An Examination of How Personality Traits and Implicit Theories of Intelligence Affect Metacognitive Control Over Study-Time Allocation

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ABSTRACT

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Effective monitoring and control over one's thinking, or effective metacognition, is a central component to many cognitive tasks and thus is essential to optimize learning (Metcalfe, 1993; Paul, 1992; Reder, 1987; Reder & Ritter, 1992; Schneider & Lockl, 2002; Simon & Newell, 1971; Willingham, 2007). Many factors impact how strategies are implemented. We know a good deal about the cognitive variables that affect implementation of cognitive strategies, but nothing about personality or motivational traits that contribute to effective metacognitive strategy use. This study aimed to explore and clarify the relationship between personality traits, implicit theories of intelligence (Dweck, 1999) and metacognitive control over study time allocation and subsequent test performance. The independent variables included the personality traits described in the Five Factor model (McCrae & Costa, 1997; Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness) and participants' implicit theories of intelligence (entity or incremental theory), as well as one between-subjects factor, which was time allotted to study passages, or time pressure (High Time Pressure vs. Low Time Pressure). The dependent variables included test performance and metacognitive strategy used. This study used a study-time allocation paradigm similar to the design used in the Son and Metcalfe (2000) study, where participants first ranked passages based on difficulty and interest, then studied the passages under either high or low time pressure. Participants were tested on their understanding of the material after studying. Participants also completed self-report measures of personality and implicit theories of intelligence. Primary findings revealed that participants high on

Conscientiousness allocated more study-time to passages judged as interesting compared to participants who were average or low on Conscientiousness. Additionally, when faced with time constraints, participants who identified with an incremental theory of intelligence were more likely to allocate study-time to passages judged as interesting compared to participants who did not identify with an incremental theory of intelligence. Openness was positively related to test performance, and Extraversion was negatively related to test performance. Lastly, the trait Openness was significantly related to having an incremental theory of intelligence.

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Chapter I

INTRODUCTION

Metacognition, a central component of higher order cognitive functioning, is widely accepted as having an impact on memory and learning outcomes (Dunlosky & Ariel, 2011; Metcalfe, 1993; Metcalfe, 2009; Paul, 1992; Reder, 1987; Reder & Ritter, 1992; Schneider & Locke, 2002; Simon & Newell, 1971; Willingham, 2007). While there is growing evidence to support how metacognitions guide our study behavior, there is little research explaining individual differences in metacognition that might inhibit or enhance these strategies. A better understanding of such differences in how people regulate their learning and achievement through metacognitive judgments is needed.

Previous research has utilized a study-time-allocation paradigm in order to gain a better understanding of different metacognitive control strategies. The Discrepancy Reduction Model was the first model to explain how metacognitions guide our study behavior, where people focus primarily on the most difficult items while studying in order to reduce the discrepancy between what they wish to learn and what they have already learned. They then proceed to the easier items once they feel they have mastered the difficult items (Dunlosky & Herztog, 1998; Nelson & Narens, 1990). In these studies, participants are typically presented with word pairs and given the choice as to which pairs to study first, and how long to study each pair. However, when people are tested under more realistic learning situations than the conditions used in studies that support the Discrepancy Reduction Model, data now support a Region of Proximal Learning model (Ariel, Dunlosky, & Bailey, 2009; Metcalfe, 2002; Metcalfe, 2009; Metcalfe & Kornell, 2003). Results supporting this model have found that when complete mastery of material is not possible, people choose to study unfamiliar items they view as easy first, followed by the most

difficult items. People tend to not study items that are already known. Further, they will persevere in studying until they no longer perceive themselves as learning.

Son and Metcalfe (2000) conducted a series of experiments that supported the Region of Proximal Learning model. Generally they found that when faced with varied time pressure (i.e., high versus moderate time pressure) or test expectations (i.e., studying for a test versus free reading), people's strategies changed. In these experiments, participants were presented with passages, as opposed to paired-associates, that varied in difficulty and asked to order each passage in terms of its perceived ease of learning. Then, during a study phase, they had to choose which passages to study first, and how long to study each passage. They were subsequently tested on the material. When people were given ample time to study all stimulus materials, people allocated more study time to judged-difficult items. In contrast, under high time pressure, where people were not given enough time to study all of the stimulus materials, they found that people allocated more study time to judged-easy items and tended to study judged-easy items first to optimize test performance. People did not show a preference in study-time allocation (i.e., choosing to study difficult or easy items first) under moderate time pressure, suggesting they were not making metacognitive decisions in terms of what to study. The use of passages, presence of time pressure, and the expectation of a test are arguably more reflective of real world studying and learning conditions.

Most of the research on how students monitor their studying has focused on some cognitive and situational variables that affect metacognitive functioning, such as difficulty of passages, time, and the expectation of a test. There is little research on the influence of affect on metacognitive strategies. This dissertation will investigate how affective variables, namely personality traits and motivation, will influence metacognitive control over study time while

learning passages of varying difficulty when they are expecting a test under either high time pressure or low time pressure in an attempt to address these issues.

Most of the personality variables associated with academic outcomes are contained in the Five Factor model, which is widely accepted as a comprehensive representation of adult personality traits (Goldberg, 1990; Hendriks, Perugini, Angletiner, Ostendorf, Johnson, De Fruyt…Nagy, 2003; McCrae & Costa, 1987; Saucier & Goldberg, 1996). The five factors include, Extraversion (sociable, friendly, dominant), Agreeableness (cooperative, helpful, trustworthy), Conscientiousness (careful, reliable, hardworking) Neuroticism (nervous, high-strung, emotional), and Openness (intellectual, independent-minded, imaginative). Of the five, Conscientiousness is the trait most consistently associated with better study skills, higher academic achievement, and test performance (Chamorro-Premuzic & Furnham, 2003b; Conrad, 2006; Furnham & Chamorro-Premuzic, 2004; Graziano & Ward, 1992; Noftle & Robins, 2007; Porporat, 2009). Though there is a relationship between Openness and academic achievement, Openness is found to be more related to intelligence and aptitude than achievement (Ackerman & Heggested, 1997; Conrad 2006; Goff & Ackermann, 1992; Noftle & Robbins, 2001). The relationship between the other three factors and academic achievement is somewhat unclear. Some research indicates a negative relationship between extraversion (Bauer & Liang, 2003; Furnam, Chamorro-Premuzic & McDougall, 2003; Goff and Ackerman, 1992) and neuroticism (Chamorro-Premuzic & Furnham, 2003; Chamorro-Premuzic & Furnham, 2005) on academic outcomes, while other research does not (O'Connor & Paunonen, 2009; Rothstein, 1994). Additionally, in some studies agreeableness was associated with academic performance (Farsides & Woodfield, 2003), and other studies did not find a significant relationship (Conrad, 2006; Porporat, 2009; Rothstein, 1994).

Despite the positive relationship between metacognition and learning, as well as learning and Conscientiousness, there might be a negative relationship between effective metacognitive strategies and Conscientiousness under certain circumstances. Firstly, there is speculation that Conscientiousness serves as a compensatory mechanism for average intelligence, in that individuals who are high on Conscientiousness are high achievers despite average cognitive abilities (Moutafi, Furnham, & Crump, 2003; Chamorro-Premuzic & Furnham, 2004; Wood & Englert, 2009). As such, it is possible that Conscientiousness is also compensatory for higher order cognitive skills, such as metacognition and a person's ability to make judgments about their own learning. In one study examining the association between personality traits and academic performance, the authors found a negative relationship between Conscientiousness and critical thinking skills (Bauer & Liang, 2003). Critical thinking is potentially analogous to higher order cognitive functioning abilities, such as metacognition. Secondly, it is possible that characteristics associated with Conscientiousness (e.g., organized, cautious, rule-following), may mitigate against the use of effective decision-making under high time pressure studying situations. Cucina and Vasilopulos (2005) found that very high levels of Conscientiousness were associated with lower grades because high conscientious individuals can take on too much at once or attempt to complete all assigned tasks, rather setting goals and prioritizing tasks. The relationship between Conscientiousness and metacognitive control warrants further investigation.

In addition to personality, research has shown that there is an association among motivation, task performance and metacognitive strategy use. This dissertation used Dweck's research on implicit theories of intelligence to operationalize motivation since there are supported associations between how people's theories about their own intelligence impact their interpretations of how well they understand and comprehend new material. Specifically, the

implicit theory of intelligence states that people's beliefs about their own intelligence potentially alters their judgments of learning when faced with tasks of varying difficulty, which in turn impacts their effort (Dweck,1999; Molden & Dweck, 2006).

