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# THE EFFECT OF A BRIEF YOGA PRACTICE ON LEARNING

by

Brittany Nicolette Ballard

A Thesis

Submitted to the  
Department of Educational Services and Leadership  
College of Education  
In partial fulfillment of the requirement  
For the degree of  
Master of Arts in School Psychology  
at  
Rowan University  
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Thesis Chair: Terri Allen, Ph.D.

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## **Dedications**

I would like to dedicate this manuscript to my parents, Tom and Kim Ballard, and Will McNally, my biggest fans and supporters. Thank you.

## Acknowledgements

I would first like to express my appreciation to Dr. Terri Allen and Dr. Roberta Dihoff for their guidance during my research. I would also like to thank all of my family and friends who encouraged and supported me during one of the most exciting and important times of my life.

## Abstract

Brittany Nicolette Ballard

THE EFFECT OF A BRIEF YOGA PRACTICE ON LEARNING

2015-2016

Terri Allen, Ph.D.

Master of Arts in School Psychology

The purpose of this study was to explore whether yoga practice facilitates learning. Specific aims of the study were to compare student performance on a basic learning task following either a relaxing task, i.e. yoga, or a more stressful activity. The subjects that volunteered for this study will completed a brief learning task pre-test. Subjects were split into two separate intervention groups at random. One group completed a beginner's yoga task while the other group viewed a more exciting, stimulating video clip from a game show. After both groups completed their intervention task, they completed a brief learning task post-test. The results were collected and compared using a mixed between-within subjects ANOVA to look at the score differences between the two intervention groups. There was no significant interaction between condition type and time period. Furthermore, there was a significant main effect for time with both groups showing a decrease in quantitative reasoning scores, however, the main effect comparing the two types of intervention conditions was not significant.

## Table of Contents

Abstract.....	v
List of Figures.....	viii
List of Tables.....	ix
Chapter 1: Introduction.....	1
Need for Study.....	1
Purpose.....	1
Hypothesis.....	1
Operational Definitions.....	1
Assumptions.....	1
Limitations.....	2
Summary.....	2
Chapter 2: Literature Review.....	3
Introduction.....	3
Benefits of Yoga.....	4
Yoga and Learning – Cognitive Function.....	5
The Benefits of Yoga in Gym Class.....	7
Yoga and the Benefits for Athletes.....	8
Yoga and the Impact on Behavior and Attention.....	10
Yoga and Learning Disabled Children.....	11
The Overstimulating Environment.....	12
Yoga and the Overstimulating Environment.....	13
Chapter 3: Methodology.....	16

## Table of Contents (Continued)

Participants.....	16
Materials .....	16
Procedure .....	16
Design .....	17
Chapter 4: Results.....	18
Chapter 5: Discussion.....	20
Summary .....	20
Implications.....	20
Limitations .....	21
Future Direction .....	22
References.....	23
Appendices.....	31
Appendix A: Rowan Subject Pool Consent Form .....	31
Appendix B: Pre-Test .....	37
Appendix C: Post-Test .....	53
Appendix D: YouTube Videos .....	69

## List of Figures

Figure	Page
Figure 1. Difference in Mean Test Scores Between Intervention Groups .....	19

## List of Tables

Table	Page
Table 1. Comparison of Mean Test Scores Between Groups .....	19

## Chapter 1

### Introduction

#### Need for Study

The need for study was to investigate whether a yoga activity facilitates learning and to explore possible implications for the classroom.

#### Purpose

The purpose of this study was to explore whether yoga practice facilitates learners. Specific aims of the study were to compare student performance on a basic learning task following either a relaxing task, i.e. yoga, or a more mind stimulating activity.

#### Hypothesis

It was hypothesized that the brief yoga practice would facilitate specific learning. Following a pre-test, students who completed a brief yoga practice compared to students who participated in a more stimulating activity would demonstrate improvement in a post-test learning activity.

#### Operational Definitions

Yoga - “a system of mental and physical practices for health and well-being” (Fouladbakhsh, 2011).

#### Assumptions

Yoga practice would allow students to be better learners and achieve higher scores than students who participated in more stress related activities.

## **Limitations**

There were some limitations in this study. The Rowan subject pool was used to gather volunteers, so the sample size was smaller. A smaller sample size could result in data that may not be as accurate compared to a larger sample size.

## **Summary**

Yoga is defined as “an ancient tradition that originated approximately 5,000 years ago in Central Asia, is a complete system of mental and physical practices for health and well-being” (Fouladbakhsh, 2011). While there is much research on the positive effects of yoga for an individual’s physical and mental health, there are fewer studies that show the positive effects that the practice can have when it comes to learning (Ross, Bevans, Friedmann, Williams, Thomas, 2013). Fouladbakhsh (2011) says “research into yoga has only been conducted for the past several decades”. “Yoga based intervention appears to have a beneficial effect on cognitive functions like delayed recall of verbal and visual memory, attention, executive function and psychomotor speed when practiced for 6 months” (Hariprasad et al., 2013). Furthermore, Beets and Mitchell (2010) state that they “found yoga to be beneficial in reducing adolescents’ acute perceptions of stress”. The purpose of this study is to investigate whether yoga practice versus a more stressful or stimulating activity truly has an impact on a student’s learning.

## Chapter 2

### Literature Review

#### Introduction

“Yoga is the cessation of compulsive functions of the mind so the seeker can stand in the true essence of their nature” (Fouladbakhsh, 2011, p. 40). According to Mosby's Dictionary of Medicine (2012), yoga is defined as “a discipline that focuses on the body's musculature, posture, breathing mechanisms, and consciousness. The goal of yoga is attainment of physical and mental well-being through mastery of the body, achieved through exercise, holding of postures, proper breathing, and meditation”. “The physical, mental, and emotional health benefits of yoga have been studied extensively over the past several decades” (Ross, Bevans, Friedmann, Williams & Thomas, 2013, p. 67). Although there are many findings and studies about the beginnings of yoga, most experts and researchers concur that yoga originated around the year 500 B.C. in India. Archaeologists came to this conclusion after digging up a 4,000 year old piece of pottery in India in the 1920's, which pictured a person in a yoga pose. This find would actually make the practice even older than predicted (Yoga's Origin, 1998). Starting around the 1990's, it has become a booming business that is bringing in millions of dollars in revenue all around the world (Singleton, 2010). There are many ways that people are getting involved with yoga, such as taking classes at the local gym, getting a membership at a professional yoga studio or even practicing in your living room by following along with an at-home video. The practice of yoga has drawn in many followers, and ultimately turned it into the \$27 billion dollar industry that it is today, because of the perceived mental and physical benefits of the practice (Gregiore, 2013).

