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**Effects of Situational Attributions on Mental and Physical Fatigue**

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**Effects of Situational Attributions on Mental and Physical Fatigue**

A THESIS

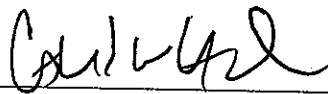
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## Abstract

Strength models of self-regulation assume that depletion of a limited cognitive resource may impair performance on subsequent tasks requiring that resource (Baumeister et al., 1999) but multiple resource models assume that external influences or cues (situational attributions) may help moderate performance (Clarkson et al., 2010). Resource attribution hypothesis predicts that people who are physically or emotionally fatigued (ego depleted) will still be able to self-regulate if they have useful situational attributions for their performance but strength models predict that situational attributions will not help self-regulation. 29 women from the UCO Track and Field team performed physical and mental tasks requiring physical and mental perseverance (e.g., completing a routine training session, letter elimination task, and anagram task); the dependent variable was duration of perseverance. Half received a situational attribution (placebo) and half did not. Results supported a multiple resource model (resource attribution hypothesis).

*Keyword:* ego depletion, fatigue, performance, resource attribution, situational attribution

## Effects of Situational Attributes on Mental and Physical Fatigue

I would not be just a nuffin'  
My head all full of stuffin'  
My heart all full of pain  
I would dance and be merry  
Life would be a ding-a-derry  
If I only had a brain  
*The Wizard of Oz* (1939)

“If I only had a brain”. The famous line sung by the Scarecrow character in the movie adaptation of the book, *The Wizard of Oz*, introduced viewers to the lovable, yet self-conscious Scarecrow. In the movie, *The Wizard of Oz*, main character Dorothy traveled from her Kansas home to a fictional land, Land of Oz, by an unexpected tornado. The Land of Oz is filled with talking, brainless scarecrows, heartless tin men, a cowardly lion, and other fictitious characters. However, Dorothy’s first companion throughout her journey of the Land of Oz was the Scarecrow. As viewers watched the Scarecrow descend from his post surrounded by sunflowers, viewers learned the Scarecrow’s heartfelt desire: to have a brain. The Scarecrow believes that he is unable to accomplish amazing feats or retain large quantities of knowledge due to not having a brain. However, further into the storyline, the Scarecrow countlessly helps Dorothy and the rest of the group evade the Wicked Witch of the West’s trickery. As the storyline concludes, viewers learn along with the Scarecrow that he did not need to have a metaphysical brain inside of his head. Instead, the Scarecrow possessed the intelligence and wit all along.

Although the fictional story, *The Wizard of Oz*, provides an adolescent example of human perseverance, the movie does not apply to realistic dilemmas. Specifically, the movie does not describe how Dorothy or the Scarecrow were able to travel throughout the vast Land of Oz without being fatigued. For instance, the only incidence of Dorothy and her fellow travelers sleeping is when the Wicked Witch of the West placed them under a spell. Also, the Scarecrow’s



ability to outwit the Wicked Witch of the West required mental and physical strength; normally both qualities could inhibit a person's performance. Fortunately, questions regarding human performance, fatigue, and attributions are addressed.

### **Mental Fatigue and Self-Regulation**

Human endurance upon mental tasks has sparked interest in self-regulation amongst individuals varying in age and skill. Self-regulation, the ability to exert control over one's self, has provided individuals answers about their intended behavior (Baumeister & Vohs, 2007). Researchers have questioned the positive and/or negative behaviors of individuals and how people are able to maintain those behaviors (Ross, Lepper, & Hubbard, 1975). Specifically, self-regulation has provided answers to how and why an individual controls and exerts willpower. For example, a recovering drug addict's ability to maintain sobriety or how a cigarette smoker abstains from cigarettes after deciding to quit requires an individual to be cognitively aware of their decisions and subsequent behavior. Effort to maintain and increase positive behaviors of those individuals requires both physical and mental strength (Muraven, Baumeister, Tice, 1999). Therefore, the Scarecrow from *The Wizard of Oz* might not have been able to outwit the Wicked Witch of the West as easily due to fatigue. However, previous research discusses how external factors, such as positive or negative comments, can have an influence in an individual's perception of their mental exhaustion level (Higgins, 1996).

