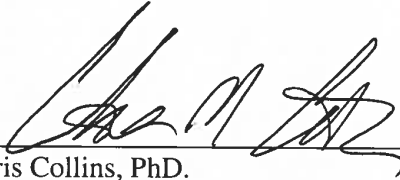


The Effect of Critical Thinking Induced by Reading Prior to Cognitive Testing

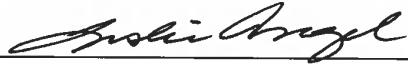
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This thesis by Rebecca Armstrong has been approved for honors recognition for the Department of Psychology.


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Abstract

Various aspects of individuals' lives have an impact on their cognitive functioning, which affects the scores that each person obtains during cognitive examination. Long-term conditions such as culture, age and location as well as shorter duration stimuli such as fatigue, familiarity and exercise have been shown to influence the outcome of cognitive testing. The current study examined the effect of critical and casual reading on the immediate verbal comprehension test scores of participants using questions from Graduate Record Examination (GRE) practice booklets. It was predicted that the practice GRE exam scores of the participants who were asked to concentrate on an excerpt to induce critical thinking were expected to be higher than those who were told to simply read through a less rigorous work. The scores of the control group were also expected to be significantly lower than those of the "reading" groups. Though results indicated that this hypothesis could not be supported by the data set, further research concerning the effects of reading in both clinical and nonclinical settings is advised.

Background

Psychological testing has revealed much about an individual's cognitive and neurological state. Throughout the years, psychologists have relied on cognitive examinations in order to help diagnose and determine the condition of various patients in clinical settings. In many cases, cognitive testing has provided information about what a patient is really dealing with and how their health care providers can better assist them when other forms of diagnoses and assessment have not been clear. Different batteries of tests measure various cognitive and neural capacities including but not limited to memory, language, motor skills, problem solving, cognitive impairment, and intelligence. The outcomes from these tests may result in a better understanding due to the neurological localization of possible damage that many batteries of tests are able to expose. The results regarding these examinations have been useful because of the statistical power they wield, but there are several confounds within and variables outside of these tests that have become more prevalent in the psychological world. These include but are not limited to positive affect, environmental causes, socio-cultural background, fatigue, personal effort, sex, nutrition and stress.

In 1999, Ashby, Isen and Turken published a theory concerning the effect of positive affects on the performances of cognitive tasks. Much of their theory lay in speculative assumptions, but through the theoretical analysis of various studies, they found that positive affect does in fact raise dopamine levels in the brain. When the dopamine levels of the participants were elevated, the participants' scores on a variety of cognitive tasks, including olfactory, episodic memory, working memory and creative problem solving were influenced (1999). The theory was supported by numerous studies

concerning cognition and demonstrated that positive feedback did affect cognitive processes and could affect outcomes such as attention length (Wadlinger & Isaacowitz, 2006).

Other researchers have looked at the exams themselves, questioning the presentation of the battery of tests. Computerized cognitive testing with software programs such as the Automated Neuropsychological Assessment Metrics (ANAM) have long been used to assess aspects of cognition and many studies have looked at the familiarity of computer software programs like ANAM in order to see if a person's prior knowledge in dealing with these programs had any affect on their cognitive scores in regards to complex attention tasks, psychomotor speed and cognitive flexibility. (Iverson, Brooks, Ashton, Johnson & Gualtieri, 2009; Roebuck-Spencer et al. 2008). These studies indicated that computer familiarity could influence the performance of cognitive testing on computers and that this occurred in both military and civilian settings. Significant differences were found between the groups who were more acquainted with computers compared to those who were not, although the study conducted on military personnel also emphasized the importance of considering demographic factors for all reaction time-based computerized assessment batteries (Roebuck-Spencer et al. 2008).

Phillip Ackerman and his colleagues also questioned the methods by which cognitive testing was measured, but approached it through a different mechanism. They asked two questions: "can people work on a cognitively demanding test or task over an extended time without showing fatigue-related impairments?" and "are there individual differences in the propensity to experience cognitive fatigue during effortful tests/tasks over an extended period (either in terms of performance or in terms of subjective

reactions)?” (Ackerman, Kanfer, Shapiro, Newton, & Beier, 2010). Through two different experiments, these researchers found that cognitive fatigue (which the article defined as being associated with feelings such as dullness, being weary and worn out when there are sustained demands on cognitive activities such as thinking, problem solving, and frequent responding) did have a negative impact on the cognitive functioning of the participants in the study and that individual differences, such as individual demographics, did in fact matter in cognitive performance in regards to oral comprehension and memory through the administration of the Cloze Tests and the Completion Tests (Ackerman, Kanfer, Shapiro, Newton, & Beier, 2010).