## Benefits of Yoga

There are many reports of the physical and mental health benefits from yoga practice. Yoga is becoming a popular alternative to medications and therapies because of the lower cost and that anyone can practice it no matter their age, level of experience or income level. This also allows people to practice independently and take charge of their health on their own rather than be dependent on medicine, therapy or other medical related interventions (Diamond, 2012). Bethany-Bonura and Tenenbaum (2014) investigated the positive impacts from complementary and alternative medicines, also known as CAM, on people with a variety of health issues. “26.5% of respondents with depression, 18.5% with chronic pain, 18.0% with heart problems or chest pain, 13.3% with insomnia, and 12.1% with fatigue, used CAM therapies to manage symptoms” (p. 1334). Yoga has been used as an alternative to medicine to help people with cardiovascular diseases (Innes, Bourguignon & Taylor, 2005). It has also shown a decrease in the risk of metabolic syndrome and type 2 diabetes (Taylor, 2009), symptom improvement in cancer patients (Culos-Reed et al., 2012), improvements with rheumatoid arthritis symptoms and flare ups (Büssing, Ostermann, Lüdtker & Michalsen, 2012), asthma attack reduction and improved lung function (Posadzki & Ernst, 2011), physical symptoms from anxiety and learning anxiety control (Kirkwood, Rampes, Tuffrey, Richardson & Pilkington, 2005), and improvements of physical symptoms from post-traumatic stress disorder (Meyer et al., 2012).

Yoga has also been used to help reduce stress and anxiety (Smith, Hancock, Blake-Mortimer & Eckert, 2007). Bethany-Bonura and Tenenbaum (2014) found that

“34% of respondents with anxiety spectrum disorders reported used mind-body therapies in the management of their condition” (p. 1334). According to Hayes and Chase (2010):

Any number of daily stressors can activate the neurotransmitters norepinephrine, serotonin, gamma-aminobutyric acid (GABA), and cortisol, causing the pupils to dilate, the heart to beat faster and harder, sweating, increased blood pressure, and shunting of blood away from the abdominal organs to the large muscle groups.

During the stress response, white cells marginate, platelets aggregate, and stored energy sources are mobilized through activation of the sympathetic nervous system. (p. 38)

### **Yoga and Learning - Cognitive Function**

Practicing yoga may help individuals manage their daily stress. A study conducted on adolescents and yoga concluded that it “found yoga to be beneficial in reducing adolescents’ acute perceptions of stress, while simultaneously increasing measures of over- all HRQL and several sub-dimensions of HRQL (i.e., physical health, general feelings, and self-esteem)” (Beets & Mitchell, 2010, p. 51). Yoga practice seems to have a positive impact on cognitive functions in addition to the described physical and psychological benefits (Gothe & Mcauley, 2015). According to Hariprasad et al. (2013), “yoga based intervention appears to have a beneficial effect on cognitive functions like delayed recall of verbal and visual memory, attention, executive function and psychomotor speed when practiced for 6 months” (p. 362). Yoga practice has the potential to assist in improving cognitive functions in areas such as attention, processing speed, working memory, and executive functions and some studies show that there is a

bit of a gap between cognitive functions in individuals who do and do not practice yoga (Gothe & Mcauley, 2015).

The benefits of yoga in the classroom have been described in popular and professional articles. Teachers have anecdotally described the positive effect noticed on yoga within the classroom. For example, a 3rd grade teacher in Atlanta began integrating yoga practice into her classroom after she tirelessly struggled to instruct her students with attention and behavior issues. After she began to incorporate yoga instruction in class, she noticed a change in her students' performances in the classroom. She saw that her students were giving her more attention, were less distracted during lessons and instruction and began problem solving more independently. Students even began to request some time to take a deep breath before a test in order to gain their composure and focus on the tasks at hand (Williamson, 2013). Cotant (2009) also gives an example of a teacher who teaches yoga once a week at her middle school. She received a lot of positive feedback from other teachers about how calm and well behaved their students are in class after a brief yoga practice. Her students also had positive comments about doing yoga at school, such as that they enjoy the break from doing school work, they have an easier time staying focused in class and they worry much less compared to if they didn't do yoga that day. Furthermore, Bellhouse (2010) states to "picture a math or science class in the last period of the day. Students are often tired, hungry, and drained. An uplifting breathing exercise with some poses can help them to regain focus as the final bell approaches" (p. 42).

While there is much interest in the perceived benefits of yoga practice and the positive effects on stress, anxiety, cognition and focus, Gonzalez et al. (2010) say there

needs to be more in depth study. More volunteers that practice yoga on a regular basis are needed to get a true understanding on how much it truly works. Gonzalez, Hooper, Lee, and Lin (2010) state that their yoga group was small and they did not practice yoga long enough to see and feel the perceived benefits. Using a group of people who practice yoga regularly compared to a group who never practices yoga would give researches better results. Alternatively, research done by Harvard Health states that “the evidence is growing that yoga practice is a relatively low-risk, high-yield approach to improving overall health” (“Yoga for Anxiety and Depression”, 2009, para. 2). For example, Rocha et al. (2012) conclude that after 6 months of yoga practice, individuals who practiced yoga on a regular basis compared to a control group performed better on memory tasks. “After 6 months of practice, the yoga group performed significantly better in the easy context when compared to control group. In the difficult context, the difference between controls and yoga practitioners was marginally significant” (Rocha et al., 2012, p. 846). However, Rocha et al. (2012) states that there needs to be further research to understand how yoga practice can cause positive effects on cognition.

### **The Benefits of Yoga in Gym Class**

Stanec, Forneris, and Theuerkauf (2010) investigated the benefits of offering yoga as an alternative option in a school gym class. Students that choose the yoga activity appeared to have an easier time calming down after gym and returned to class more relaxed. When students practice yoga as a cool down exercise, not only do they have a chance to relax, but their brain can also relax and be prepared for the lectures and lessons in the next class. “The National Association for Sport and Physical Education's president, Fran Cleland, supports yoga in physical education classes as long as it's taught

appropriately. Yoga is an excellent movement form for balance, strength, coordination, flexibility, and overall body awareness” (Mikulski, 2009, para. 9). Furthermore, when practiced in a school gym class, it helps the students become more aware of their peers in a positive light. Yoga allows the students to connect in a new, positive way with classmates, which could lead to a more connected group of children (Yoga 4 Classrooms®, 2015). This was explained further in a study by Gillis (2012) that focused on a gym class yoga session in Nova Scotia. At the end of a yoga practice, all students will repeat the yoga term “Namaste” in unison. This gave the students time for positive reflection and the opportunity to positively connect with themselves and their peers. Jones (2010), in collaboration with The Wellness Initiative and Center for Policy Research, investigated yoga practices and high school students. Forty seven high school students from four different schools were surveyed after taking part in yoga sessions in school. “More than a third of the students reported improvement in how they felt about their body; their ability to concentrate; feeling good about themselves; feeling less stress” (Jones, 2010, para. 7).