Research has shown that an individual's ability to regulate their behavior may be based upon a mental source and can be depleted if an individual uses it completely (Doer & Baumeister, 2010). Essentially, research would suggest that if a person is faced with mentally exhausting tasks, then later task performance will suffer substantially (Scmeichel, Vohs, & Baumeister, 2003). Moreover, a limited strength model indicates that an individual's mental

strength is like a muscle; repetitive use of self-regulatory behavior exhausts the mental strength and leaves the 'muscle' weakened. Although an individual's mental state can be depleted through self-regulatory behavior, the mental state can be strengthened. A limited strength model provides answers about human performance, self-regulation, and how fatigue influences task performance. However, a person's ability to overcome the effects of mental fatigue have created flaws into the limited resource model. According to a limited resource model, a mentally fatigued individual's task performance should suffer, but inconsistencies have shown otherwise. For example, how do soldiers maintain concentration upon mentally taxing tasks when sleep deprived? How do student athletes complete pre-school and post-school practices and have energy to complete mental tasks? Although previous research suggests a limited strength model hypothesis, further research contradicts and suggests that an individual's mental state may be influenced by external factors. While previous research of self-regulatory behavior and its strength model process has provided answers, new research concerning cognitive depletion has emerged.

### **Situational Attributions and Mental Fatigue**

Current research by Clarkson et. al (2010) suggests that a person's state of mental capability may not necessarily be derived from a single mental resource. Instead, researchers hypothesized that individuals who are low in mental strength may be able to perform future tasks successfully after being subjected to mentally exhausting tasks. Additionally, researchers postulated that external suggestion can positively affect task performance when success at this exhaustion level is not expected. To test a multiple strength model theory, researchers required participants to engage in two cognitive tasks: a letter elimination task and an anagram task. The purpose of the letter elimination task was to induce mental fatigue. Situational attributes, or

external cues, along with mental fatigue served as the independent variables. Participants' persistence on the anagram task, measured in milliseconds, served as a behavioral dependent variable.

At the beginning of the study, participants were randomly assigned to either a low or high depletion condition. Depletion (high versus low) indicating the amount of effort required upon the mental tasks. In regards to depletion, researchers induced mental fatigue through a mentally fatiguing task known as a letter elimination task. Participants were given two tasks, labeled 'TASK 1' and 'TASK 2' within the letter elimination task. Both letter elimination tasks were printed on a faded piece of yellow paper. Additionally, the faded color of the paper required participants to exert more control so the task could be completed. Participants assigned to the low depletion condition were instructed to eliminate the letter 'e' from a provided text. The text contained an excerpt from a graduate statistics textbook. Upon completion of 'TASK 1', low depletion condition participants received 'TASK 2' with the same instructions. However, participants assigned to the high depletion condition received an additional stipulation.

Before onset of 'TASK 2', high depletion participants eliminated the letter 'e', but were also required to 'eliminate the letter 'e' except when another vowel follows the 'e' in the same word (e.g., 'read') or when a vowel is one letter removed from the 'e' in either direction (e.g., 'vowel'; Clarkson et. al, 2010). Following the letter elimination task, participants received a crucial situational attribution about their potential task performance upon the anagram task. Participants were assigned to receive feedback, or situational attribute, about the color of paper the letter elimination task was printed upon. Researchers wanted to follow previous misattribution research by using false information rather than true (Clarkson, 2010). Particularly, participants were given false information with false researchers. Participants were randomly

assigned to either receive a mentally replenishing (positive feedback), mentally depleting (negative feedback), or no attribution. Mental fatigue and situational attribution effectiveness were assessed through a timed anagram task. Participants created as many non-repeating, three-letter English words as possible. Results showed a significant interaction between depletion and feedback. Results indicated that high depletion/depleted feedback conditions persisted significantly longer on the anagram task than non-depleted controls. Additionally, high depleted/depleted feedback persisted longer than non-depleted controls given replenished feedback. Essentially, results indicated that a mentally depleted person may misattribute the current state of depletion and persevere in high cognitive functioning.

Both limited and multiple strength models have provided answers about human perseverance and self-regulation when mental fatigue is present, yet, a crucial element has been ignored: physical fatigue. The combination of mental and physical fatigue plagues numerous individuals including athletes, armed forces, full-time employed workers, and students (Kirkendall, Junge, & Dvorak (2010); Lieberman et. al (2002); Ginnis & Bray (2010); & Wegner et. al (1990). Considering a misattribution theory, or multiple resource model, an individual may be able to perform later task performances successfully given a compelling situational attribution. For example, a construction worker who works full-time and is also a full-time college student. The worker endures a physically straining job consisting of physically fatiguing work objectives. Following his daytime shift, the worker is enrolled in nighttime classes to obtain a college degree. As required, the worker must complete assignments before his next scheduled class. The construction worker/student completes his assignments, but compromises the amount of rest he can receive before returning to work the next day.

Numerous people experience the dilemma of balancing work and school, but does performance in either area (e.g. work or school) suffer due to fatigue? How does the construction worker/student complete work and school objectives without his task performance suffering? What if the worker/student were given external information to overpower the effects of fatigue and delay a potential lapse in work performance? For example, what if a co-worker mentioned that drinking green tea before sleep will boost the worker's energy for both work and school.