Much like the previously mentioned studies, more surveys and experiments have been conducted in order to find out what variables contribute to differences concerning cognitive and neuropsychological examination performances. In 2009 a neuropsychological study done with African Americans, Hispanics and Caucasians examined how ethnicity, age, and education affected testing scores and determined how much of a correlation there was between the brain volumes of these participants and their age and education scores. Research indicated that age actually had a weaker relationship to the overall outcome of the cognitive test scores, while the participants’ ethnicity seemed to have a higher relationship with the overall outcome of the test scores. Education increased exam outcomes with Hispanics, made no difference in the Caucasian group, but decreased some associations in the African American population. Although no direct correlations seemed to be made concerning the overall volume of the participants’ brains and their test scores, these results suggested that the cognitive and neuropsychological examinations used were correlated to the age, ethnicity and education

level of the participant (Mungus Reed, Farias, & DeCarli, 2009). These different variables within the study supported the previously mentioned studies considering the impact of individual demographics, socio-cultural and environmental influences that affect the outcome of psychological examinations.

Studies have also shown that stress can exert a negative influence on cognitive function in selective attention, verbal learning, logical memory, working memory, and intelligence in regards to cognitive examination (Mackenzie, Smith, Hasher, Leach, & Behl, 2007) but also that stress could be counteracted with physical activity, which had been shown to reduce tension, depression, anger and fatigue associated with stress (Perkins, 2011). This study demonstrated that 20-minute walks increased performance on short-term memory tasks and showed significant benefits associated with stress-induced effects. Similarly, a study done by Hannon, Norling, Ruddell, Sibthorp, and Suchy implied that high intensity running restored attention significantly more than those who did not participate in physical activity before taking the Conners' Continuous Performance Test II, which is a standardized, psychometric performance-based index of attention (2010).

While some researchers focused on the effects of stress on brain functions, others looked into how motivation can be a confounded when dealing with various cognitive examinations. External incentives have had an impact on the motivation of participants' performances on examinations such as the Word Memory Test, a cognitive exam that measures both verbal learning and memory, as well as the National Adult Reading Test (known to measure general intelligence) and the California Verbal Learning Test. The results of these studies have indicated that poor effort is associated with lower test

performance, and magnifies the need for effort testing to be integrated into cognitive assessments (Flaro, Green, & Robertson, 2007; Stulemeijer, Andriessen, Brauer, Vos & Van Der Werf, 2007).

External influences as well as internalized motivations, individual demographics, test administration, and emotional states appeared to contribute to the neurological functioning and the cognitive performance of the subjects being observed, indicating that multiple variables, including the presence of a short term stimuli directly prior to testing, have affected the outcomes of cognitive testing in various circumstances. Although various aspects concerning the effects of different stimuli on cognition have been researched, neither reading nor critical thinking has been thoroughly considered. The effect of critical thinking induced by reading is a subject that has not been meticulously researched even though testing the verbal comprehension of participants who have read an unrelated excerpt in order to induce cognitive activity could measure the logical comprehension and possible cognitive impact of critical and casual reading directly before an exam is administered. Research could indicate the importance between the difference of critical and casual reading, as well as the variation in the scoring that reading may cause to an individual in general. It was hypothesized that the GRE composite cognitive exam scores of the participants asked to critically concentrate on the higher-level, critical reading excerpt would be significantly higher than those who were told to casually read through a lower-level excerpt from a novel, and that the scores of the control group (those who did not receive an excerpt) would be significantly lower than those of the “reading” groups as well.

Methods

Participants

One Hundred and thirty three undergraduate Psychology students at Carroll College participated in this study. Of these participants, 32 were male and 101 were female. The average age of the participants was 20.28. There were 55 participants who self-identified as college freshman, 26 sophomores, 24 juniors, 24 seniors and three participants who self-identified as ‘other’, indicating a non-degree seeking or nontraditional academic track. One participant was excluded from the study due to ineligibility in regards to age. The scores of the remaining 132 participants were used in the following data analysis. Each student was given extra credit in their respective Psychology class for their participation in the study.