### **Yoga and the Benefits for Athletes**

Hendricks (2013) says that yoga is becoming a very well-known practice for many school and professional teams and is a part of the daily workouts for many athletes in different kinds of sports. Athletes also state that they enjoy yoga as a part of their routine and the more that they work out and train, the more they want to practice yoga because of all the positive benefits they feel from it (“Extreme fitness launches a new group fitness class designed to give high performing athletes the benefits of yoga”, 2012). Furthermore, increasingly high school and college athletic teams are starting to

incorporate yoga into their everyday practice. Players state that they feel more focused, relaxed, more flexible and ready to play after a brief yoga warm up. Coaches and players note that there are fewer injuries after integrating yoga into their warm ups (McClatchy, 2008). There are more yoga practices being added and incorporated into the pre and post-game warm up and cool down exercises for high school students, college athletes and athletes on professional teams, such as the Philadelphia Eagles and the New York Giants. It is no longer uncommon to find that athletes are utilizing the physical benefits of yoga to help themselves become more limber and recover from sports related issues such as injuries, tightness and soreness (Hendricks, 2013). “All self-identified athletes found that yoga enhanced their performance. For example, yoga helped to loosen tight muscles, remove soreness, avoid injury, regulate respiration, and calm a fast heartbeat after exercise” (Conboy, Noggle, Frey, Kudesia & Khalsa, 2013, p. 173). It has been reported by many sports players that yoga makes them physically feel good. It is also helping them mentally stay clear and focused when game time comes. Doing deep breathing exercises before the big game begins, players report feeling in control of themselves and their mind and feel as if they are less likely to get angry, resulting in what they feel as a better personal performance (Hendricks, 2013). A basketball player interviewed about his love for yoga simply says "I got hooked on it because I never felt so good” (Niiler, 2013). In a 10 week study on the impact of yoga on athletes, Polsgrove, Eggleston & Lockyer (2016) found that “that the practice of yoga as part of traditional training methods enhances the components of fitness that are the essential components of sports performance. Thus, the practice of yoga may provide an additional training option to enhance performance (p. 33). In order to get the most accurate results, Polsgrove et al. (2016) also mention that

future studies on yoga and athletics should “explore the impact of yoga training on specific components of fitness in relation to sport specific tasks or compare group athletes from the same sport (p.33).

### **Yoga and the Impact on Behavior and Attention**

According to Butzer, Day, Potts, and Ryan (2015) after a yoga intervention with second and third grade students with disciplinary issues, “students in both grades demonstrated perceived improvements in creativity, ability to be in control of behavior, and ability to manage anger” (p. 46). Children diagnosed with Attention-Deficit Hyperactivity Disorder (ADHD) have shown positive results and improvements when practicing yoga according to Jensen and Kenny (2004). They tested boys between the ages of eight and thirteen diagnosed with ADHD, according to DSM-IV criteria, to determine whether yoga practice along with their medication could further improve their ADHD symptoms. The results show that the boys had a decrease in behaviors associated with inattention, impulsivity, restlessness and hyperactivity. These results were gathered by conducting a pre and post-test using the Connors’ Global Restless Impulsive Index sub scale after a 20 week yoga intervention that met once a week (2004). Non-traditional practices such as yoga and deep breathing exercises may be a good alternative or additional treatment for children with ASD or children who have other disabilities (Moss, 2003). Also, “Yoga may become a promising alternative or complement to behavioral and medical interventions that are commonly used for children with attention problems” (Peck, Kehle, Bray & Theodore, 2005, p. 422).

## **Yoga and Learning Disabled Children**

The benefits of yoga are not just limited to individuals with behavior and attention problems. There have been many studies done that show the positive effects of relaxation techniques, such as yoga, meditation and deep breathing, on children with disabilities related to hyperactivity and emotional problems (Zipkin, 1985). Betts and Betts (2006) examined children with Autism Spectrum Disorder and found that yoga can potentially benefit those with ASD. Yoga poses and breathing exercises may help with focus, attention and memory and can physically help their bodies increase muscle tone, improve balance and coordination. It also assists the child with becoming more self-aware and self-accepting of their bodies and has the potential to improve their self esteem academically and physically (Betts & Betts, 2006). Additionally, there are studies that show that they are also beneficial for children with cerebral palsy (Hughes & Davis, 1980), learning disabilities (Carter & Russell, 1980), and individuals with minor brain injuries (Carter & Synolds, 1974). For example, Hawkins, Stegall, Weber, and Ryan (2012) demonstrate how yoga practice can be beneficial for students who have learning disabilities. Not only does it give those individuals a greater chance of living a healthier life and possibly avoiding major health issues, such as obesity and cardiovascular diseases, it gives them the opportunity to socialize with other people. If those individuals are exposed to different people, it gives them the chance to be social and mingle with people whom they usually wouldn't come in contact with, whether they are learning disabled or not. Furthermore, yoga practice may help individuals with motor skill and performance problems. For learning disabled children, continued yoga practice can potentially improve the lacking skills through relaxation and concentration. Also, it is

believed that yoga may help motor skills and performance because of posture and positioning when completing and holding specific yoga poses, which improves hand-eye coordination (Telles, 1993). “Yoga being safe and devoid of side effects, has a distinct advantage over pharmacotherapy in terms of acceptability” (Rao, Varambally & Gangadhar, 2013, p. 149).