Although the co-worker's suggestions may be false, the worker may consider the co-worker's suggestion to eliminate the effects of his fatigue. Essentially, the misattribution theory suggests that the construction worker/student will be able to delay fatigue and still perform successfully at work and school by receiving external information: consumption of green tea. External cues, whether true or false, may be exchanged between numerous types of individuals including co-worker to co-worker, professor to student, coach to athlete, etc. For example, Hampson et. al (2011) utilized the benefits of external information for performance regulation in fatigued athletes. Specifically, researchers were able to incorporate positive feedback to athletes regarding their physical performance. Also, athletes were able to monitor their level of fatigue without the help of external information for later physical trials (Hampson et. al, 2011).

In contrast, a limited resource model suggests that situational attributions will not have an effect upon task performance once an individual is both mentally and physically fatigued (Baumeister, 2002). For instance, the same construction worker/student will have a decrease in work performance the next day once the worker completed his school assignments. Specifically, the model is suggesting that regardless of the external information, whether positive or negative, work performance suffers based upon fatigue. Additionally, the worker/student would not be

able to suspend sleep with false information (Langer, 1975). Instead, the student would succumb to fatigue.

Although the model does not indicate a specific amount of time that is required to regain mental strength, the model does suggest that time is essential for the worker to compensate the effects of mental fatigue endured. Additionally, the combination of the construction worker's physically demanding job may have an effect upon his ability to perform subsequent tasks successfully (Converse & DeShon, 2009; Coyle 2009).

Further exploration of situational attributions should include mental and physical fatigue. Essentially, research concerning a limited strength and multiple strength model hypotheses have investigated self-regulation, but have not determined if situational attributions can override the combination of mental and physical fatigue. The incorporation of both positive and negative situational attributions with mental and physical fatigue will act as a catalyst concerning human strength and its' limitations.

### **Situational Attributions & Mental and Physical Fatigue**

Do situational attributions, or external cues, affect mental and physical fatigue? Specifically, can a situational attribute overpower a person's mental and physical fatigued state and supplement task performance? To answer this question, research concerning self-regulation and ego depletion must be discussed. Previous research has implicated that a person's mental state is based upon a strength model, such that a person's ability to execute complex cognitive functioning is like flexing a muscle (Baumeister et. al, 1999). When mentally weakened, subsequent task performance is lessened, but can be renewed with motivational influences and glucose (Gailliot et. al, 2007; Schmeichel & Baumeister, 2003). For example, annual state exams for post-secondary school children elicit mental fatigue due to duration and complexity of test.

However, students are supplemented with snacks, usually in the form of crackers and juice, to replenish the students' ability to persevere upon the exam. Additionally, self-regulatory behavior can be increased through routine exposure to ego depletive tasks (Higgins, 1996; Mayer & Gaschke, 1988; Muraven et al, 1999). Initial investigations of the limited strength model further supplement self-regulatory behavior and ego depletion (Stucke & Baumeister, 2006). Stucke & Baumeister (2006) further implemented the limitations of self-regulatory behavior by investigating the link between aggressive behavior and self-regulation, or control.

Although a limited strength model gives an impressive explanation for lessened task performance, the model fails to answer how external factors have an influence upon a person's cognitive state. While the previous research of self-regulatory behavior and its strength model process has provided answers, new research concerning cognitive depletion has emerged.

Current research by Clarkson et. al (2010) suggests that a person's state of mental capability may not necessarily be derived from a single mental resource. Instead, researchers hypothesized that individuals who are low in mental strength may be able to perform future tasks successfully after being subjected to mentally exhausting tasks. Additionally, researchers believed that external suggestion can positively affect task performance when the individual is believed to fail.

Although both models of strength have provided explanations about ego depletion and self-regulatory behavior, neither models have explained how physical fatigue affects cognitive performance. Additionally, neither models provide an answer to whether situational attributions can surpass both mental and physical fatigue. The proposed study is needed to answer which strength model should be supported and potential effects of situational attributions when mental and physical fatigue are present.

A limited resource model and multiple resource models are competing theories for mental and physical fatigue affecting self-regulation. Although both models are theoretically impressive, a limited resource model provides substantial support for how mental fatigue creates a deficiency in individuals towards later task performance. (Baumeister, Bratslavsky, Muravan, Tice; 1999; Doerr & Baumeister, 2010; Vohs et. al (2008). However, there are inconsistencies within the model that should be addressed. How are people able to successfully persist upon mentally exhausting tasks when expected to disappoint? A limited resource model fails to explain how individuals are able to persist. Yet, multiple resource models are unable to deny the overpowering effects of fatigue (Clarkson et. al (2010); Hubbard, (1984); Tice & Baumeister, (1990). Researcher hypothesizes that a limited resource model will be supported rather than a multiple resource model. The purpose of this study is to investigate the dynamics of situational attributions when both mental and physical fatigue are present.