Judgments of learning are a measure of an individual's metacognitive assessments of memory and comprehension. Entity theorists, or people who believe intelligence is a fixed, stable entity tend to interpret difficult tasks as an indication of a lack of innate ability (Dweck, 1999). As such, when presented with a difficult task, research indicates these individuals report lower levels of perceived understanding of the material (Miele & Molden, 2010). In contrast, incremental theorists, or people who believe intelligence is a malleable construct that can be developed, tend to interpret difficult tasks as an indication that more effort is required to complete the task. Since they put forth more effort in a difficult task, these individuals report higher levels of perceived understanding. While this research indicates that implicit theories of intelligence impact metacognitive judgments of learning, or assessments of understanding, whether or not one belief about intelligence is superior to another in terms of metacognitive ability is unclear. This is supported by no differences in actual understanding of material between entity and incremental theorists in past research despite differences in perceived understanding (Miele & Molden, 2010).

Though there is no current research on how implicit theories impact metacognitive strategies, there is reason to believe there may be a negative association between an incremental view and metacognition. A paramount characteristic of incrementalists is increased effort when faced with difficult tasks. This increased effort potentially impacts the understanding of how well they learned a difficult item and their subsequent studying decisions. Effort to persevere on challenging items might actually be an ineffective study strategy, as indicated by the Region of

Proximal Learning Model. Relatedly, people who scored high on Conscientiousness were more likely to report an incremental theory of intelligence (Furnham, et al., 2003). Given the association between Conscientiousness and implicit theories of intelligence, and an inconclusive relationship between implicit theories of intelligence and metacognition, a better understanding of how these factors are related to metacognitive strategies in terms of study time allocation is needed. The purpose of this dissertation was to explore and clarify the relationship between personality traits, motivational variables, and metacognitive strategies on study-time allocation and subsequent test performance.

Chapter II

REVIEW OF RESEARCH

Metacognition and Study-Time Allocation

The construct of metacognition is a central component of higher order cognitive functioning that consists of the knowledge and regulation of one's own thinking, or the monitoring and control of one's own cognitions (Dunlosky & Ariel, 2011; Flavell, 1979; Nelson & Narens, 1990). Many theories support that effective metacognition is a central component to many cognitive tasks, such as memory (Metcalfe, 1993; Reder, 1987; Reder & Ritter, 1992), declarative and procedural knowledge (Schneider & Lockl, 2002), problem solving (Simon & Newell, 1971), and other critical thinking skills (Paul, 1992; Willingham, 2007). Although we know a great deal about the relationship of metacognition to memory and other cognitive processes, we still have a lot to learn about how we self-regulate knowledge acquisition through monitoring and control in order to optimize learning. Nelson and Narens (1990) introduced a theoretical framework of metacognition that explained self-regulation through monitoring and control of cognitions. Within this framework, an individual's cognitive processes are split into a *meta-level* and an *object-level*. Information, or knowledge, flows between these levels. Within the meta-level, there is a mental representation of the object-level. The meta-level continuously tracks incoming information and uses this information to regulate whether the mental representation of the object-level needs to be modified. The tracking of incoming information is referred to as *monitoring*, and the decisions made about what to do with the information (i.e., modify the object-level representation or keep it the same) are referred to as *control*. Since learning in an academic context is often the product of studying, research has focused on the role of monitoring and control in guiding how people study and subsequently learn (Dunlosky &

Herztog, 1997; Metcalfe & Cornell, 2005; Nelson & Narens, 1994). Individuals differ in their capacity to monitor their own learning, as well as their capacity to control, or regulate, what they do with this information through various strategies (Dunlosky & Thiede, 2013; Nelson & Dunlosky, 1991). While there is evidence supporting the link between monitoring, control and learning, there is little research examining individual differences that might affect this relationship.

Investigations of monitoring have looked at factors that affect judgments of whether an individual knows something or not, and whether these judgments are accurate (e.g., Higman. 2013; van Loon et al., 2013). Two widely used terms to describe an individual's ability to monitor their learning are ease of learning (EOL) judgments, or judgments of ease of acquisition (Richardson & Erlenbacher, 1958) and judgments of learning (JOL), or judgments of how well information is learned (Nelson & Dunlosky, 1991). The accuracy of judgments made while studying, or effective monitoring, is important because people use them to decide how to control their studying. The learner decides which information to study and how long to study it. As such, this relationship has been investigated using a study-time allocation paradigm. Studies have supported the relationship between accurate judgments and effective control decisions, since subjective ease of material is positively correlated with JOLs. The ability to make accurate judgments of learning impacts their ability to successfully guide their decisions while studying, such as what to study and how long to study it (Dunlosky & Rawson, 2012; Higman, 2013, Metcalfe & Finn, 2008; Thiede and Dunloskly, 1999, van Loon et al., 2013). Effective metacognitive control does enhance learning (Kornell & Metcalfe, 2006; Thiede et al., 2003). However, some studies have found adults are not good at making accurate judgments of learning

(Koriat & Bjork, 2005; Peverly, Brobst, Graham, & Shaw, 2003; Pressley & Ghatala, 1988; Presseley, Ghatala, Woloshyn, & Pirie, 1990), which has implications for their study strategies.

Early research supported an inverse relationship between monitoring judgments and the amount of allocated study time, in that the lower the perceived EOL of a particular item, the greater the allocated study time to that item (Nelson & Leonesio, 1988). Further research on this relationship gave rise to the Discrepancy Reduction model of self-regulated study (Dunlosky & Herztog, 1998). According to the model, people set a goal for learning then select items to study. They continue to study, monitor and test their understanding of the item until they meet or exceed their desired goal of learning, and there is no longer a perceived discrepancy between their desired and current state of learning. They then move on to the next item. People study the most difficult items first since they represent the greatest discrepancy between their desired and current state of learning (Dunlosky & Thiede, 1998; Nelson & Narens, 1990).

Though the Discrepancy Reduction model makes sense, in that people choose to study those items they perceive as most difficult first and will continue to study until the material is mastered, there are a few inherent problems with the model and the design of the research. Firstly, participants in the earliest studies had unlimited time to study the material so they were able to devote as much time as they desired to items perceived as most difficult. Real-life testing or studying situations, as well as certain personality tendencies (i.e., procrastination), may not afford participants the luxury of time, which likely impacts an individuals' study-time allocation. Secondly, the goal in most of the studies of the Discrepancy Reduction model was total mastery, or complete verbatim recall. Most of these studies required participants to memorize short materials, such as word pairs. However, it is not always possible to completely master all material. For example, some findings suggest a "labor-in-vain" effect, which indicated that

despite allocating extra study time to perceived difficult items, there was little to no increase in recall (Mazzoni & Cornoldi, 1993; Nelson & Leonesio, 1988). Similarly, total mastery, or complete recall, might not always be the learning goal. While some tasks require mastery (e.g., learning a new language), others do not (e.g., understanding the meaning of text).

These limitations to the Discrepancy Reduction model led to alternative models, and data now support a Region of Proximal Learning model (Ariel, Dunlosky, & Bailey, 2009; Kornell & Metcalfe, 2006, Metcalfe, 2002; Metcalfe, 2009; Metcalfe & Kornell, 2003), which better explains people's study-time allocation during more realistic testing situations. According to this model, under time pressure, people select *easy* items they do not know first over the *difficult* items they do not know, and do not study items they already know (Son, 2004). This is arguably an effective strategy because if they do not have enough time to study and learn all material, their ability to master easy (but unknown) material is more likely than their ability to master difficult material. Once people choose which items to study and the order in which they will study them, they need to decide when to stop studying an item. The rule for stopping studying, or perseverance, is based on a person's judgment of the *rate* of their own learning (jROL), and was first introduced in the Region of Proximal Learning model (Metcalfe & Kornell, 2005). When people have unlimited time, which makes it possible to master difficult items, their study-time allocation reflects predictions made by the Discrepancy Reduction model. People will choose to study the difficult items first and will allocate more study time to difficult items (Koriat et al., 2006, Son & Metcalfe, 2000).

In addition to time constraints, real-life studying and testing conditions require the understanding of longer tests or passages. Son and Metcalfe (2000) investigated how people's metacognitive judgments influence study-time allocation strategies under realistic testing

conditions. This study consisted of three experiments. Experiment 1 manipulated the test expectations of the participants to investigate whether participants who were expecting a test (study-for-test group) would allocate study time differently than participants who were reading for no purpose (free reading group), when given insufficient time to study all materials. The materials consisted of eight biographies, and participants were first required to rank the biographies in terms of EOL and judgments of interest (JOI). Participants' interest is important because it potentially impacts their views as to whether they believe the information is useful and/or relevant. They were then allotted 30 minutes to study the biographies. The study-for-test group was told they would be tested on the material and the free reading group was not. All participants were subsequently tested on the material. Experiment 2 replicated the test expectation manipulation of Experiment 1 and participants again had to make EOL and JOI judgments about the materials. However, study materials included haiku poems rather than lengthy biographies and allotted more study time than needed to read the poems to support previous findings that people will choose to study difficult items first with shorter materials and without time pressure. Experiment 3 further examined the impact of time pressure on study time using a similar design to the prior two experiments, where participants had to make JOI and EOL judgments, with the exception of manipulating the amount of time allotted to study (high time pressure and moderate time pressure) and using sonnets that were longer than the haiku poems but shorter than the biographies.