### **The Overstimulating Environment**

A stimulating environment is extremely important in order to become familiar with the world around us, but does an overstimulating environment make an impact on an individual (Geller, 2013)? According to Mosby’s Dictionary of Medicine, Nursing and Health Professions (2012), sensory overload is defined as a “condition in which an individual receives an excessive or intolerable amount of sensory stimuli, as in a busy hospital or clinic or an intensive care unit. The effects of sensory overload are similar to those of sensory deprivation” (para. 1). Because of technology people are multitasking more often. One of the most common examples is how many teenagers do homework, watch television, text and use social media outlet all at the same time. While these individuals may be getting their homework done and get good grades, how much of that material will be committed to memory when test time comes? Technology can become an issue when trying to focus on school work. It is everywhere and so easy to access that it is very easy to become distracted by it (Scherr, 2006). “The problem now is resisting the notion that technology is the answer to everything - it's clearly not” (Barseghian, 2012, p. 60) “Kids - all kids - don't use their imagination very often because they are so overly stimulated by other sources: cell phones, text messaging, computers. They are constantly engaged in some sort of system” (Palleschi, 2008, para. 21). “TV, cinematic and music

videos, computer and video games, the Internet, and the myriad forms of cyberspace communication are all major sources of childhood domestication” (Mercogliano, 2008, p. 121). A survey done on children comparing the amount of television watched compared to time spent reading concluded that they “watch an average of 1 hour 40 minutes of television or DVDs per day, compared to 29 minutes reading or being read to-despite doctor warnings against too much screen time” (The New Nation, 2014). Also, social media is also becoming a hot topic among children, adolescents and even adults. Many studies have been done recently that tell the negative effects of social media, such as fear of missing out, jealousy of others, and constantly trying to keep up with making their lives seem perfect online to their followers, which creates a lot of stress on a person (Trieste, 2015). “These technologies are said to takeover people’s lives, creating time and social pressures that put people at risk for the negative physical and psychological health effects that can result from stress” (Hampton, Rainie, Lu, Shin & Purcell, 2015, para. 1).

### **Yoga and the Overstimulating Environment**

“Wavering focus is one of the major causes for low productivity at the work place or low grades at school and college” (“Get Focus with Yoga”, N.D., para. 1). Swanepoel (2013) explains that her mother, a school principal, was concerned about the children who used public transportation to get to school every day. She noticed that the kids who used those modes of transportation were either exhausted and in a fog or totally wired and amped up when they arrived, which made it very difficult for them to focus in class on lessons and lectures. Swanepoel (2013) questions whether the overstimulating environment that these children were exposed to when taking public transportation to school had anything to do with their lack of attention and/or hyperactivity. One method

that she suggests to calm down overstimulated children is an exercise called Rise and Shine. This exercise calls for the child to stretch their arms out as far as they can while breathing in slowly, then bringing their arms back into their body and hugging themselves while breathing out slowly, like performed in a basic yoga practice.

Furthermore, Trantrina (2010), a yoga instructor since 2001, states that;

With our brains over-stimulated and our bodies more sedentary than ever, many of us suffer from the fatigue and imbalance that comes from chronic stress without sufficient recovery. A yoga practice is an excellent way to soothe nerves that are in a constant state of overdrive. Yoga can help give us the ability to live healthy amidst hectic schedules and bustling environments. Why does it seem that as technology evolves at such epic pace we have less and less time at our disposal? Now more than ever we need to slow down, quiet our minds, take a deep breath. (para.1)

“Subjects who took a single, 20-minute yoga session were significantly faster and more accurate on their tests than subjects who walked or jogged on a treadmill for 20 minutes” (“Doing yoga for 20 minutes boosts brain function: Study”, 2013, para. 3) This article’s validity is confirmed by the original study, which states “participation in a 20-minute yoga session resulted in superior cognitive performance compared with acute aerobic activity and baseline assessment” (Gothe, Pontifex, Hillman & McAuley, 2013, p. 494). Yoga is continuing to become a more mainstream technique used to help individuals improve their ability to concentrate (Hopkins, Perlman, Hechtman & Weiss, 1979), to relax (Angus, 1989) and may help students with test anxiety, which can help improve test scores (Klein, 1990). Yoga has the potential to help people take a break

from the over-stimulating environment and improve many aspects of not only their physical health, but their mental health as well (Griffin, 2013).

## Chapter 3

### Methodology

#### Participants

Freshman college students were contacted and asked for their participation in a graduate student's study. 36 students volunteered to take part in the study, 20 females and 16 males. There were no limitations to who could participate in this study, therefore no one who wished to participate was excluded.

#### Materials

The experiment required a pre-test and a post-test. Each test had a total of 15 questions comprised of quantitative reasoning problems. Answer sheets to the pre-test and post-test were used by the investigator to score the participant's answers. Two YouTube videos, both under 8 minutes each, were used. Only one video was shown per intervention group in the study.

#### Procedure

First, freshmen college students were contacted to gather volunteers for the study. Those who were interested signed up online and completed a consent form the day of the study. After giving consent, volunteers were randomly assigned an ID number, sent to a testing room and then completed a pre-test. The subjects were asked to write their randomly assigned ID number on the front page of the test before it was collected. After the pre-test was completed, the group of subjects were split in half and separated into two different rooms. One group watched an 8 minute YouTube clip from a game show and they were called the highly stimulated group. The other group completed an 8 minute YouTube yoga exercise and they were called the yoga group. When both groups finished

watching their YouTube videos, all the subjects came back to the testing room to complete a post-test. Again, the subjects were asked to write their ID number on the front page of the test before it was collected and the subjects were excused from the study by the investigator. Next, the investigator used the subjects' assigned ID numbers, which were written on the top of both tests, to match the pre-tests and post-tests. The answer keys were used to score both the pre-test and the post-test, then the scores of both tests were compared using a mixed between-within subjects ANOVA in SPSS.

### **Design**

The independent variables were the pre-test and post-test scores and the dependent variable was the type of intervention, which was either completing a yoga activity or watching a clip from a game show. The study used a mixed between-within subjects ANOVA to compare data sets between the yoga group and the highly stimulated group.

## Chapter 4

### Results

This study analyzed the relationship of pre-test and post-test scores between the yoga intervention group and the game show intervention group. It was hypothesized that a brief yoga practice would facilitate specific learning. Following a pre-test, students who completed a brief yoga practice were predicted to demonstrate greater improvement in a post learning activity than students who participated in a more stimulating activity.

A mixed between-within subjects analysis of variance was conducted to assess the impact of two different conditions (Yoga, Game Show) on participants' scores on quantitative reasoning questions, across two time periods (pre-test and post-test). There was no significant interaction between condition type and time, Wilks' Lambda = .994,  $F(1, 34) = .203$ ,  $p = .65$ , partial eta squared = .006. There was a significant main effect for time, Wilks' Lambda = .753,  $F(1,34) = 11.17$ ,  $p < .002$ , partial eta squared .247, with both groups showing a decrease in quantitative reasoning scores across the two time periods, pre-test and post-test (see Figure 1 and Table 1). The main effect comparing the two types of intervention conditions was not significant,  $F(1,34) = .071$ , partial eta squared = .09, suggesting no difference in the effect of the two conditions.