Materials

An excerpt of a popular fictional novel, *Harry Potter and the Deathly Hallows* (Rowling, 2007), was used as the work from which the first experimental group read. This excerpt was selected because it was at a lower reading level (approximately at a high school reading level) and is fairly well known, making it more ideal for a ‘casual’ reading experience, where the reader was given the opportunity to briefly enjoy an easily understandable tale whether they had previously read the series or not. Each participant was given five minutes to read as much of the excerpt as they could at a comfortable reading speed. The second experimental group read an excerpt called “Self-Reflective Consciousness and the Projectable Self” from the book *The Missing Link in Cognition: Origins of Self-Reflective Consciousness* (Metcalf & Heder, 2005), which was a peer-reviewed, educational excerpt of higher reading level that focused the participants’

attention on critical thinking and metacognition. It was specifically chosen for its' information concerning metacognition in an attempt to encourage the reader to reflect upon critical thinking, as defined as a concept that encompassed the skills of using metacognition, understanding context, analyzing arguments, challenging assumptions and evaluating the work as well as its' sources (Cotter, 2009). An agreement form (see Appendix A), along with the demographics of age, gender, and year of school for each participant were used, as well as a series of cognitive intelligence tasks compiled by the researcher using randomized pre-written questions from verbal comprehension sections within two Graduate Record Examination practice booklets, *McGraw-Hill's New GRE* (Dulan, 2011) and *Powerscore Weekend GRE Course* (2005), whose purpose was to measure the cognitive ability of the participant at the time directly following the priming techniques used (see Appendix B for examination distributed to all participants). The materials and questions in regards to the test used were chosen specifically for the purpose of inducing critical thinking through verbal learning skills, similar to many of the examinations explained beforehand (Ackerman, Kanfer, Shapiro, Newton, & Beier, 2010; Flaro, Green, & Robertson, 2007; Mackenzie, Smith, Hasher, Leach, & Behl, 2007; Stulemeijer, et al., 2007). Graduate Record Examinations have previously been used as measurements for cognitive functioning in dealing with cognitive variables (Mrazek, Franklin, Phillips, Baird, & Schooler, 2013) An electronic timer was also used to ensure that all participants had the same time restraints.

Procedure

Participants came to the lab at a prescheduled time. They were given a consent form and asked to complete demographic information such as age, education level and

gender. They were then randomly placed within one of three groups using a semi-random generator, which manipulated the groups to be randomly distributed for every nine participants. The three groups were: the critical reading group (group 2), the casual reading group (group 1) and the control group (group 0). The participants in the critical reading group were told that they would be given an excerpt to read from a peer-reviewed, scholarly book and that they would be given five minutes to read it. They were also told that they needed to read the excerpt critically, as if they were going to write a short essay concerning the subject or as if they were studying for a test over the material. Participants were informed that they did not need to finish reading the excerpt by the end of the time period, so that they could take their time and read at their own pace. Emphasis was put on trying to focus on the story and each participant was encouraged to read as much as comfortably possible. The participant was then handed the critical reading excerpt and was told to begin reading when the researcher had indicated that the timer had started and to stop reading when the researcher specified that the timer had stopped.

The participants in the casual reading group were told that they would be given an excerpt of a popular novel, and that they would be given five minutes to read it. They were also told that they needed to read the excerpt casually, as if they were reading it for pleasure, only needing to understand the storyline of the work. Participants were informed that they did not need to finish reading the excerpt by the end of the time period, so they could take their time and read at their own pace. Emphasis was put on trying to focus on the story and each participant was encouraged to read as much as comfortably possible. The participant was then handed the casual reading excerpt and was told to begin reading when the researcher specified that the timer had started and to

stop reading when the researcher indicated that the time was up. The control group did not receive any excerpt to read. The first two groups were given exactly five minutes to read their respective excerpts. After five minutes, they were promptly given the GRE verbal composite cognitive assessment tasks (the control group did forgo the five minute time period and simply took the test right away). The participants were told they would be given 20 minutes to complete the cognitive tasks. After they had completed each of the cognitive tasks, they were free to leave. Though a short debriefing was applied (see Appendix C), the participants were not informed of the exact purpose of this testing, and were not given their scores directly. All of the participants completed the cognitive tasks within 20 minutes and the entire process did not take more than 25-30 minutes.