### **Method**

#### **Participants**

29 women from the University of Central Oklahoma's Track & Field team participated in this study to enter a drawing to win a \$50 prepaid VISA credit card. Participants varied in height (4'10 to 5'10), age (18-23 years old), and athletic background. All participants met National Collegiate Athletic Association (NCAA) guidelines. Additionally, all participants were deemed suitable, or healthy, as indicated by a routine, medical physical taken as a requirement for team membership. Finally, all participants held a 2.5 grade point average or higher as a requirement for team membership.

#### **Materials**



Two *New Balance Trainer* stopwatches were used to record participants' response time upon the anagram task. Both stopwatches feature a resolution of 1/100 second for accurately measuring elapsed time and splits. Additionally, both stopwatches were equipped with alarms for monitoring amount of time elapsed between tasks. Each stopwatch's dimensions were 3.0' height (H) x 0.5 width (W) x 2.0' length (L) and weighed 1.6 pounds (lb). Participants received three packets labeled 'TASK 1', 'TASK 2', and 'TASK 3' (see Appendices A-F). 'TASK 1' and 'TASK 2' were used to elicit mental fatigue while 'TASK 3' (see Appendix G) was used to assess persistence upon a multiple-solution anagram.

### **Procedure**

Participants were tested at two practice locations. The first location was a local high school track. The second location was the upper level of the basketball court at the University of Central Oklahoma. Before commencement of study, participants were notified of the purpose of the study and informed that non-participation would not elicit penalization from researcher, coach, or coaching staff via email. Participants at the high school track were assigned to exercise (experimental group) condition; other half were assigned to not exercise (control group).

First, participants engaged in medium to high intensity exercise ranging from 45 minutes to 1 1/2 hours as part of a regular track practice. Exercises varied amongst participants (long distance, middle distance, sprints, pole vault, hurdles, and throwers). Due to position upon team, participants assigned to exercise induced fatigue through long distance (5000 meters), middle distance (800-3000 meters), and sprints (60-400 meters) running. Additionally, hurdle runners completed 60-400 meter hurdle jumps. Finally, throwers completed various rounds of shot put throws.

Following each participants' exercise, participants verbally confirmed willingness to participate in study. Upon receiving verbal approval, participants received an informed consent form and allowed to read silently along as researcher read aloud. Upon signature of informed consent form, participants completed a demographic questionnaire. After completion of demographic questionnaire, participants were informed that two mental tasks would begin: letter elimination task and anagram task. Participants sat in one of three groups on the track field's grass. Assignment of participants' group assignment was determined by which type of feedback each participant received: replenished, none (control), or depleted.

Before commencement of the first mental task, letter elimination task, participants received a packet labeled 'TASK 1' (see Appendix A) along with a pencil. The packet consisted of an excerpt from a graduate-level statistics textbook copied onto light yellow paper. Following a brief explanation of instructions, participants began the first task. Participants crossed out the letter 'e' within the text excerpt.

Upon completion of 'TASK 1', all participants received a second packet labeled 'TASK 2' (see Appendix B). Again, participants received an excerpt from a graduate-level statistics textbook, different from 'TASK 1'. Additionally, participants received additional instructions to the letter elimination task. In Task 2, participants crossed out the letter 'e' located in the passage unless another vowel followed the 'e' in the same word (e.g., 'read') or a vowel was one letter removed from 'e' in either direction (e.g., 'vowel'). The purpose of the letter elimination task was to elicit mental fatigue as done in previous depletion research (Baumeister et. al, 1999).

Following the letter elimination task, participants in the replenished and depleted feedback conditions received a sheet containing false feedback regarding the color tone the letter elimination tasks were printed upon (see Appendix C & D). In the replenished feedback

condition, participants received information that the color tone was evidenced to replenish thinking abilities. In the depleted condition participants received information that the color tone was evidenced to... Additionally, participants either received information that the color tone is shown to either mentally replenish or mentally exhaust thinking abilities. Upon receiving either replenished, none, or depleted feedback, participants completed the final task of the study: a timed anagram task.

Participants received a final packet labeled 'TASK 3' (see Appendix E). Participants read instructions silently as researcher read instructions aloud. Additionally, participants received a stopwatch and instructed to hold the stopwatch in non-writing hand. Participants watched a brief demonstration by the researcher demonstrating how to operate the stopwatch. Next, participants were encouraged to take as much time as needed on the anagram task, but instructed to hit the 'start' and 'stop' button upon completion of the anagram task. Following completion of the anagram task, participants' response time was recorded on the 'TASK 3' packet in milliseconds by researcher. Participants in the exercise condition were debriefed about the true nature of the study after completing the final task. Next, participants were asked not to discuss the purpose of the study. Participants were thanked for their time and participation in the study.