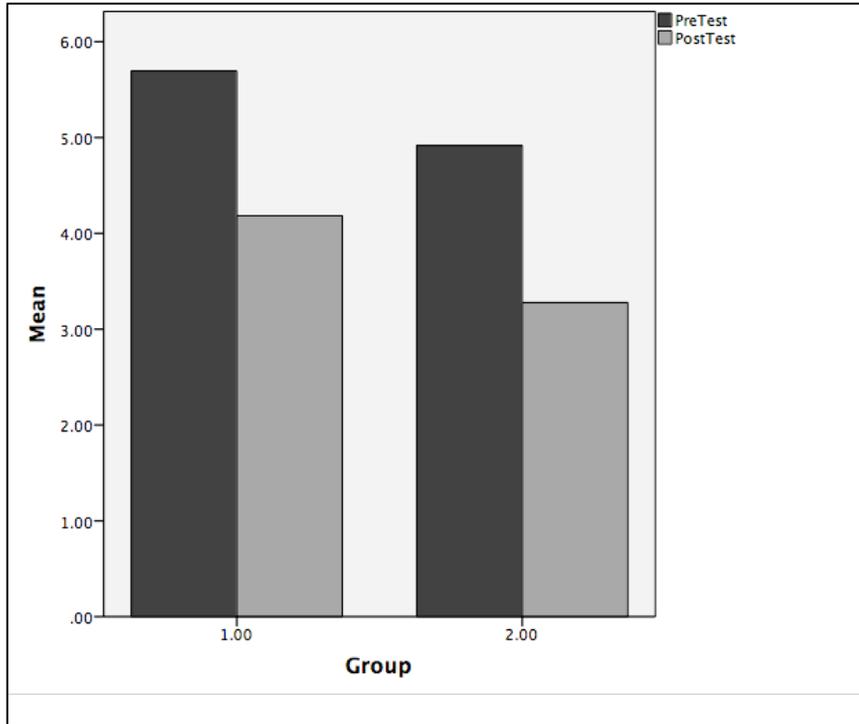


Figure 1. Difference in Mean Test Scores Between Intervention Groups

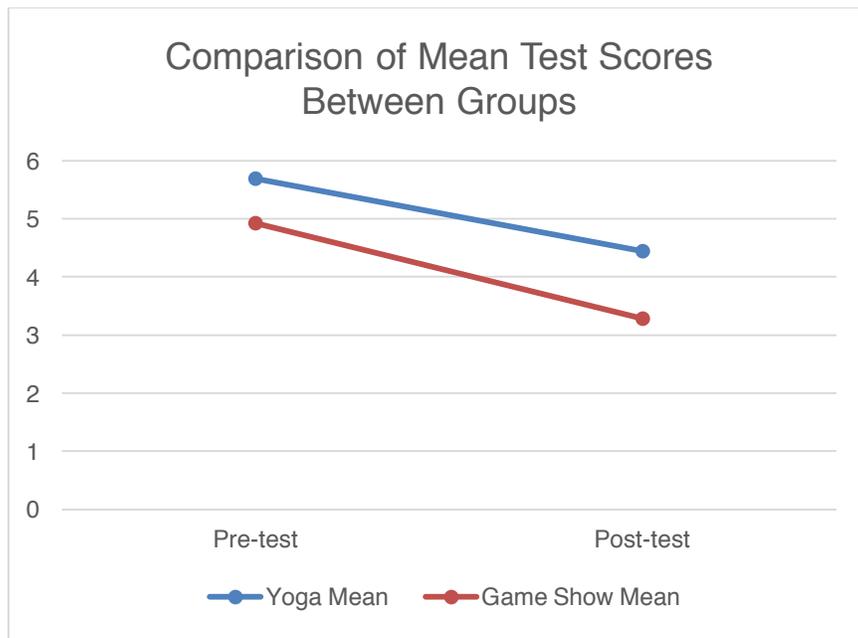


Table 1. Comparison of Mean Test Scores Between Groups

## Chapter 5

### Discussion

#### Summary

The purpose of this study was to determine whether a brief yoga practice would have a positive effect on learning. It was predicted that a more relaxing activity, such as yoga, would allow students to have a better academic performance compared to a more exciting, stimulating activity, such as watching a clip from a game show. During the study, volunteers completed a pre-test, participated in either a yoga or game show intervention, then completed a post-test. The scores were analyzed to see if there was any significance between pre-test and post test scores for both intervention groups. The results showed that there was no significant difference between the two intervention groups, but both intervention groups displayed a decrease in mean scores across both times periods.

#### Implications

The results of this study were not consistent with prior research because there was no significance between the condition type and the time period. Both groups displayed a decrease in quantitative reasoning scores, however, there was no significance when comparing the two intervention types. Gothe and Mcauley (2015) discuss how yoga could help improve cognitive function, such as attention, processing speed, working memory, and executive functions. It is possible that the yoga intervention group could have had a higher mean score because of improved overall cognitive functioning.

## Limitations

The small sample size was a limitation of this study. 36 participants were recruited for two groups of 18. Also, the groups were not representative of the population given they were chosen from a convenience sample of college students at a northeast public university. There were more female participants than male participants in this study. According to data collected by Niche (2016), there are 1,420 freshman enrolled at Rowan University, 829 (59%) males and 583 (41%) females. In this study, out of the 36 participants, 15 (42%) were male and 21(58%) were female. The statistics from this study are not representative of the university population statistics. Also, the study could have been affected by a number of confounding variables that could have compromised the fidelity and integrity of the testing periods. For example, during one testing period, a student arrived 15 minutes late. During another session, two students were talking to one another during testing. Finally, all of the testing groups had to be reminded to put away their laptops and cell phones. Some subjects still chose to use their electronic devices after they were prompted to put them away.

Next, the difficulty level of the pre and post-test materials chosen may have been a confounding variable. The questions were taken from a GRE practice exam (POWERPREP II, 2016), an exam which is taken as a requirement for entry to most graduate schools. “Across the nation, 42 percent of community college freshmen and 20 percent of freshmen in four-year institutions enroll in at least one remedial course” (Alliance for Excellent Education, 2006, para. 6). Since the subject pool used in this study includes only freshman students, there is a chance that they did not have the mathematical skill set required to answer questions at the post-undergraduate level.

Because of difficulty level of the questions, it is possible that the subjects felt the problems were too hard and they became discouraged, which lead to unanswered questions or guessing answers.