Analyses

T-tests were used to convert the raw scores of the cognitive tasks into statistical scores. An Analysis of Variance (ANOVA) was used to examine the mean scores of the groups in regards to the hypothesis.

Results

The null hypothesis stated that the scores of the varied groups would be the same. The alternative hypothesis stated that the exam scores of the individuals who were asked to concentrate on the critical thinking excerpt would be significantly higher than those who were told to simply read through the fictional work. Similarities found in statistical analysis of the F-Values indicate that the data was not substantially varied between groups, therefore the null hypothesis was not rejected. The scores of the control group did not vary from those of the “reading” groups. The summaries of the performances of the

two experimental groups as well as the control group are included in Figure 1. The results of the Analysis of Variance between groups are included in Figure 2.

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Column 0	44	525	11.93181818	7.785940803
Column 1	44	514	11.68181818	16.73361522
Column 2	44	574	13.04545455	8.974630021

Figure 1. Statistical Analysis of Group Test Scores.

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	46.3787878	8	23.18939394	2.07702	0.12947	3.06639
Within Groups	1440.25	129	11.16472868	2613	317	1037
Total	1486.62878	8	131			

Figure 2. Analysis of Variance (ANOVA) between groups and within groups, indicating the Sum of Squares, the Degrees of Freedom, the Mean Squares, the F-Value, the P-Value and the F Critical Value.

Discussion

Implications

Because the null hypothesis was not rejected, the results of this pilot study suggest that individuals were not capable of being primed before cognitive testing and therefore did not have higher scores on certain tests depending on the order in which the test battery was given in regards to other unrelated critical thinking tasks. The results also

indicated that critical reading may not influence cognitive functioning any more or less than casual reading.

Future Directions

Since this research was a pilot study, the next step would be further testing with similar independent and dependent variables and with different cognitive measurements that better pinpoint the domains of cognitive functioning. A more reliable cognitive examination battery that included assessments of attention, working memory, episodic memory, motor control, and aspects of executive function would increase the validity of a cognitive study similar to this (Wesnes, 2010). New materials in regards to the inducement of critical and casual thinking would also be recommended, as well as clear and defined working definitions of critical and casual thinking. Future studies concerning critical and casual thinking and its' effect on cognitive functioning in regards to Functioning Magnetic Resonance Imaging would also be encouraged. Though data did not support differences concerning cognitive functioning within this study, it would still be advised that more studies of the same nature be done in order to completely understand the cognitive implications of critical thinking induced by reading in neurological, clinical and everyday settings.

Limitations

Time was a limitation within this experiment on various levels, because of the fact that many cognitive tasks used for this type of experiment usually take much longer than 20 minutes and it was suggested that each participant could not be expected to allot more than a half-hour time span for their involvement in the study. Therefore it was not logical to administer an entire cognitive battery, as this could have created other confounds, or

resulted in a Type II Error, where the testing would not have enough validity to produce accurate data. Because of this and other confounds, a compilation of verbal questions within the GRE practice booklets were used as cognitive measures. It is questioned whether this mechanism was the most accurate way to measure cognitive performance in regards to critical thinking. The limit set on the amount of time spent reading may have also been a confound, as five minutes may have not been enough time to completely understand the excerpts given, or induce a state of critical or casual thinking. Another confound was found in regards to reading materials and whether the excerpt given to the critical reading group was sufficient in inducing critical thinking within its' readers. The excerpt was a peer-reviewed piece that may have been too difficult of a reading level for the average participant in this particular study, as the mean age of the participants was approximately 20 years old. During the debriefing process, many participants from group two indicated that the reading was difficult to understand and 'follow', which may be a confound in regards to the inducement of critical thinking. Though each participant was instructed in detail as to how they were expected to read their respective excerpt, it is possible that many participants may not have completely understood or known the implications between reading critically or casually, and therefore may not have read their excerpt as appropriately as the research within this study called for.

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Appendix A

Carroll College

**Subject Consent Form
For Participation in Human Research**

You are being asked to participate in a research study about cognitive processes.

You have previously signed up for a specific time slot as a volunteer to participate in this study. If you agree to participate at this time, you will be asked to compliantly follow the directions of the researcher and exhibit effort concerning the tasks provided. The study is expected to involve approximately 150 participants and will be conducted from August 2013 until January 2014.