Participants in the second practice location were recruited via email as track location participants. Participants were randomly assigned into one of the three feedback conditions at the basketball court in the University of Central Oklahoma's Hamilton Field House. Specifically, participants completed tasks seated on the bleachers; yet separated by feedback manipulation group. Due to scheduling conflicts, all members of team were not able to attend scheduled team practice. However, all team members were required to attend a mandatory team meeting after practice. Remaining members who did not attend practice were told purpose of the study and

informed that non-participation would not result in penalization from researcher, coach, or coaching staff.

Participants who did not exercise (control condition) completed both letter elimination tasks and anagram task. However, participants were randomly assigned and seated in groups based upon which feedback ( or none) participants were to receive. Upon completion of both tasks, letter elimination and anagram, participants were debriefed about the true nature of the study. Additionally, participants were thanked for their time and participation in the study.

## Results

### Data Analysis

The inputs to the data analysis were persistence upon the anagram task in seconds (s) following either exercise (experimental condition) or no exercise (control condition). A factorial mixed Analysis of Variance (ANOVA) was conducted to measure response time differences amongst both experimental and control conditions.

Initial data was subjected to a histogram graph to determine distribution of data. Due to skewness of persistence data, a square root transformation was conducted following submission to a factorial mixed ANOVA. Transformed means, from milliseconds to seconds, are presented in Table 1.

Table 1: *Persistence on the Multiple-Solution Anagram as a Function of Fatigue and Situational Feedback*

Mean Scores	Exercise	No Exercise
replenished	720.48	171.75
control	286.88	148.20
depleted	321.72	225.60

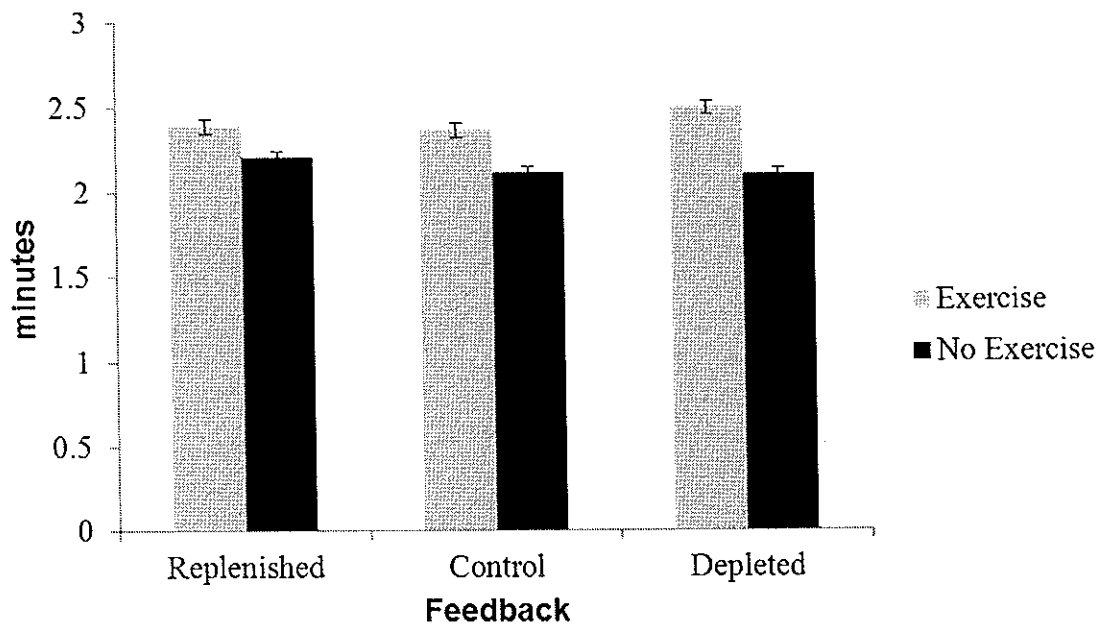
*Note: Data are measured in seconds.*

Upon completion of square root transformation, persistence data required winsorization. Winsorising describes the transformation of statistics in limiting extreme values to reduce deceptive outliers (Field, 2008). In such case, participants' mean scores originally measured in milliseconds were transformed to minutes. Initially, winsorization of data occurred at both 10-

20%, yet power was reduced. Finally, experimental and control conditions were subjected to a log analysis to correct skewness and increase original power detected in initial data analysis.