Primary findings across the three experiments indicated that 1) under *high* time pressure, people allocated more study time to judged-easy items than judged-difficult items, 2) under *moderate* time pressure, people did not show a preference in study-time allocation, 3) when people were studying for a test and not under significant time pressure, they were more likely to

allocate study time to judged-difficult items than people who were free reading, and 4) people's JOI and EOL judgments were significantly correlated, which means material that was judged easy was also judged as interesting, but people allocated more study time to judged-interesting material over judged-easy material when they were *not* expecting a test. These findings suggest that the strategies people choose are a function of time, knowledge they are being tested, and the materials they are studying. Subsequent research has replicated the findings that people allocate more study time to difficult items under less time constraints (Koriat & Nussinson, 2009; Koriat et al., 2006; Metcalfe, 2002).

Though research supports that people tend to allocate more study time to judged-easy items when faced with time pressure, is this an effective strategy that actually increases learning? Kornell and Metcalfe (2006) conducted a series of three experiments which supported that people's metacognitive control over study-time allocation does effectively increase learning. Further, findings from one of the experiments indicated that people chose to study easy unlearned items, supporting a Region of Proximal Learning model, and this strategy benefited learning as indicated by increased test performance. The data suggests choosing to study easier items is effective in enhancing learning because when people know there is not enough time to learn material, easier items will take less time to learn and therefore will be more effective in boosting test performance.

Although research suggests that people have the capacity to use their metacognitive judgments strategically, many factors impact how strategies are implemented. Given what we know about studying under realistic testing conditions, namely, studying longer material under time pressure, how might non-cognitive factors affect a person's capacity to effectively monitor

and make control decisions? This dissertation attempted to clarify the relationship between non-cognitive factors, namely personality traits and motivation, and metacognitive strategies.

Personality Traits and Study-Time Allocation

There is little research on the impact of non-cognitive factors on the effectiveness of metacognitive strategies, but there is research that suggests personality traits and other non-cognitive factors predict academic performance (Rothstein, Paunonen, Rush, & King, 1994). The impact of personality traits on academic performance outcomes are of interest because personality measures predict what an individual will do, or their *typical* performance, as opposed to what they can do, or their *maximal* performance (Goff & Ackerman, 1992). There is growing evidence to support the use of non-cognitive constructs, such as personality measures, to supplement cognitive measures as predictors for work and college performance (Oswald et al., 2004; Conrad, 2006) since many studies have illustrated that intellectual ability alone does not predict performance well (Ackerman, 1996; Wolf & Johnson, 1995, Chamorro-Premuzic & Furnham, 2006). If personality traits are a predictor of academic outcomes, it is possible they also predict a person's capacity to use metacognitive strategies while studying.

Most of the personality variables associated with academic performance are contained in the Five Factor model, which is widely accepted as a comprehensive representation of adult personality traits (Goldberg, 1990; McCrae & Costa, 1987). This model has been validated in many cultures and languages (Hendriks et al, 2003; Saucier & Goldberg, 1996). The Five Factor model includes the following dimensions: Extraversion (sociable, friendly, dominant), Agreeableness (cooperative, helpful, trustworthy), Conscientiousness (careful, reliable, hardworking) Neuroticism (nervous, high-strung, emotional), and Openness (intellectual,

independent-minded, imaginative). Conscientiousness is the personality dimension most related to academic outcomes. The relationship between the other four dimensions and academic performance is inconclusive.

Most studies have found a positive relationship between Conscientiousness and academic performance, both in terms of GPA (Conrad, 2006; Porporat, 2009; Noftle & Robins, 2007) and exam scores (Chamorro-Premuzic & Furnham, 2003b; Furnham & Chamorro-Premuzic, 2004). These findings hold true when controlling for academic ability, and also are equally predictive of academic performance as intelligence or ability measures (Porporat, 2009). Although most of these data were gathered using self-report measures, research also supports an association between teacher ratings of Conscientiousness and school performance (Graziano & Ward, 1992).

It is logical that people high on Conscientiousness perform better in school, since this construct contains many traits that describe the ideal student and worker. Specifically, some of the many traits Hogan and Ones (1997) used to define Conscientiousness include hardworking, ambitious, organized, cautious, willing to comply with current rules, cooperative, and dependable. Further, this construct is arguably related to persistence, or the will to achieve (Digman, 1989). Webb (1915) described the will to achieve as the *w* factor, which is associated with academic performance (De Raad & Schowenburg, 1996) and sustained effort and goal setting (Barrick et al., 1993). Lastly, Conscientiousness is highly correlated with other socially desirable behaviors in the classroom beyond performance, such as attendance and participation (O'Connor & Paunonen, 2007). In other words, people who are conscientious are motivated and hardworking, and these qualities suggest such individuals will perform well in school.

Despite generally consistent findings that show a relationship between Conscientiousness and academic performance, a meta-analysis conducted by O'Connor and Paunonen (2007)

indicated substantial variability in the strength of this relationship across studies, and there is one study that did not find any relationship (Farsides & Woodfield, 2003). Further, there is some research that suggests that extremely high levels of Conscientiousness may have a negative affect on academic performance. Cucina and Vasilopulos (2005) found a quadratic relationship between Conscientiousness and GPA, such that students rated either extremely high or extremely low on this personality trait had lower GPA's than students rated either moderate or moderate-to-high.

Overall, there is evidence to support a strong relationship between Conscientiousness and academic performance. However, there may be reason to believe that there is a negative relationship between Conscientiousness and the use of effective metacognitive strategies while studying for a test under some conditions. First, while individuals high on Conscientiousness arguably perform better academically, there is evidence that those who self-reported high Conscientiousness scored lower on intelligence tests (Chamorro-Premuzic, et al., 2004; Wood & Englert, 2009). As such, there is speculation that this dimension serves as a compensatory mechanism for low-to-average intelligence (Moutafi et al., 2003; Chamorro-Premuzic & Furnham, 2004) and low critical thinking skills (Bidjerano & Dai, 2007). One study examining the association between personality traits and academic performance found a negative relationship between Conscientiousness and critical thinking skills (Bauer & Liang, 2003), though it is of note the authors argued this finding was a function of students' lack of motivation during the study. If Conscientiousness serves as a compensatory mechanism for higher order cognitive skills, then it is possible Conscientiousness is compensatory for the effective use of metacognitive decision-making while studying.

Secondly, as discussed previously, those high on Conscientiousness are described as hard working, organized, cautious, and rule-following (Hogan & Ones, 1997). It is possible that under time pressure, such individuals will struggle to use monitoring to make effective control decisions while studying, since choosing to study everything assigned as opposed to making decisions about what and what to not study is better aligned with Conscientious traits (e.g., rule-following). Given the evidence that high (and low) levels of Conscientiousness might be related to lower academic performance, it is possible that students high on Conscientiousness attempt to complete all tasks, or take on too much at once (Cucina & Vasilopoulos, 2005). Similarly, there is evidence that individuals who are achievement-oriented (or having Type A characteristics) performed worse than individuals who did not have these characteristics, or had them to a lesser degree (or having Type B characteristics) when faced with several tasks of equal importance. Type A individuals attempted to complete all of the tasks simultaneously (De le Casa et al, 1997).

Further, there is some support for a positive relationship between Conscientiousness and self-regulated learning strategies, including metacognition (Blickle, 1996). However, there is also evidence this relationship is mediated by effort regulation and moderated by Openness, such that individuals high on Conscientiousness and low on Openness were more likely to invest more time and effort (Bidjerano & Dai, 2007).

Unlike Conscientiousness, the relationship between the other four factors and academic outcomes are not as straightforward. Some studies have found a positive relationship between Openness to Experience and academic performance, as measured by GPA (Farsides & Woodfield, 2003) and final grades (Lounsbury et al., 2003; Lounsbury et al., 2005). This association is explained by Openness as being more related to academic ability or aptitude,

where the association between Conscientiousness and academic performance is more related to motivation or perseverance (Goff & Ackermann, 1992; Noftle & Robbins, 2001; Conrad 2006). Similarly, some researchers argue that Openness to Experience overlaps highly with intellectual ability (Ackerman & Heggested, 1997). The relationship between aptitude and Openness is supported by the idea that people high on Openness are more likely to engage in abstract thinking and other intellectual activities (Saucier & Goldberg, 1996). Though some studies have supported the relationship between Openness and academic performance, other studies have failed to find a significant relationship (Busato et al., 1999; Rothstien et al., 1994, Wolfe & Johnson, 1995).