Participation in this study does not involve any risks, although you may feel mildly stressed, which can be associated with the tasks provided. The study is of no benefit to you, although you may use this experience as an extra credit option within a predetermined class. You may withdraw from this experiment at any time. If you feel as though you would like to withdraw from this experiment while it is in progress, please let the researcher know and all activity concerning the experiment will cease.

Funding for this study will be provided by Carroll College so if you choose to participate, there is no cost to you.

Your privacy is important to us. Confidentiality of records identifying you will be maintained by researchers and kept within locked premises, available only to researchers of the study. Your individual outcome will not be associated with your identity, so there is no way to determine your personal outcome in the future.

Further information about this research study may be obtained by emailing Rebecca Armstrong at rarmstrong@carroll.edu. Additional questions about the rights of human subjects can be answered by the Chair of the Institutional Review Board, Dr. Jamie Dolan (406) 447-4969 or jdolan@carroll.edu.

I, _____ (*name of subject*), acknowledge that I am 18 years of age or older and agree to participate in this research study. The investigator has thoroughly explained process of this research to me. I have read the above and understand the discomforts, inconvenience and risk of this study. I understand that I have the right to refuse to participate in this study and that refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled. I also understand that I may withdraw

from the study at any time without penalty or loss of benefits to which I am otherwise entitled. To the best of my knowledge I have no physical or mental condition that would be adversely affected by my participation. I have received a copy of this consent form for my own records.

Signature of Participant

Date

Printed Name of Participant

Signature of Witness

Date

Printed Name of Witness

Appendix B

Group () Answer Sheet

Age:

Gender: M / F

Year of school: Freshman Sophomore Junior Senior Other

Have you read the excerpt you were given before today?

Yes

No

don't know

Please answer the following questions by selecting one answer choice.

- 1) The author spends so much time on this intricate description of scenery that the reader becomes lost in this _____, and the point of the entire article is overlooked or forgotten.
 - a) rabble
 - b) vocabulary
 - c) opulence
 - d) digression
 - e) machination

- 2) To label the Renaissance as a _____ limited only to western-Europe is considered _____ by many scholars, who are now beginning to realize the global impact of the philosophical and artistic revolution.
 - a) movement. . . narrow-minded
 - b) phase . . . appropriate

- c) plague . . .insightful
 - d) period . . .speculative
 - e) temperament . . . sensible
- 3) An institution judged by its reputation is justified in monitoring the actions of its members, due to the fact that society is all too willing to _____ an entire body based on the behavior of a subset of that group's constituents.
- a) intimidate
 - b) uphold
 - c) compel
 - d) discredit
 - e) modify
- 4) Although Hemingway is sometimes _____ for his unpleasant depiction of women, we nonetheless find some _____, even heroic, female figures in his novels and later short stories
- a) diluted. . . posturing
 - b) forsaken . . . manageable
 - c) criticized . . . affable
 - d) exploited . . . intimidating
 - e) rejected . . . dreary
- 5) The supply of fresh water continues to be a _____ for most environmentalists since, surprisingly, over 97 percent of the world's water is unpotable because it comes from salty oceans.
- a) digression
 - b) concern
 - c) catalyst
 - d) precept
 - e) compromise
- 6) The administrators have finally begun, however _____, to acknowledge the _____ of some of the concerns.
- a) timidly . . . falsity
 - b) belligerently . . . accuracy
 - c) haltingly . . . legitimacy
 - d) elaborately . . . scarcity
 - e) graciously . . . truthfulness
- 7) Carolyn suffers from myopia, often known as nearsightedness, which necessitates the use of contacts or eyeglasses, and recent genetic studies indicate that it appears to be a(n) _____ condition.
- a) inherited
 - b) contagious
 - c) predominantly
 - d) untreatable

- e) discrimination
- 8) To the shareholders' dismay, the revised annual report revealed that some losses _____ by the corporation in the third quarter of last year were _____ than previously thought.
- a) incorporated . . . weaker
 - b) overlooked. . . less
 - c) invented . . . greater
 - d) presented . . . looser
 - e) sustained . . . worse
- 9) The parents often bragged about the child, presuming his silence to be indicative of his attentive, _____ nature.
- a) valiant
 - b) mettlesome
 - c) remorseful
 - d) vigilant
 - e) gullible
- 10) In the ancient, time-honored traditions of the natives, _____ is taught at a young age: as intolerance and close-mindedness are believed to have resulted in the majority of the peoples' suffering.
- a) clemency
 - b) efficiency
 - c) devotion
 - d) apathy
 - e) culpability
- 11) Television often exhibits a fundamental flaw in that it presents _____ people—people lacking the power and influence of their favorite celebrities—with a distorted view of justice; fame and fortune take instant precedence over the legal system as celebrities are repeatedly _____ of their crimes, regardless of guilt.
- a) intrigued . . . aware
 - b) lonely . . . absolved
 - c) foolhardy . . . negligent
 - d) industrious . . . mindful
 - e) ordinary . . . exonerated
- 12) A search that is _____ will occasionally meet with promising, if not revolutionary, results, but typically such results are dependent upon definitive, premeditated exploration.
- a) half-hearted
 - b) indiscriminate
 - c) jovial
 - d) tedious
 - e) momentous