Finally, the choice of a quantitative reasoning task, although chosen because it measured not only known material but also fluid reasoning, may have been a factor. There were not enough subjects in the experiment to account for the random distribution of individual abilities on such a test. In other words, the group of students' abilities on quantitative reasoning may have been skewed towards one direction or another because the sample size was not large enough to account for variability. Another test, such as a paired associates test for memory or an object reasoning test for reasoning (Cambridge Brain Sciences, n.d.) could have been appropriate alternatives. For example, Rocha et al. (2012) noted that individuals who practiced yoga had improved scores on working memory tasks. Gothe, Pontifex, Hillman & McAuley, (2013) also mention that there was an improvement in cognitive performance after a brief yoga practice.

### **Future Direction**

For future study, a larger sample size that is representative of the population should be used. It would be assumed that demographics, such a gender and race, would be more accurately represented with a larger sample size. Also, choosing appropriate testing material for the selected sample group would decrease the probability of having a confounding variable. Finally, testing the subjects with working memory and reasoning tasks should be considered. They could be better testing alternatives for this study, especially if there is a smaller sample size.

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## Appendix A

### Rowan Subject Pool Consent Form



#### CONSENT TO TAKE PART IN A RESEARCH STUDY

**TITLE OF STUDY:** The Effect of a Brief Yoga Practice on Learning  
**Principal Investigator:** Terri Allen

This consent form is part of an informed consent process for a research study and it will provide information that will help you to decide whether you wish to volunteer for this research study. It will help you to understand what the study is about and what will happen in the course of the study.

If you have questions at any time during the research study, you should feel free to ask them and should expect to be given answers that you completely understand.

After all of your questions have been answered, if you still wish to take part in the study, you will be asked to sign this informed consent form.

The Principal Investigator or another member of the study team will also be asked to sign this informed consent. You will be given a copy of the signed consent form to keep.

You are not giving up any of your legal rights by volunteering for this research study or by signing this consent form.

#### **SPONSOR OF THE STUDY:**

The Principal Investigator/Rowan University is an investor in this company. The Principal Investigator and Rowan University are joint owners of the patent for device and stand to gain financially if the results of this research prove that this product/device helps the condition being studied.

#### **FINANCIAL INTERESTS:**

The Principal Investigator/Investigator/Rowan University is an investor in this company. The Principal Investigator(s). Investigator, and Rowan University are

joint owners of the patent for this device and stand to gain financially if the results of this Study prove that this device helps the condition being studied.

### **Why is this study being done?**

This study is being conducted for a Master's program requirement.

### **Why have you been asked to take part in this study?**

You are being asked to take part in the study since you are a part of the Rowan subject pool. There are no additional requirements to take part in the study and no one who wishes to participate will be turned away or rejected.

### **Who may take part in this study? And who may not?**

Everyone who wishes to participate in this study will be included. No one will be excluded from this study.

### **How many subjects will be enrolled in the study?**

Approximately 60 total subjects will be enrolled in this study.

### **How long will my participation in this study take?**

The study will take place over a one month period. As a participant, we ask you to spend one hour participating in this study.

### **Where will the study take place?**

You will be asked to come to Rowan University's Glassboro campus. You will be notified about the time and location where the study will take place when the information becomes available.

### **What will you be asked to do if you take part in this research study?**

You will be asked to come to Rowan's Glassboro campus at a specific building, date and time that will be announced at a later time. You will only be asked to participate in this study once for about an hour. You will first be asked to take a short learning task pre-test. Next, you will be in either one of two intervention groups. You will be selected for a group at random by using your confidential ID number assigned to you. After the intervention task, you will take a learning task post-test. When the post-test is completed, you will have completed the study and you will be dismissed.

**What are the risks and/or discomforts you might experience if you take part in this study?**

As with any physical activity, such as yoga, there is always the possibility of injury if performed inappropriately, incorrectly or too vigorously. You do not have to complete any poses that you do not feel comfortable with or feel are too difficult for you. It is also recommended that you wear comfortable clothing or workout attire, such as loose fitting tee shirts, sweatpants, yoga pants, sneakers, etc., prior to the beginning of the study. Wearing tight or uncomfortable clothing may make you feel uncomfortable, could cause you to not do the yoga poses correctly, or you could feel embarrassment if there were to be a wardrobe malfunction during the study. In addition, both the pre and post tests contain mathematical equations, which some may find stressful and cause anxiety.

**Are there any benefits for you if you choose to take part in this research study?**

The benefits of taking part in this study may be:

- Completion of a course requirement
- Continuation of yoga practice if you find it personally beneficial

However, it is possible that you might receive no direct personal benefit from taking part in this study. Your participation may help us understand which can benefit you directly, and may help other people to understand the benefits of yoga practice.

**What are your alternatives if you don't want to take part in this study?**

There are no alternative treatments available. Your alternative is not to take part in this study.

**How will you know if new information is learned that may affect whether you are willing to stay in this research study?**

During the course of the study, you will be updated about any new information that may affect whether you are willing to continue taking part in the study. If new information is learned that may affect you, you will be contacted.

**Will there be any cost to you to take part in this study?**

There will be no cost to take part in this study.

### **Will you be paid to take part in this study?**

You will not be paid for your participation in this research study.

### **How will information about you be kept private or confidential?**

All efforts will be made to keep your personal information in your research record confidential, but total confidentiality cannot be guaranteed. Your personal information may be given out, if required by law. Presentations and publications to the public and at scientific conferences and meetings will not use your name and other personal information. Each participant will be assigned an ID number for the study and no other personal information will be collected for study purposes. Electronic data will be stored in a secure folder on the investigator's personal computer, which is password locked, and paper data will be stored in a locked filing cabinet. The investigator will be the only person allowed access to information related to the study. When the study is complete, all information will continue to be stored in their secure locations, then deleted or destroyed after 6 years in order to protect the participants.

### **What will happen if you are injured during this study?**

If you are injured in this study and need treatment, contact the Wellness Center at 201 Mullica Hill Road, Glassboro, NJ 08028 or call (856) 256-4333 and seek treatment.

We will offer the care needed to treat injuries directly resulting from taking part in this study. Rowan University may bill your insurance company or other third parties, if appropriate, for the costs of the care you get for the injury. However, you may be responsible for some of those costs. Rowan University does not plan to pay you or provide compensation for the injury. You do not give up your legal rights by signing this form.

If at any time during your participation and conduct in the study you have been or are injured, you should communicate those injuries to the research staff present at the time of injury and to the Principal Investigator, whose name and contact information is on this consent form.