Similar to Openness to Experience, associations between Extraversion and academic performance are inconclusive. While some studies have found a negative relationship between Extraversion and academic performance, others have either found no significant relationship or even a positive relationship. The variation in results is best explained by how academic performance is operationalized. For instance, a positive relationship between Extraversion and academic performance in MBA students was found when performance was based on participation (Rothstein, 1994), whereas a negative relationship was found when examining GPA (Bauer & Liang, 2003, Furnam et al., 2003, Goff and Ackerman, 1992) and exam grades (Hair & Hampson, 2006; Furnham & Chamorro-Premuzic, 2004). Arguably students high on Extraversion spend more time socializing, both during and outside of class, whereas individuals low on Extraversion (or introverts) spend more time studying (Chamorro-Premuzic & Furnham, 2005).

According to a meta-analysis conducted by O'Connor and Paunonen (2009) there is little evidence to support an association between Neuroticism (or Emotional Stability) and academic

performance. The few studies that do support a relationship revealed a negative correlation between Neuroticism and GPA (Chamorro-Premuzic & Furnham, 2003). Students high on Neuroticism (or low on Emotional Stability) are more likely to experience anxiety and stress which impacts their academic performance (Chamorro-Premuzic & Furnham, 2005). Lastly, Agreeableness is the dimension least related to academic performance, although there are some findings that indicate a positive association between Agreeableness and final grades (Conrad, 2006), as well as GPA (Farsides & Woodfield, 2003), although others found a negative association (Rothstein, 1994).

Implicit Theories of Intelligence and Study-Time Allocation

Similar to personality variables, there is little research on the relationship between motivational variables and metacognitive strategies, but there is a supported relationship between certain motivational models and academic outcomes. One such motivational model indicates that people's beliefs about intelligence impact their response to academic challenges (Dweck, 1999; Dweck & Leggett, 1988). This model is particularly of interest because people's theories about their own intelligence impact their interpretations of how well they understand and comprehend new material, as well as their perception of their capability to understand new material, which might then impact metacognitive decisions while studying.

According to this model of implicit theories of intelligence, people have different beliefs about the nature of intelligence. Some people hold an "entity" theory of intelligence, meaning they believe intelligence is a fixed, stable entity, and tend interpret difficult tasks as an indication of a lack of innate ability. In contrast, some people hold an "incremental" theory of intelligence, meaning they believe intelligence is a malleable construct that can be developed, and tend to

interpret difficult tasks as an indication that more effort is required to complete the task (Dweck & Leggett, 1988, Dweck, 1999).

Research supports that these beliefs have implications for students' academic outcomes, specifically how they respond to challenging tasks or failure, and are independent of actual intellectual ability. These beliefs alter people's JOLs when faced with difficult tasks, which in turn impacts their effort (Dweck, 1999; Molden & Dweck, 2006). When faced with an academic challenge or setback, incremental theorists put forth effort to build skill acquisition and overcome difficulty, whereas entity theorists withdraw or give up because they believe they do not have enough intelligence to overcome difficulty (Dweck & Leggett, 1988). Further, incremental theorists tend to have learning goals, which focus on increasing competence. Conversely, entity theorists tend to have performance goals, which focus on gaining favorable judgments from others of their competence, and these goals facilitate different response patterns to setbacks (Dweck & Leggett). Performance goals can lead to responses of helplessness, whereas learning goals, which support mastery-oriented strategies and challenges, are associated with increased effort and/or the adaptation of strategies (Elliott & Dweck, 1988)

Studies have found that students with a more incremental view earned higher grades than students with a more entity view (Henderson & Dweck, 1990). Similarly, Blackwell and colleagues (2007) found that an incremental view in junior high school students predicted an upward trajectory in grades, where an entity view predicted a flat trajectory. Further, there is evidence that implicit theories of intelligence can be taught and manipulated in the classroom. In one study, college students who were taught an incremental view earned higher grades and achievement test scores than the control group, even when controlling for aptitude (Aronson, Fried, & Good, 2002; Good, Aronson & Inzlicht, 2003). In another study, an intervention

teaching an incremental view of intelligence facilitated a change in motivation; students who received the intervention improved their grades whereas students in the control group's grades continued to decline (Blackwell et al., 2007). The control group in this study received instruction on the structure of memory, as opposed to instruction on the incremental theory of intelligence.

While there is a supported relationship between implicit theories of intelligence and academic outcomes, the relationship between theories of intelligence and metacognitive strategies is unclear. Some argue that metacognition and classroom motivation are related since effective metacognition includes self-monitoring and self-appraisal of learning, which impacts persistence or perseverance when faced with difficult tasks (Cross & Paris, 1988; Paris & Winograd, 1990). Self-appraisal is inherently an affective process since it involves the judgment of one's own skills and abilities (Cross & Paris). If a student is studying material and makes the judgment that the material is difficult, motivation will impact whether they persist to learn the material (in concurrence with an incremental theory of intelligence). As such, some argue that metacognition is an important skill that fosters motivation in the classroom and should be developed (Paris & Winograd, 1990). While this makes sense in terms of promoting self-efficacy and perseverance, it is unclear how motivation might impact effective metacognitive strategy use when allocating study-time.

While there is no research on *how* beliefs about intelligence impact metacognitive strategy use, there is evidence that beliefs about intelligence affect people's interpretations of how well they comprehend easy or difficult material. Miele and Molden (2010) found that entity theorists reported lower levels of perceived understanding when reading difficult material, whereas incremental theorists reported higher levels of perceived understanding when faced with difficult material. These findings extended to both third and fifth grade students (Miele, Son, &

Metcalfe, 2013). The authors across both studies hypothesized that incremental theorists associate increased effort with developing a greater understanding of material, and since they exerted more effort as the task increased in difficulty, they perceived higher levels of understanding, or believed they understood the material more than they did. In contrast, entity theorists perceived increased effort when faced with difficulty as an indication they were reaching the limits of their ability to understand the material, so as effort and difficulty increased, their perceived understanding decreased. It is of note that across these studies, there were no differences in actual comprehension of the material despite differences in perceived understanding. This means both incremental and entity theorists used their experiences to judge their comprehension, but they interpreted their experiences differently.

Since research supports that differences in people's beliefs about intelligence impact perceived understanding of material, these differences also likely impact how individuals allocate study time. However, which belief is superior is unclear since there are reasons to believe that both entity and incremental theories of intelligence may have a positive or negative impact on metacognitive strategies while studying for a test, depending on the conditions of studying (time, difficulty, etc.). As discussed previously, according to the Region of Proximal Learning model, an effective metacognitive strategy is to study easy material over difficult material under time pressure (Son & Metcalfe, 2000). Since entity theorists are more concerned with performance goals than incremental theorists, it is possible people with an entity theory of intelligence will choose to study judged-easy materials first, demonstrating effective study-time allocation decisions. Another reason entity theorists might choose easy material is because they might be less confident in their ability to understand judged-difficult material and avoid studying difficult material altogether. Conversely, incremental theorists are more concerned with learning

or mastery goals, which results in increased effort to persevere on challenging items. Since Molden and Dweck (2006) found that incremental theorists tend to interpret difficult tasks as an indication that more effort is required to complete the task, incremental theorists might choose to study judged-difficult items over judged-easy items. Also, if increased effort on challenging tasks results in incremental theorists reporting high levels of perceived understanding of test material, this might result in inaccurate monitoring of information. Incremental theorists might perceive they understand something more than they do because of the effort put into the task, impacting subsequent studying decisions. Taken together, these findings suggest that incremental theorists might not engage in accurate monitoring and/or make effective control decisions while studying, and entity theorists might make more effective control decisions while studying, under some conditions.

Further, research supports that people who scored high on Conscientiousness were more likely to report an incremental theory of intelligence (Furnham, et al., 2003). This makes sense because many traits associated with Conscientiousness are also associated with an incremental theory of intelligence (e.g., perseverance and effort). However, the similarities between people high on Conscientiousness and people with an incremental view of intelligence suggest incremental theorists might not make effective studying decisions under time pressure.

Conversely, there are reasons to believe that an entity theory of intelligence might be negatively associated with effective metacognitive strategies, and an incremental theory of intelligence might be positively associated. Entity theorists' concern with their performance relative to others could suggest these they will choose to persevere on challenging or difficult material so they will not underperform relative to their peers. Incremental theorists' focus on increasing competence through effort might suggest they are more apt to adapt strategies while

studying and might be more pragmatic in their study-time allocation. Given the association between Conscientiousness and implicit theories of intelligence, and an inconclusive relationship between implicit theories of intelligence and metacognition, ultimately it is unclear how differing views of intelligence are related to study-time allocation under time pressure. A better understanding of how these factors are related to metacognitive strategies is needed and is one of the primary aims of this dissertation.