- 13) For years the scientific community has used animals as _____ for people in experiments to avoid any _____ risk to human life.
- a) companions . . . extraneous
 - b) precursors . . . prolonged
 - c) pioneers . . . temporary
 - d) precedents . . . poised
 - e) surrogates . . . unnecessary
- 14) Music in prose is often the result of _____ : the deliberate repetition of larger structures of phrases, even clauses and whole sentences.
- a) attenuation
 - b) parallelism
 - c) proximity
 - d) concentration
 - e) heedlessness
- 15) The author's introductory statements are the key to understanding the work; consequently, the conclusions of any reader who takes no _____ of the prelude will be inherently _____ .
- a) notice . . . perceptive
 - b) summation . . . critical
 - c) cognizance . . . limited
 - d) account . . . instructive
 - e) perusal . . . unbiased
- 16) That Jon's delight in jazz is more _____ than his joy of classical music is mostly due to his father's life-long participation in a jazz band.
- a) abstract
 - b) finite
 - c) trivial
 - d) agnostic
 - e) profound
- 17) Many were drawn to Jackie's _____ personality; she was always so happy and light-hearted, that it was natural to want to spend time with her.
- a) sparse
 - b) dubious
 - c) buoyant
 - d) spurious
 - e) amenable
- 18) As their opponents increased their lead in the fourth quarter, Lisa began to wonder if her team's _____ attitude before the game might have been a bit _____ .
- a) morose . . . early
 - b) celebratory . . . premature

- c) arrogant . . . judicious
 - d) jubilant . . . belated
 - e) casual . . . pessimistic
- 19) Pathological liars are seldom disturbed by the use of a polygraph, since their overall ___ response to lying is often drastically reduced and as such, is undetectable.
- a) cognitive
 - b) operational
 - c) physiological
 - d) qualitative
 - e) correlative
- 20) In simulations, the squadron was trained to work _____ but _____; each member could defuse a bomb in seconds, without mistakenly detonating the device.
- a) swiftly . . . haphazardly
 - b) laboriously . . . cautiously
 - c) effortlessly . . . perilously
 - d) expeditiously . . . meticulously
 - e) quickly . . . maladroitly

Appendix C

The Effect of Critical Thinking Induced by Reading Prior to Cognitive Testing. **Debriefing**

The purpose of this cognitive study is to determine if critical thinking induced by reading has an effect on cognitive exam scores. It is the hypothesis of this study that the exam scores of the individuals who are asked to read an excerpt to induce critical thinking directly before taking the exam will receive higher scores than those who are given a fictional excerpt where critical thinking is not directly involved or induced. The scores of the people who do not receive an excerpt to read prior to testing are also expected to vary from those of the “reading” groups. Demographics are recorded primarily for the purpose of classification for controls, although these factors will be considered with the results of the study. The scores of the cognitive tasks are anonymous, and will not be personally linked to you in any way.

Research such as this is important in the fields of psychology and education, as information regarding the effects of priming could potentially change the way in which people are tested in any circumstance. It could also help people understand the cognitive implications of reading (both critically and casually) in neurological, clinical and everyday settings.

Since the factor of greatest interest in this study is the difference between the scores of those who read the excerpt where critical thinking is induced and those that did

not, your personal results will not be linked to you or reflect your intelligence level in any way, rather they will focus on the overall effect of the cognitive functioning of the brain at the time of the exam. Therefore, any concern you may have about your examination score will not be able to be seen or used as a reflection of your own skill or intelligence level in this study.

A reference list providing relevant literature concerning this research is available upon request. If you have further questions about this study, please contact Rebecca Armstrong at ramstrong@carroll.edu.