### **What will happen if you do not wish to take part in the study or if you later decide not to stay in the study?**

Participation in this study is voluntary. You may choose not to participate or you may change your mind at any time.

If you do not want to enter the study or decide to stop participating, your relationship with the study staff will not change, and you may do so without penalty and without loss of benefits to which you are otherwise entitled.

You may also withdraw your consent for the use of data already collected about you, but you must do this in writing to Terri Allen

If you decide to withdraw from the study for any reason, you may be asked to participate in one meeting with the Principal Investigator.

**Who can you call if you have any questions?**

If you have any questions about taking part in this study or if you feel you may have suffered a research related injury, you can call the study doctor:

Terri Allen  
College of Education  
856-256-4500 x3110

If you have any questions about your rights as a research subject, you can call or email:

Brittany Ballard  
ballardb7@students.rowan.edu  
609-364-1409

**What are your rights if you decide to take part in this research study?**

You have the right to ask questions about any part of the study at any time. You should not sign this form unless you have had a chance to ask questions and have been given answers to all of your questions.

---

**AGREEMENT TO PARTICIPATE**

I have read this entire form, or it has been read to me, and I believe that I understand what has been discussed. All of my questions about this form or this study have been answered.

Subject Name: \_\_\_\_\_

Subject Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**Signature of Investigator/Individual Obtaining Consent:**

To the best of my ability, I have explained and discussed the full contents of the study including all of the information contained in this consent form. All questions of the research subject and those of his/her parent or legal guardian have been accurately answered.

Investigator/Person Obtaining Consent: Brittany N. Ballard

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

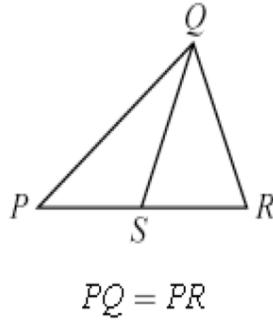
**Appendix B**

**Pre-Test**



**Pre-Test**

**Subject ID# \_\_\_\_\_**



Quantity A

$PS$

Quantity B

$SR$

- Quantity A is greater.
- Quantity B is greater.
- The two quantities are equal.
- The relationship cannot be determined from the information given.

If  $5x + 32 = 4 - 2x$ , what is the value of  $x$  ?

-4

-3

4

7

12

A car got 33 miles per gallon using gasoline that cost \$2.95 per gallon. Approximately what was the cost, in dollars, of the gasoline used in driving the car 350 miles?

- \$10
- \$20
- \$30
- \$40
- \$50

Which two of the following numbers have a product that is between  $-1$  and  $0$ ?

Indicate both of the numbers.

$-20$

$-10$

$2^{-4}$

$3^{-2}$

Which of the following integers are multiples of both 2 and 3 ?

Indicate all such integers.

8

9

12

18

21

36

One pen costs \$0.25 and one marker costs \$0.35. At those prices, what is the total cost of 18 pens and 100 markers?

\$

Rectangle  $R$  has length 30 and width 10, and square  $S$  has length 5. What is the ratio of the perimeter of  $S$  to the perimeter of  $R$ ?

Give your answer as a fraction.

$$\frac{\square}{\square}$$

A merchant made a profit of \$5 on the sale of a sweater that cost the merchant \$15. What is the profit expressed as a percent of the merchant's cost?

Give your answer to the nearest whole percent.

%

Questions 9- 11 are based on the following data.

ANNUAL PERCENT CHANGE IN DOLLAR AMOUNT OF SALES  
AT FIVE RETAIL STORES FROM 2006 TO 2008

Store	Percent Change	
	From 2006 to 2007	From 2007 to 2008
<i>P</i>	10	-10
<i>Q</i>	-20	9
<i>R</i>	5	12
<i>S</i>	-7	-15
<i>T</i>	17	-8

If the dollar amount of sales at Store *P* was \$800,000 for 2006, what was the dollar amount of sales at that store for 2008 ?

- \$727,200
- \$792,000
- \$800,000
- \$880,000
- \$968,000

Based on the information given, which of the following statements must be true?

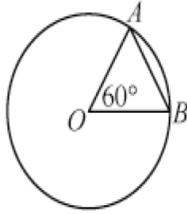
Indicate all such statements.

- For 2008 the dollar amount of sales at Store *R* was greater than that at each of the other four stores.
- The dollar amount of sales at Store *S* for 2008 was 22 percent less than that for 2006.
- The dollar amount of sales at Store *R* for 2008 was more than 17 percent greater than that for 2006.

At Store  $T$ , the dollar amount of sales for 2007 was what percent of the dollar amount of sales for 2008 ?

Give your answer to the nearest 0.1 percent.

%



$O$  is the center of the circle, and the perimeter of  $\triangle AOB$  is 6.

Quantity A

The circumference of the circle

Quantity B

12

- Quantity A is greater.
- Quantity B is greater.
- The two quantities are equal.
- The relationship cannot be determined from the information given.

A certain recipe requires  $\frac{3}{2}$  cups of sugar and makes 2 dozen cookies. (1 dozen = 12)

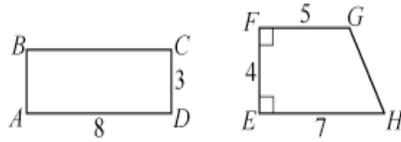
Quantity A

The amount of sugar required for the same recipe to make 30 cookies

Quantity B

2 cups

- Quantity A is greater.
- Quantity B is greater.
- The two quantities are equal.
- The relationship cannot be determined from the information given.



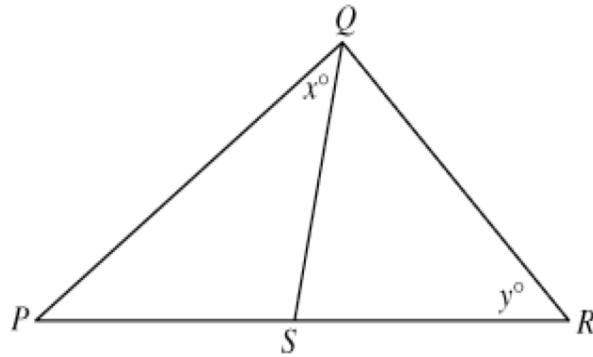
Quantity A

The area of rectangular region  $ABCD$

Quantity B

The area of trapezoidal region  $EFGH$

- Quantity A is greater.
- Quantity B is greater.
- The two quantities are equal.
- The relationship cannot be determined from the information given.



$$PS = SR$$

Quantity A

$x$

Quantity B

$y$

- Quantity A is greater.
- Quantity B is greater.
- The two quantities are equal.
- The relationship cannot be determined from the information given.