The Current Study

In summary, the aim of this dissertation is to explore and clarify the relationship between personality traits, motivational variables, and metacognitive control over study time allocation and subsequent test performance. The personality traits of interest are the five traits in the Five Factor Model. While most research only supports a consistent relationship between Conscientiousness and academic achievement, and Conscientiousness is of most interest to this study, the other variables were still measured since there is little research investigating personality as it relates to metacognitive strategies. Additionally, measuring Conscientiousness in isolation will potentially prime subjects to the primary research questions. Finally, students' beliefs about their own intelligence were also measured to determine if they lead to different strategic choices than would be predicted with the core personality construct of Conscientiousness.

In order to reflect realistic studying conditions, this dissertation used a study-time allocation paradigm similar to the design used in the Son and Metcalfe (2000) study, where participants first ranked passages based on difficulty (EOL) and interest (JOI), then studied the

passages under either high or low time pressure, and lastly were tested on their understanding of the material.

This study firstly aims to replicate the general study-time allocation findings from the Son and Metcalfe (2000) study, but additionally investigates the following research questions: (1) Is there a relationship between any of the Five Factor personality traits and metacognitive strategy used? (2) Is there a relationship between any of the Five Factor personality traits and test performance? (3) Is there a relationship between implicit views of intelligence and metacognitive strategy used? (4) Is there a relationship between implicit views of intelligence and test performance? (6) Is there an association between the Five Factor personality traits and implicit views of intelligence?

Based on previous research, it is possible to generate hypotheses about some of the relationships among the aforementioned variables. As previously discussed, choosing to allocate more study time to easier items when faced with time constraints is considered an *effective strategy* in increasing test performance. Therefore, it is hypothesized H1) Under high time pressure, participants will allocate more study-time to judged-easy, where under low time pressure, participants will not show a preference for study-time allocation, regardless of their personality trait and/or beliefs about intelligence; H2) Under high time pressure, participants who score high on Conscientiousness will use *less effective metacognitive strategie*s (i.e., will not choose to allocate more study time to judged-easy passages) compared to participants who score low on Conscientiousness; H3) Under high time pressure, students who identify with an incremental theory of intelligence will use *less effective metacognitive strategies* (i.e., will not choose to allocate more study time to judged-easy passages) compared to participants who

identify with an entity theory of intelligence; and H4) Students who identify with an incremental theory of intelligence will also score high on Conscientiousness.

Chapter III

METHODS

Participants

All participants were recruited in accordance with institutional review board procedures. Participants were undergraduate students from Columbia University enrolled in an introductory psychology class. Approximately two thirds of participants were recruited in one term (Spring 2016) and the other third in a subsequent term (Fall 2016). The students received course credit for their participation. No participants were excluded based on gender, race, or ethnicity. The original sample consisted of 127 students but two students were eliminated because their computer program crashed during the study and their experimental data could not be recovered. A third participant was eliminated because she did not follow instructions. The total sample used for the analyses was 124 participants. The mean age for the sample was 21.62 years (SD=4.17) and ranged from 18.00 to 32.75 years. Fifty-three percent of the sample was female (n = 66). Race/ethnicity reported by the participants was as follows: White American (31.4%), Asian American/Pacific Islander (30.6%), Multiple Races/Ethnicities (19.4%), Latino/a (9.7%) and Black/African American (8.9%). Twenty-three percent were declared psychology majors.

Design

The study replicated the general study-time allocation paradigm used in Son and Metcalfe (2000), with some modifications to address specific research questions. The design used in Son and Metcalfe consisted of a judgment phase, where participants rated written material for difficulty and interest, a studying phase, where participants were allotted a given an amount of time to study the material, and a testing phase, where participants were tested on the material

they studied. The main differences between the Son and Metcalfe study and this dissertation study are the: 1) administration of measures of affective variables (personality and motivation, 2) length of materials participants' studied, and 3) memory test format. These differences are discussed in greater detail below. The main between-subjects manipulation, which is consistent with Son and Metcalfe, was the amount of time the participants were allotted to study materials (high time pressure vs. low time pressure).

Materials

Most of the data were collected using a computer program to effectively capture participants' studying behaviors and efficiently score materials. The personality questionnaire was a self-report measure filled out by hand since it is a standardized form that could not be replicated on the computer program for scoring purposes. Materials displayed with the computer program included a demographic questionnaire, a motivation questionnaire, the eight study passages, and a multiple-choice test.

Demographics. The demographics questionnaire was used to collect information about participants' gender, age, race/ethnicity, year in school, and GPA. There was also a question asking participants to provide their SAT scores. Studies have shown a significant correlation between SAT scores and cognitive ability (Frey & Determan, 2004), so participants' SAT scores were used as a control for aptitude. However, Frey and Determan (2004) had access to university records so SAT scores were not self-reported, which is the case in the current study. Lastly, there was a question about whether participants are psychology majors.

Five Factor Model of Personality. To measure the construct of personality, this study used the NEO Five-Factor Inventory-3 (NEO-FFI-3; McCrae & Costa, 2007), which is a 60-item

self-report questionnaire that provides a measure of the five domains of personality of adolescents and adults. The five domains include: Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. Participants rated descriptive statements between 1 and 5 (1 = Strongly Disagree and 5 = Strongly Agree) based on how true the statement is of them. Using the scoring criteria in the NEO-FFI-3 manual, participants' self-reported raw scores across the five personality domains were converted to standardized *T*-scores. The *T*-scores for each of the five domains were then used to determine the qualitative description, which ranged from "Very Low" to "Very High." Based on these ranges, the qualitative description was recoded into a numerical variable from 1 to 5, with 1 being "Very Low," 2 being "Low," 3 being "Average," 4 being "High," and 5 being "Very High," Participants who were considered low-to-average on Conscientiousness had ratings between 1 and 3, where participants who were considered high on Conscientiousness had ratings between 4 and 5.

The NEO FFI-3 has high internal consistency ($\propto$ =.78 -.86), and converges with the NEO-Personality Inventory from which the items were derived (McCrae, Costa, & Paul 2007), as well as other measures of personality (Costa & McCrae, 1992). The internal consistency for each of the five scales, which consisted of 12 items for each scale, was as follows: Neuroticism ($\propto$ = .82), Extraversion ($\propto$ = .80), Openness ($\propto$ = .78), Agreeableness ($\propto$ = .72) and Conscientiousness ($\propto$ = .83). The internal consistency for the current sample was also high ($\propto$ = .74, N = 124). The internal consistency for each of the five scales in the current sample was as follows: Neuroticism ($\propto$ = .89), Extraversion ($\propto$ = .84), Openness ($\propto$ = .76), Agreeableness ($\propto$ = .79), and Conscientiousness ($\propto$ = .85). While the internal consistency reported by the authors of the NEO-FFI-3 and observed in the current sample was high, the reliability for Neuroticism,

Extraversion, and Conscientiousness was higher than the reliability for Conscientiousness and Agreeableness in both cases.

Implicit Theories of Intelligence. To measure implicit theories of intelligence, the study used questions developed by Henderson, Dweck, and Chiu (1992). There are three items in total and they consist of statements that depict intelligence as a fixed entity. Participants rated each item on a scale of 1 to 6 based on their degree of agreement with each statement (with 1 = Strongly Agree and 6 = Strongly Disagree). The score was averaged, and an average score less than or equal to 3 is classified as having an entity theory of intelligence, where a score greater than or equal to 4 is classified as having an incremental theory of intelligence. Participants who scored between a three and four do not indicate a clear theory. While there are questionnaires that include more than three items, Hong, Chiu, and Dweck (1994) argue that only three items are included because the items have the same meaning, and continued repetition of the same idea is potentially tedious. They report high internal consistency ($\propto$ = .96, N = 50) and high test-retest reliability (r = .82, N=50). The internal consistency for the sample in the current study was also high ($\propto$ = .93, N = 124). A sample item includes, "You have a certain amount of intelligence and you really can't do much to change it."

Passages. The passages selected for this study were chosen based on length and topic. First, the passages had to be long enough to reflect the more realistic studying conditions seen in the classroom, where total mastery of material while studying is not possible, but short enough that participants in the low time pressure studying condition could study all the materials completely. Passages were also selected to capture a breadth of topics so there would be variability in reader interest and difficulty. The passages were taken from Wikipedia, which is an online public encyclopedia. Wikipedia is a freely licensed encyclopedia so its contents can be

copied and used for any purpose. There are a total of eight passages, and passage length ranged from 123 words to 193 words. Five graduate students (four female, one male) were instructed to select two passages on topics of interest, and as a group, they determined which eight best met the above conditions. The passage titles are: Angkor Wat, Emergency Banking Act, Infinite Jest, Magnetohydrodynamics, Rococo Movement, Succulent Plants, Video Game Addiction, and William T. G. Morton. Appendix E contains the passages.