Persistence scores were submitted to a mixed factorial ANOVA with fatigue (exercise vs. no exercise) and feedback (replenished vs. none vs. depleted) as the independent variables; participants' response time in seconds (s) as the dependent variable. Individuals in the exercise/depleted condition persisted longer ( $M = 2.51, SD = 0.02$ ) as opposed to exercise/control ( $M = 2.37, SD = 0.26$ ) or exercise/replenished ( $M = 2.39, SD = 0.34$ ). Individuals in the no exercise/replenished condition persisted longer ( $M = 2.21, SD = 0.02$ ) as opposed to no exercise/control ( $M = 2.12, SD = 0.23$ ) and no exercise/depleted ( $M = 2.11, SD = 0.08$ ). Overall, individuals who received replenished feedback persisted longer ( $M = 2.25, SD = 0.028$ ) as opposed to no feedback ( $M = 2.25, SD = 0.26$ ) and depleted feedback ( $M = 2.31, SD = 0.22$ ).

Transformed means, from seconds to minutes, are presented in Figure 1.



*Figure 1.* Transformed means of persistence on the multiple-solution anagram as a function of fatigue and situational feedback. This figure illustrates exercise/depleted condition persisted longer upon the anagram task than other conditions.

A significant main effect amongst individuals who exercised when compared to those who did not (no exercise condition),  $F(1,15) = 11.927, p < .002$ . A Bonferroni post hoc test revealed that participants assigned to the exercise condition response times were significantly shorter than non-exercise condition. There was a non-significant main effect of replenished feedback on fatigued individuals,  $F(1,14) = 2.03, p = .341$ . Additionally, there was not a significant interaction between type of feedback and fatigue,  $F(2, 28) = .650, p < .005$ . This indicates that feedback did not have an effect upon individuals who are fatigued when compared to the non-exercise condition.

### Discussion

Results suggest the importance of fatigue upon task persistence, particularly with external cues, or situational attributions, involved. Participants assigned to exercise response times were significantly shorter than those who did not exercise; regardless of receiving positive, none, or negative feedback. The study suggests that a limited resource hypothesis should be supported. Yet, surprising results concerning fatigued individuals who received negative feedback. Specifically, results indicate the unimportance of attributions upon mental and physical fatigue. Although a multiple resource model would provide a simpler solution concerning self-regulation, a limited resource model requires more extensive research and answers to find a solution. However, errors within the current must be discussed before further research can continue.

Within experimental studies, limitations can have an effect upon results obtained. Current study had limitations that limited expected results and hindered further support for a limited resource hypothesis. Due to site locations, participants were not able to be separated from other teammates by partitions or other devices. Instead, participants were aware of other teammates presence which could have interfered with task persistence. Participants may have been aware of fellow teammate(s) duration, or task persistence, upon the anagram and refused to cease creating words. According to Hampson et. al (2011), in-group competition may have played a critical role into participants' persistence upon the anagram task. Furthermore, in-group competition jeopardized expected results and resulted into partial support of study's hypothesis. Further analysis of possible three letter long, non-repeating English words showed only a combination of four words total. However, analysis of various participants' list of created words showed long lists of nonsense words. Hence, participants' persistence on the anagram task seemed to be externally motivated by in-group competition. Furthermore, another limitation is the amount of participants recruited. Stronger support for a multiple resource model, or resource attribution hypothesis, requires 20-25 participants are assigned to all conditions within the study. Additional recruitment through larger databases or athletic teams could allow for the required number of participants to achieve desired results. Variation in participants (e.g., sex, age, ethnicity, overall health) could yield different results and possibly gravitate stronger support towards study's original hypothesis.

Overall results weakly suggest support for a multiple resource model, resource attribution hypothesis, due to slight differences amongst those who exercised and those who did not. Unfortunately, study's original hypothesis could have provided insight into how numerous individuals are affected by fatigue. Specifically, members of armed forces, Air Force pilots, are



subjected to long durations of fatigue (Lieberman et. al, 2002). Training techniques that induce fatigue are essential for pilots to overcome to be better prepared in hostile situations. Moreover, stronger support for a limited resource model could have indicated the ineffectiveness of attributions when mental and physical fatigue are present.

Surprising results produced by current study can provide a stepping stone towards replicating the study with additional stipulations. First, determining participants' level of fatigue, both physically and mentally, requires a reliable physiological or behavioral measurement. Previous ego depletion studies have provided reliable behavioral measures via task persistence (Baumeister et. al, 1999; Muraven & Slessanova, 2003), manipulation checks are essential to determine individuals' perceived level of fatigue. In regards to physical fatigue, heart rate monitors can be used to assess individuals' resting heart rate and heart rate once physical exertion is exhibited (Miller, 2011).