**Appendix C**

**Post-Test**



**Post-Test**

**Subject ID# \_\_\_\_\_**

$$6 < x < 7$$
$$y = 8$$

Quantity A

$$\frac{x}{y}$$

Quantity B

0.85

- Quantity A is greater.
- Quantity B is greater.
- The two quantities are equal.
- The relationship cannot be determined from the information given.

The average (arithmetic mean) of 100 measurements is 23, and the average of 50 additional measurements is 27.

<u>Quantity A</u>	<u>Quantity B</u>
The average of the 150 measurements	25

- Quantity A is greater.
- Quantity B is greater.
- The two quantities are equal.
- The relationship cannot be determined from the information given.

List  $L$  consists of the numbers  $1$ ,  $\sqrt{2}$ ,  $x$ , and  $x^2$ , where  $x > 0$ , and the range of the numbers in list  $L$  is  $4$ .

Quantity A

$x$

Quantity B

$2$

- Quantity A is greater.
- Quantity B is greater.
- The two quantities are equal.
- The relationship cannot be determined from the information given.

One of the roots of the equation  $x^2 + kx - 6 = 0$  is 3, and  $k$  is a constant.

Quantity A

The value of  $k$

Quantity B

-1

- Quantity A is greater.
- Quantity B is greater.
- The two quantities are equal.
- The relationship cannot be determined from the information given.

In the  $xy$ -plane, what is the slope of the line whose equation is  $3x - 2y = 8$  ?

- $-4$         $-\frac{8}{3}$         $\frac{2}{3}$         $\frac{3}{2}$         $2$

If  $p$  is a negative number and  $0 < s < |p|$ , which of the following must also be a negative number?

$(p + s)^2$

$(p - s)^2$

$(s - p)^2$

$p^2 - s^2$

$s^2 - p^2$

10, 10, 10, 10, 8, 8, 8, 8, 12, 12, 11,  $y$

The twelve numbers shown represent the ages, in years, of the twelve houses on a certain city block. What is the median age, in years, of the twelve houses on the block?

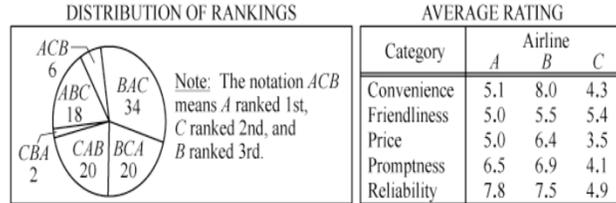
years

Of the 750 participants in a professional meeting, 450 are female and  $\frac{1}{2}$  of the female and  $\frac{1}{4}$  of the male participants are less than thirty years old. If one of the participants will be randomly selected to receive a prize, what is the probability that the person selected will be less than thirty years old?

- $\frac{1}{8}$
- $\frac{1}{3}$
- $\frac{3}{8}$
- $\frac{2}{5}$
- $\frac{3}{4}$

Questions 14 to 16 are based on the following data.

In a survey, 100 travel agents each ranked Airlines  $A$ ,  $B$ , and  $C$  in order of preference. Each of the 100 travel agents also rated the three airlines in five categories on a scale of 1 through 10, with 10 being the best rating.

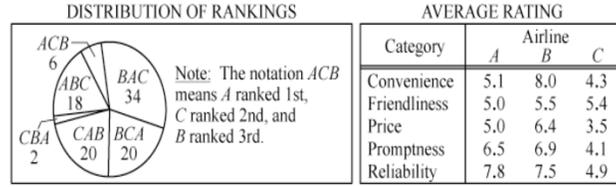


The sum of the five average ratings was calculated for each of the three airlines. The airline with the least sum was ranked 1st by what fraction of the travel agents?

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Questions 14 to 16 are based on the following data.

In a survey, 100 travel agents each ranked Airlines *A*, *B*, and *C* in order of preference. Each of the 100 travel agents also rated the three airlines in five categories on a scale of 1 through 10, with 10 being the best rating.

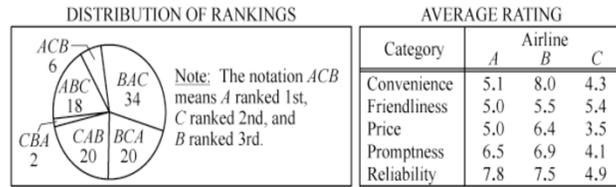


Airline *B*'s average rating for convenience was approximately what percent greater than Airline *A*'s average rating for convenience?

- 30%   
  36%   
  40%   
  57%   
  64%

Questions 14 to 16 are based on the following data.

In a survey, 100 travel agents each ranked Airlines *A*, *B*, and *C* in order of preference. Each of the 100 travel agents also rated the three airlines in five categories on a scale of 1 through 10, with 10 being the best rating.



If each of the average ratings was the arithmetic mean of the ratings given by the 100 travel agents, approximately how much greater was the total of the ratings given to all three airlines for reliability than that for promptness?

- 25   
 50   
 125   
 250   
 500

A developer has land that has  $x$  feet of lake frontage. The land is to be subdivided into lots, each of which is to have either 80 feet or 100 feet of lake frontage. If  $\frac{1}{9}$  of the lots are to have 80 feet of frontage each and the remaining 40 lots are to have 100 feet of frontage each, what is the value of  $x$  ?

- 400
- 3,200
- 3,700
- 4,400
- 4,760

If the diameter of circle  $C$  is 3 times the diameter of circle  $D$ , then the area of circle  $C$  is how many times the area of circle  $D$ ?

Last year Kate spent between  $\frac{1}{4}$  and  $\frac{1}{3}$  of her gross income on her mortgage payments. If Kate spent \$13,470 on her mortgage payments last year, which of the following could have been her gross income last year?

Indicate all such gross incomes.

\$40,200

\$43,350

\$47,256

\$51,996

\$53,808

The quantities  $S$  and  $T$  are positive and are related by the equation  $S = \frac{k}{T}$ , where  $k$  is a constant. If the value of  $S$  increases by 50 percent, then the value of  $T$  decreases by what percent?

25%

$33\frac{1}{3}\%$

50%

$66\frac{2}{3}\%$

75%

## Appendix D

### YouTube Videos

Basic Yoga Warmup – Sarah Beth Yoga

<https://youtu.be/ftLAgXeOJ8k>

Let's Make a Deal 09-30-2014 - Kerri Anne

[https://youtu.be/2ImCPjxTM\\_Y](https://youtu.be/2ImCPjxTM_Y)