***Pretesting of Passages*.** Data from the pilot study was used to determine the amount of study time allotted to the participants in each condition (high time pressure and low time pressure). The participants in the pilot were graduate students and were required to participate in all components of the current study. The only deviation was the amount of time allotted to each condition since one of the purposes of the pilot was to determine this. The goal of the high time pressure condition was to create a studying environment where the participants did not have enough time to study all of the passages. Conversely, the goal of the low time pressure condition was to create a studying environment where participants had enough time to comfortably read all of the passages. In the pilot study, participants in the low time pressure condition (n = 5) were given unlimited time to study the passages. The range of overall study time for participants in the low time pressure condition was 8 to 16 minutes, with a mean study time of 11.4 minutes. Since the purpose of the low time pressure condition is to allot sufficient time to participants to study all of the passages, the *maximum* amount of study time observed in the pilot study (16 minutes) was used for the low time pressure condition in the current study.

Participants in the high time pressure condition (n = 5) were given nine minutes to study the passages. The range of overall study time for participants in the high time pressure condition was 8 to 9 minutes, with a mean of 8.5 minutes. Since the purpose of the high time pressure

condition was to allot insufficient time to participants to study all of the passages, the *minimum* amount of time observed in the pilot study for studying (eight minutes) was used for the high time pressure condition in the dissertation study.

Multiple Choice Test. The memory test consists of 48 multiple-choice questions based on the eight passages. There are six questions per passage. Four of the questions are memory items based on information stated explicitly in the text. Two of the questions for each passage are inference items that require participants to draw inferences in order to answer the questions. Two independent raters, who were psychology graduate students, rated question type (inference or memory item) to determine inter-rater agreement. The inter-rater reliability was high (r = .81, p <.01). Analysis of internal consistency for total test items yielded a Cronbach's alpha coefficient of 0.81 (N = 124), as was the internal consistency for the memory items, which yielded a Cronbach's alpha coefficient of 0.74 (N = 124). Internal consistency for the inference items was lower, yielding a Cronbach's alpha coefficient of 0.60 (N = 124).

Procedure

The study occurred in one session. Participants were told the following about the study prior to participation: "You are invited to participate in a research study on individual differences in reading and studying. You will be asked to fill out questionnaires. You will also provide your perceptions about how easy or interesting material will be to learn, study passages, and take a test on the passages you studied." Participants first filled out the NEO-FFI-3. They then began the experiment by accessing a computer program that navigated participants through the phases of the study. The experiment on the computer consisted of three phases: judgment of passages, studying of passages, and the multiple-choice test. Participants completed the demographic

questionnaire and answered the questions regarding their beliefs about their intelligence in between studying the passages and taking the test as a distractor task.

Judgment Phase. Participants were first asked to read the titles and the first two lines of each passage, and based on this information rate each passage for ease of learning (EOL) and interest (JOI). JOI and EOL data were collected to replicate findings in Son and Metcalfe (2000) where there were high correlations between EOLs and JOIs, such that passages that were judged-easy were also judged more interesting. Participants first rated each passage based on EOL (with 1 = easiest and 8 = most difficult) and JOI (with 1 = most interesting and 8 = least interesting). Once participants rated the passages, they were then asked to rank the passages in terms of EOL and JOI in case any of the passages received the same rating. If participants did not give any passages the same rating, the computer program ranked the passages automatically based on their initial ratings. Participants' initial ratings of EOL and JOI were collected in addition to their forced ranking of the passage in order to obtain initial perceptions of the passages and to see if their ranking deviated from their initial judgments. In sum, each participant had ratings of EOL and JOI for each passage, as well as the rank order of EOL and JOI for all eight passages.

Studying Phase. Prior to the study, participants were randomly assigned to one of two conditions: high-time pressure and low-time pressure. They were assigned unique identification numbers. Participants with odd identification numbers were in the high time pressure condition, and participants with even identification numbers were in the low time pressure condition. Participants in the high time pressure condition were allotted eight minutes to study the passages, and participants in the low time pressure condition were allotted 16 minutes to study all of the passages. Participants in the high time pressure condition received the following instructions: "You will now have the opportunity to read through and study the full passages for eight

minutes. You can always go back to one that you've read and studied already. Note taking is not allowed. There will be a test after the 8 minutes has ended, and it will be testing the material from all 8 passages." Participants in the low time pressure condition received the following instructions: "You will now have the opportunity to read through and study the full passages for 16 minutes. You can always go back to one that you've read and studied already. Note taking is not allowed. There will be a test after the 16 minutes has ended, and it will be testing the material from all 8 passages." All eight passage titles were displayed in a circular array on the computer screen. Their position within the circular array was randomized. There was a clock displaying the remaining study time. Participants were able to select passages to study from the main menu in any order and at any time could return to the main menu to select a different passage. The computer program recorded each participant's studying activities. The following data were captured: the total time studying, the cumulative time spent on each passage, which passages were read, the total number passages read, the order in which the passages were read, and the number of times participants viewed each passage. Once the allotted time ran out, participants were immediately taken to the demographics questionnaire.

Test Phase. The participants received a 48-item, multiple choice test. The questions were grouped together by passage, but the order the participants' answer to each of the passage's questions was presented randomly on the computer screen. Three scores were recorded by the computer: total items correct, total memory items correct, and total inference items correct. Participants had unlimited time to answer the questions, however, the computer program recorded the amount of time participants took to complete the test.

Research Design

This study used an experimental design to explore and clarify the relationship between personality traits, implicit theories of intelligence, and metacognitive control over study time allocation and subsequent test performance. The experiment consisted of one between-subjects factors, which was time allotted to study the passages, or time pressure (High Time Pressure vs. Low Time Pressure). The dependent variables included test performance and metacognitive strategy.

Chapter IV

RESULTS

This study sought to explore and clarify the relationship between personality traits, motivational variables, and metacognitive control over study time allocation and subsequent test performance when faced with varying time pressure, in order to replicate the general study-time allocation findings from Son and Metcalfe (2000). In addition, this study investigated the following research questions: (1) Is there a relationship between any of the Five Factor personality traits and metacognitive strategy use? (2) Is there a relationship between any of the Five Factor personality traits and test performance? (3) Is there a relationship between implicit views of intelligence and metacognitive strategy use? (4) Is there a relationship between implicit views of intelligence and test performance? (5) Is there an association between the Five Factor personality traits and implicit views of intelligence?

Based on previous research, it was hypothesized: H1) Under high time pressure, participants will allocate more study-time to judged-easy passages, where under low time pressure, participants will not show a preference for study-time allocation, regardless of their personality traits and/or beliefs about intelligence; H2) Under high time pressure, participants who score high on Conscientiousness will use *less effective metacognitive strategie*s (i.e., will not choose to allocate more study time to judged-easy passages) compared to participants who score low on Conscientiousness; H3) Under high time pressure, students who identify with an incremental theory of intelligence will use *less effective metacognitive strategies* (i.e., will not choose to allocate more study time to judged-easy passages) compared to participants who identify with an entity theory of intelligence; and H4) Participants who identify with an incremental theory of intelligence will also score high on Conscientiousness.

As previously stated, the dependent variables included test performance and metacognitive strategy use, which was determined by using Goodman-Kruskal Gamma correlations (*G*). Gamma correlations are nonparametric rank order correlations, and were computed to examine the relationship between participants' metacognitive judgments (i.e., EOL and JOI rankings of passages) and metacognitive decisions while studying (i.e., the amount of time allotted to each passage), as well as between metacognitive judgments (EOL) and test performance. Gamma correlations have been used in the majority of studies on metacognitive judgment accuracy. As argued by Nelson (1984), gamma correlations are the best available tool for metacognitive research, especially when there are ties in the data. Multiple gamma correlations were computed. The first gamma correlations measured the total study time allocated to each of the eight passages as they related to each person's 1) EOL judgment of each passage, and 2) JOI judgment of each passage. A positive correlation indicates participants allocated more study time to passages judged as difficult or not interesting, and a negative correlation indicates participants allocated more study time to passages judged as easy or interesting. Another gamma correlation between participants' EOL and test performance was computed. A negative gamma correlation indicates participants performed better on judged-easy passages, where a positive correlation indicates participants performed better on judged-difficult passages.

Frequency of Personality Traits in the Sample

Since many of the research questions pertained to participants' self-reported personality traits, a closer examination of the frequency of each trait within the sample was conducted. Using the scoring criteria in the NEO-FFI-3 manual, participants' self-reported raw scores across

the five personality domains were converted to standardized *T*-scores. The *T*-scores for each of the five domains were then used to determine a qualitative description, which ranged from "Very Low" to "Very High." Based on these ranges, the qualitative description was recoded to a numerical variable from 1 to 5, with 1 being "Very Low," 2 being "Low," 3 being "Average," 4 being "High," and 5 being "Very High,". Participants who were considered low-to-average on Conscientiousness had ratings between 1 and 3, where participants who were considered high on Conscientiousness had ratings between 4 and 5. Of note, there was only a small number of participants who rated themselves as "Very High" on Conscientiousness (n =11) and Agreeableness (n = 6). No participants rated themselves as "Very Low" on Openness. Frequencies for each personality trait in the sample are reported in Table 1.