Additionally, time and location of athletes training sessions will vary amongst each team. Variations of times and locations can have an effect upon the study and lessens the researcher's controlled environment. Additionally, further research of the current study should require an assessment of each participant's prior food consumption. Various glucose levels could have an effect upon participant's motivation and energy level to perform upon cognitive tasks. Generally, the study should include participants who are more representative of the entire population. The anticipated results are not just limited to athletes; instead, are intended for individuals who are subjected to routine cases of mental and physical fatigue. Although limitations are present within the current study, future research could yield further support for the self-regulation field.

Ego depletion and self-regulation could substantially affect and provide answers for various individuals. For example, individuals who must engage in mentally and physically exhausting tasks on a daily basis could learn to assess their mental strength and determine when conservation is essential. Particularly, military soldiers in combat are faced with tasks that require both mental and physical strength daily and may benefit from the current study. Also, the current study may benefit other individuals who are abstaining from negative behaviors such as illicit drug use. Ultimately, research anticipates a further contribution to the field of self-regulation and expansion into whether situational attributions affect self-regulation when mental and physical fatigue are present.

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## Appendix A

Instructions for all participants on first task of letter elimination task.

You have been provided a packet. Inside that packet is a sheet of paper labeled 'TASK 1.' Starting at the beginning, your task is to cross out every 'e' you can locate in the text on the sheet. When you come across an 'e', simply draw a line through it. You will have five minutes to work on this task, and you will be judged on accuracy and completeness.

## Appendix B

## 70 Chapter 3 Sampling Distributions and Hypothesis Testing

importance. (Maybe the person is one of those annoying, fidgety types who spends his time tapping on everything in sight and therefore taps rapidly because he has had an unusual amount of practice.) In many other situations, however, we do not know which tail of the distribution is important (or we know that both are), and we need to guard against extremes in either tail. This situation might arise when we are considering a campaign to persuade children to brush their teeth more often by telling them to do so. We might find that the campaign led to an increase in the desired behavior. On the other hand, we might find that kids hate to be told to brush their teeth and therefore brush even less frequently just to spite us. In either case, we would want to reject  $H_0$ .

In general, two-tailed tests are far more common than one-tailed tests. There are several reasons for this. First of all, the investigator may have no idea what the data will look like and therefore has to be prepared for any eventuality. Although this situation is rare, it does occur in some exploratory work.

Another common reason for preferring two-tailed tests is that the investigator is reasonably sure that the data will come out one way, but wishes to cover herself in the event that she is wrong. This type of situation arises more often than you might think. (Carefully formed hypotheses have an annoying habit of being phrased in the wrong direction, for reasons that seem so obvious after the event.) A frequent question that arises when the data may come out the other way around is, "Why not plan to run a one-tailed test and then, if the data come out the other way, just change your test to a two-tailed test?" If you start an experiment with the extreme 5 percent of the left tail as your rejection region, however, and then turn around and reject any outcome that happens to fall in the extreme 2.5 percent of the right tail, then you are really working at the 7.5 percent level. In this situation, you will reject 5 percent of the outcomes in one direction (assuming the data fall in the desired tail) and you also are willing to reject 2.5 percent of the outcomes in the other direction (when the data fall in the unexpected tail) There is no denying that  $5 + 2.5 = 7.5$ .

To put this another way, would you be willing to flip a coin for an ice-cream cone if the other person could call "heads" but reserve the right to switch to "tails" after he saw how the coin landed? Of course you wouldn't. This is why the choice between a one- and a two-tailed test is made before the data are collected. The only situation in which I would recommend a one-tailed test is one in which we have absolutely no interest in a result in the other tail of the distribution. "We" includes not only the experimenters, but anyone who might read the report of that study. Since there are very few cases in which you can assume that an extreme outcome in the "wrong" tail would be totally uninteresting, there are very few cases in which a one-tailed test makes sense.



## Appendix C

Instructions for all participants on second task of the letter elimination task.

Inside the provided packet is another sheet of paper labeled 'TASK 2.' Starting at the beginning, your task is to cross out every 'e' you can locate in the passage, except when another vowel follows the 'e' in the same word (e.g., 'read') or when a vowel is one letter removed from the 'e' in either direction (e.g., 'vowel'). When you come across an 'e' that does not fit these exceptions, simply draw a line through it. You will have five minutes to work on this task, and you will be judged on accuracy and completeness.

