to understand them.	1	2	3	4
I wasn't happy with my performance.	1	2	3	4
I corrected my errors.	1	2	3	4

	Not at All	Somewhat	Moderately so	Very Much So
I was concerned about what would happen if I did poorly.	1	2	3	4
As I did the assessment, I asked myself questions to stay on track.	1	2	3	4
I tried to do my best on the assessment.	1	2	3	4
I did not feel very confident about my performance on the assessment.	1	2	3	4
I did not give up, even if the assessment was hard.	1	2	3	4

## Appendix G

## Penn State Worry Questionnaire

**Instructions: Rate each of the following statements on a scale of 1 (“Not at All Typical of me”) to 5 (“Very Typical of me”). Please do not leave any items blank.**

	Not at All Typical of me					Very Typical of me				
If I do not have enough time to do everything, I do not worry about it.	1	2	3	4	5					
My worries overwhelm me.	1	2	3	4	5					
I do not tend to worry about things.	1	2	3	4	5					
Many situations make me worry.	1	2	3	4	5					
I know I should not worry about things, but I just cannot help it.	1	2	3	4	5					
When I am under pressure I worry a lot.	1	2	3	4	5					
I am always worrying about something.	1	2	3	4	5					
I find it easy to dismiss worrisome thoughts.	1	2	3	4	5					
As soon as I finish one task, I start to worry about everything else I have to do.	1	2	3	4	5					
I never worry about anything.	1	2	3	4	5					
When there is nothing more I can do about a concern, I do not worry about it anymore.	1	2	3	4	5					
I have been a worrier all my life.	1	2	3	4	5					
I notice that I have been worrying about things.	1	2	3	4	5					
Once I start worrying, I cannot stop.	1	2	3	4	5					
I worry all the time.	1	2	3	4	5					
I worry about projects until they are all done.	1	2	3	4	5					

Appendix H  
Demographics Questionnaire

**Instructions: Fill out the following questions to the best of your ability. Please do not leave any blank.**

Age: \_\_\_\_\_

Gender (Please circle one):

Male      Female      Other

Year in school: \_\_\_\_\_ (e.g. Freshmen, Junior)

Major: \_\_\_\_\_

Cumulative Brockport GPA: \_\_\_\_\_ (if available)