Table 1
Personality Trait Frequencies in the Sample (n = 124)

	Very Low	*Low*	*Average*	*High*	*Very High*
Neuroticism	11	21	26	37	29
Extraversion	13	19	41	29	22
Conscientiousness	20	28	49	16	11
Openness	0	8	25	42	49
Agreeableness	25	25	45	23	6

As previously discussed, participants' initial ratings of EOLs and JOIs were collected in order to see if their ranking deviated from their initial rating of the passages. The rankings were positively and significantly correlated to initial ratings for both EOLs (Study Time: G = .83, p < .01; Test Performance: G = .83, p < .01) and JOIs (G = .84, p < .01), so only the rankings were reported in subsequent data analyses, unless they deviated from the initial ratings.

Table 2 contains the mean gamma correlations, standard deviations, and ranges by time pressure condition for the total sample. Table 3 contains the means, standard deviations, and ranges for test performance and predictor variables for the total sample. As a reminder, participants who have a mean greater than three identify with an incremental theory of intelligence. All variables met assumptions of normality so no transformations were performed.

Table 2
Mean Gamma Correlations by Time Pressure

	High Time Pressure			*Low Time Pressure*		
	Mean	*SD*	*Range*	*Mean*	*SD*	*Range*
EOL and Study-Time (*G*)	-.03	.32	-.73 to.79	.03	.31	-.71 to .57
JOI and Study-Time (*G*)	-.01	.34	-.91 to. 74	.01	.34	-.86 to 1.00
EOL and Test Performance (*G*)	-.06	.40	-1.00 to .80	-.02	.44	-1.00 to1.00

Table 3
Means, Standard Deviations, and Ranges for Predictor and Outcome Variables by Time Pressure

	High Time Pressure			*Low Time Pressure*		
	Mean	*SD*	*Range*	*Mean*	*SD*	*Range*
Test Performance (% Correct)	.65	.12	.35 to .88	.71	.15	.25 to.94
Implicit Views of Intelligence*	4.14	1.18	1.67 to 6.00	3.94	1.25	1.00 to 6.00
Neuroticism	3.26	1.29	1.00 to 5.00	3.58	1.22	1.00 to 5.00
Extraversion	3.27	1.22	1.00 to 5.00	3.12	1.22	1.00 to 5.00
Openness	4.05	.93	2.00 to 5.00	4.10	.93	2.00 to 5.00
Agreeableness	2.92	1.11	1.00 to 5.00	2.44	1.13	1.00 to 5.00
Conscientiousness	2.71	1.16	1.00 to 5.00	2.81	1.13	1.00 to 5.00

***** >3 indicates an incremental theory of intelligence

Intercorrelations

Intercorrelations among the independent and dependent variables within the total sample are presented in Table 4. Time pressure was significantly correlated with Agreeableness (r = -.21, p < .05) and test performance (r = .21, p < .05). Neuroticism was significantly correlated

with Extraversion (r = -.36, p < .01), Agreeableness (r = -.27, p < .01), and Conscientiousness (r = -.31, p < .01). Agreeableness was also significantly correlated with the gamma correlation for the relation between EOLs and study time allocation (r = -.22, p < .05). Openness was significantly correlated with test performance (r = .24, p < .01). Participant's EOL judgments, were significantly correlated (gamma correlation) with overall test performance (r = .21, p < .05), which indicates that participants who performed better on judged-difficult passages also obtained higher test scores.

Both parametric (Pearson's r) and non-parametric (G) correlations were computed and reported to examine the relationship between EOLs and JOIs since these variables involved rankings. EOLs were significantly related to JOIs, both for initial ratings (r = .42, p < .01; G = .30, p < .01) and rankings (r = .43, p < .01; G = .33, p < .01). This is consistent with previous findings (G = .25; Son & Metcalfe, 2000).

The hypothesis that participants who identified with an incremental theory of intelligence will also score high on Conscientiousness was not confirmed. In contrast, participant's implicit theories of intelligence was significantly correlated with Openness (r = .20, p < .05). The degree to which participants identified with an incremental theory of intelligence increased as a function of Openness.

Table 4
Intercorrelations Among the Independent and Dependent Variables

	1	2	3	4	5	6	7	8	9	10	11
1. Gamma EOL x Study-Time	--										
2. Gamma JOI x Study-Time,	.43**	--									
3. Gamma EOL x Test	-.05	-.08	--								
4. Time Pressure	.09	.03	.04	--							
5. Multiple Choice Test	.11	< .01	.21*	.21*	--						
6. Implicit Views of Intel.	-.08	-.13	-.05	-.09	.03	--					
7. Neuroticism	.06	.01	-.04	.13	-.07	<.01	--				
8. Extraversion	.06	<.01	.08	-.04	-.15	.10	-.36**	--			
9. Openness	-.07	-.12	-.12	.02	.24**	.20*	-.14	.02	--		
10. Agreeableness	-.22*	-.08	.04	-.21*	.07	.05	-.27**	.06	.02	--	
11. Conscientiousness	.04	-.09	.04	.04	<.01	-.06	-.31**	.02	-.12	-.01	--

*p<0.05
**p<.001

Intercorrelations among the demographic variables and the independent and dependent variables were also explored. There were significant correlations between age and beliefs about intelligence ($r = .23$, $p < .01$), which indicates that as participants' age increased, they were more likely to identify with an incremental theory of intelligence. Additionally, year in school and Openness was significantly correlated, ($r = .29$, $p < .01$), as was declared psychology majors and time pressure ($r = .21$, $p < .05$). Lastly, GPA was positively correlated with test performance ($r = .19$, $p < .05$). Of note, reported SAT scores, which are thought to be correlated to cognitive ability (Frey & Determan, 2004), were not significantly related to any of the independent of dependent variables.

Univariate Tests Independent of Personality and Implicit Theories of Intelligence

A one-way ANOVA was conducted to compare the means between the high time pressure and low time pressure conditions for overall test performance, performance on memory items, performance on inference items, and metacognitive strategy-use. The univariate test was run without the personality and implicit views of intelligence variables to examine whether

findings were consistent with Son and Metcalfe (2000). The purpose of these analyses was also test the hypothesis that when faced with high time pressure, participants would allocate more study-time to judged-easy passages, but when faced with low time pressure, participants would not show a preference for study-time allocation. Results of the univariate ANOVA for test performance as a function of time pressure are presented in Table 5. Results from the univariate ANOVA for the relation between metacognitive judgments and study time allocation are presented in Table 6.

Table 5
Univariate ANOVAs Comparing Test Performance Between High Time Pressure and Low Time Pressure

	High Time Pressure		*Low Time Pressure*			
	Mean	*SD*	*Mean*	*SD*	*F-value*	*p-value*
% Total Correct	.65	.12	.71	.15	5.46	.02*
% Memory Items Correct	.67	.12	.73	.17	5.93	.02*
% Inference Items Correct	.60	.17	.65	1.22	2.84	.10

*$p < .05$

Table 6
Univariate ANOVAs Comparing Metacognitive Judgments and Study-Time (Gamma Correlations) Between High Time Pressure and Low Time Pressure

	High Time Pressure		*Low Time Pressure*			
	Mean	*SD*	*Mean*	*SD*	*F-value*	*p-value*
EOL and Study-Time (*G*)	-.03	.32	.03	.31	.97	.33
JOI and Study-Time (*G*)	-.01	.34	.01	.34	.11	.75
EOL and Test Perform. (*G*)	-.06	.40	-.02	.44	.21	.65

*$p < .05$

Test Performance. The mean proportion correct on the multiple choice test for the high time pressure group was significantly lower than the mean proportion correct for the low time

pressure group, $F(1, 122) = 5.46$, $p < .05$. These findings are consistent with Son and Metcalfe (2000). Further, the mean proportion of both memory and inference items correct on the test for the high time pressure group was lower than the low time pressure group, but only the difference between memory items reached significance, $F(1, 122) = 5.93$, $p < .05$. Overall, participants performed better on memory items ($M = .70$) than inferences items ($M = .62$).

Additionally, a gamma correlation between participants' EOL and test performance was computed. As previously stated, a negative gamma correlation indicates participants performed better on judged-easy passages, where a positive correlation indicates participants performed better on judged-difficult passages. The mean gamma correlation for participants in the high time pressure condition was -.06 and the mean gamma correlation for participants in the low time pressure condition was -.02. The difference between the conditions did not reach statistical significance, $F(1,120) = .21$, $p = .65$), and the gamma correlations were not significantly different than zero. These results indicate that participants EOL judgments were not related to their test performance.