## Appendix D

## Section 7.2 Testing Hypotheses about Means-a Known 153

Note that the equation for  $z$  used here is of the same form as the earlier formula for  $z$ . The only differences are that  $X$  has been replaced by  $\bar{X}$  and  $a$  has been replaced by  $ax'$ . These differences occur because we now are dealing with a distribution of means, and thus the data points are now means and the standard deviation in question is now the standard error of the mean (the standard deviation of means). The formula for  $z$  continues to represent (1) a point on a distribution, minus (2) the mean of that distribution, all divided by (3) the standard deviation of the distribution.

Now, rather than being concerned specifically with the distribution of  $X$ , we have reexpressed the sample mean in terms of  $z$  scores and can answer the question with regard to the standard normal distribution. Note that to make use of the standard normal distribution (and later the  $t$  distribution) the distribution (in this case the distribution of the mean) is assumed to be normal. From Appendix  $z$ , we find that the probability of a  $z$  as large as  $+0.33$  is  $0.3707$ . Because we want a two-tailed test of  $H_0$ , we need to double the probability to obtain the probability of a deviation as large as  $0.33$  standard errors in *either direction* from the mean. This is  $2(0.3707) = 0.7414$ . Thus, with a two-tailed test (that statistics textbooks have a mean price that is different in *either direction* from that of general textbooks) at the  $0.05$  level of significance, we would not reject  $H_0$ , since the obtained probability is greater than  $0.05$ . We would conclude that we have no evidence that statistics textbooks are more or less expensive than other textbooks.

This example of textbook prices is useful for illustrating an important point about sampling. The sample used here was a random sample of those statistics texts that were found in a university bookstore. The population from which this sample was drawn is not, however, likely to be a random collection of available statistics texts. In particular, some books are so expensive that no reasonable instructor would choose them as texts. Thus, the mean of all statistics texts is likely to be somewhat larger than the mean of those stocked by a typical bookstore. Since our sample represents a random sample from a population of books actually stocked, our answer applies only to that population. Had our population been the prices of all statistics books, our answer might have been different.

The test of a sample mean that we used is predicated on the assumption that the distribution in Figure 7.3 is normally distributed, or at least that it is sufficiently normal that we will be only negligibly in error when we refer to the tables of the standard normal distribution. Many textbooks will state that we must assume that we are sampling from a normal population, but this is not strictly necessary in practical terms. What is necessary is to assume that the sampling distribution of the mean (Figure 7.3) is normal. This assumption can be satisfied in either of two ways: (1) if the population from which we sample is normal or (2) if our sample size is sufficiently large to

## Appendix E

Information participants assigned to depletion condition received.

The letter recognition task you just completed is adapted from a classic paper in cognitive psychology on perceptual accuracy (see Sharp & Hutchinson, 1974). For various reasons, these researchers used the specific color yellow as the background for their letter recognition task. In keeping to their original methods, we too have used the same color of paper...

Recent research in color perception (e.g., Rutherford et al., 2003) shows very clearly that this color tone can have *very negative effects* on people's mental abilities, in particular when this hue is used as a background—as it is in our letter recognition task. Specifically, this color tone has been shown to *exhaust and deplete* one's ability to attend to information. In short, research shows that using this color tone as a background mentally exhausts our abilities to think carefully. [emphasis added to indicate manipulated words]

## Appendix F

Information participants assigned to replenished condition received.

The letter recognition task you just completed is adapted from a classic paper in cognitive psychology on perceptual accuracy (see Sharp & Hutchinson, 1974). For various reasons, these researchers used the specific color yellow as the background for their letter recognition task. In keeping to their original methods, we too have used the same color of paper... Participants were then given feedback informing them of the effects of this color on people's mental abilities.

Recent research in color perception (e.g., Rutherford et al., 2003) shows very clearly that this color tone can have *very positive effects* on people's mental abilities, in particular when this hue is used as a background—as it is in our letter recognition task. Specifically, this color tone has been shown to *energize and replenish* one's ability to attend to information. In short, research shows that using this color tone as a background mentally replenishes our abilities to think carefully. [emphasis added to indicate manipulated words]

## Appendix G

## TASK 3

Inside the provided packet is a piece of paper with seven letters that you will use to complete an anagram task. Within this task, you will create as many words possible with the following letters:

U R A Q Z G V

Each word that you create must contain at least three letters and no words can be used twice. Additionally, you can create as many words as possible. There is no time limit for this task and please take as much time as needed to create words. You will be scored on how many correct words that you create.

Appendix H



New Balance Trainer stopwatch

UNIVERSITY OF CENTRAL OKLAHOMA

Edmond, Oklahoma

Jackson College of Graduate Studies

**Effects of Situational Attributions on Mental and Physical Fatigue**

A THESIS

SUBMITTED TO THE GRADUATE FACULTY

In partial fulfillment of the requirements

for the degree of

MASTER OF ARTS IN PSYCHOLOGY

By

Ashley House

Edmond, Oklahoma

2012