Metacognitive Judgments and Study-Time Allocation. Gamma correlations in these analyses measured the total study time allocated to each of the eight passages as they related to each person's EOL and JOI of each passage. As stated earlier, a positive correlation indicates participants allocated more study time to judged-difficult or judged-boring passages, and a negative correlation indicates participants allocated more study time to judged-easy or interesting passages.

The mean gamma correlations between EOL and study time for participants in the high time pressure condition and low time pressure condition were -.03 and .03, respectively. Neither correlation was significantly different than zero (high time pressure: $t(60) = -.71$, $p = .48$; low

time pressure: $t(61) = .68$, $p = .50$). The mean gamma correlations between JOI and study time for participants in the high time pressure condition and low time pressure condition were -.01 and .01, respectively. Neither correlation was significantly different than zero (high time pressure: $t(60) = -.12$, $p = .91$; low time pressure: $t(61) = .34$ $p = .73$).The difference between the high time pressure condition and the low time pressure condition did not reach statistical significance either for the relationship between EOL judgments and study time, $F(1,122) = 0.97$, $p = .33$) or the relationship between JOI judgments and study time, $F(1,122) = 0.11$, $p = .75$. Further, since the gamma correlations for both groups were not significantly greater than zero, this suggests that participants did not show a preference for study-time allocation in this study with regard to how interesting or difficult they found the material regardless of time pressure. While this partly confirms the hypothesis that people faced with low time pressure would not show a preference for study-time allocation, participants did not show a preference for study-time allocation regardless of time pressure.

The order in which participants studied the passages was also examined, since it is possible participants chose to study certain passages earlier based on EOL or JOI judgments. Previous studies have found that participants chose to study easier materials first (Son & Metcalfe, 2000; Thiede & Dunlosky, 1999). Another set of gamma correlations were computed between participants' EOLs and the order they studied the passages, as well as between participants' JOIs and the order they studied the passages. A positive gamma correlation indicates that participants chose to study passages ranked as easy or interesting first, and a negative correlation indicates participants chose to study passages ranked as difficult or less interesting first.

Upon inspecting the data, 68 participants studied the passages in the order they appeared

on their computer screen as opposed to using their EOLs or JOIs. Whether or not participants studied the passages in the order they appeared was not significantly correlated to any of the independent or dependent variables. However, when these 68 participants were removed from analyses, while the difference between the high time pressure condition and low time pressure was not significant (EOL: $F(1, 53) = .09$, $p > .05$; JOI: $F(1, 53) = .23$, $p > .05$), the mean gamma correlation between EOL and JOI judgments and passage study order was significantly greater than zero for both EOLs, $G = .21$, $t(54) = 4.12$, $p < .01$, and JOIs, $G = .23$, $t(54) = 4.33$ $p < .01$. This means that participants who used their metacognitive judgments chose to study judged-easy and judged-interesting passages first, regardless of time pressure, which confirms previous findings (Son & Metcalfe, 2000; Thiede & Dunlosky, 1999). Given the number of participants that did not use their metacognitive judgments to make decisions about the order they studied the passages, this set of gamma correlations was not included in the main analyses.

In general, participants did not allocate study-time on the basis of EOLs and thus the finding that participants would allocate more study-time to judged-easy material was not replicated. Follow-up analyses were conducted to further explore any other trends. Firstly, it is possible that the passages did not vary enough in difficulty or interest for participants to behave systematically. To evaluate this, frequency of initial ratings of passages on the basis of both EOLs and JOIs were examined. As a reminder, participants first rated each passage based on EOL (with 1 = easiest and 8 = most difficult) and then on JOI (with 1 = most interesting and 8 = least interesting). Initial JOIs were evenly distributed, indicating adequate variability. In contrast, for initial EOLs, most passages were rated between a 1 and 5. This indicates that the passages were not initially perceived as very difficult.

To examine whether participants who did initially judge the material as varying in difficulty had a preference for study-time allocation, participants who did *not* initially judge passages as difficult or very difficult (i.e., did not rate any passages as a 7 or 8) were removed from the analysis. There were 70 participants who perceived at least one passage as difficult or very difficult (i.e., did rate a passage as a 7 or 8). The difference in mean gamma correlations between EOLs and study-time for these participants in the high time pressure and low time pressure condition approached significance, $F(1, 69) = 3.12$, $p = .08$, indicating a trend consistent with the findings in Son and Metcalfe (2000). They were more likely to allocate study-time to judged-easy passages when faced with time pressure. While the gamma correlation was not significantly greater than zero, $G = -.11$, $t(34) = -1.88$, $p = .06$, it also approached significance. In contrast, participants in the low time pressure condition did not show a preference for study-time allocation, $G = .03$, $t(35) = .54$, $p > .05$. This indicates that participants who judged at least one passage as difficult did in fact use metacognitive judgments to allocate study-time to a greater degree than participants who did not.

Additionally, an extreme group analysis of the Gamma correlations between metacognitive judgments and study-time allocation was conducted by eliminating participants whose Gamma correlations were close to zero ($n = 25$). The cutoff points used were -0.2 and 0.2. These were selected as cutoff points because values smaller than that are relatively close to zero, which indicates no preference for study time. The results indicated no significant differences between participants in the high time pressure condition and participants in the low time pressure condition with regard to study-time allocation on the basis of metacognitive judgments (EOLs and JOIs). See Table 19 in Appendix B for results from the univariate ANOVA from these analyses. Lastly, a median split was performed using zero as a cutoff point and a Pearson Chi-

Square analysis was conducted to see if there were any differences between participants who allocated study-time to judged-easy items and participants who allocated study-time to judged-difficult items on the basis on time pressure, as well as to participants who allocated study-time to judged-interesting items to participants who allocated study-time to judged-boring items. Neither Chi-Square test was significant, EOL: Pearson Chi-Square (1, 123) = .07, $p > .05$; JOI: Pearson Chi-Square (1, 123), = .23, $p > .05$.

Univariate Tests with Personality Traits and Implicit Theories of Intelligence

Conscientiousness, Metacognitive Judgments and Study-Time Allocation. It was hypothesized that participants who scored high on Conscientiousness would use less effective metacognitive strategies compared to participants who rated themselves low on Conscientiousness when faced with time pressure. The variable Conscientiousness was transformed to distinguish participants who rated themselves high on Conscientiousness from participants who rated themselves average or low on Conscientiousness. Based on the qualitative descriptions provided in the NEO-FFI-3 manual, the qualitative description was recoded to a numerical variable from 1 to 5, with 1 being "Very Low," 2 being "Low," 3 being "Average," 4 being "High," and 5 being "Very High," Participants who were considered low-to-average on Conscientiousness had ratings between 1 and 3, where participants who were considered high on Conscientiousness had ratings between 4 and 5.

To test this hypothesis, a two-way ANOVA was conducted to compare the means between the time pressure condition (high vs. low), Conscientiousness (high vs. low-to-average), and their interaction (Conscientiousness* Condition) for metacognitive strategy-use, or gamma correlations (*G*) between EOL judgments and study time and JOI judgments and study-time.

The ANOVA indicated a significant difference between participants high on Conscientiousness and participants low-to-average on Conscientiousness for the gamma correlation between JOIs and study-time (gamma correlation), $F(3, 119) = 3.95$, $p < .05$. Participants high on Conscientiousness were more likely to allocate study-time to judged-interesting material compared to participants who were low-to-average on Conscientiousness. This finding, coupled with an insignificant interaction between Conscientiousness and time pressure, does not confirm the hypothesis that participants who rated themselves high on Conscientiousness would use ineffective metacognitive strategies compared to participants who rated themselves low on Conscientiousness. The results from the univariate ANOVA analysis are presented in Table 7. Further interpretation of the gamma correlations is provided below.

Table 7
Univariate ANOVAs Comparing Metacognitive Judgments and Study-Time (Gamma Correlations) Between Time Pressure and Degree of Conscientiousness

	EOLs		*JOIs*	
	F-value	*p-value*	*F-value*	*p-value*
Time Pressure	.00	.97	.01	.93
Conscientiousness	1.82	.18	3.94	.05*
Time Pressure*Conscientiousness	2.47	.12	.47	.50

*$p < .05$

The mean gamma correlations between EOLs and study-time allocation and JOIs and study-time allocation for participants who rated themselves high on Conscientiousness were not statistically significant from zero. This was true for participants in the high time pressure condition (EOL: $G = -.02$, $t(12) = -.15$, $p = .89$; JOI: $G = -.09$, $t(12) = -.65$, $p = .53$) and the low time pressure condition (EOL: $G = -.13$, $t(13) = -1.86$, $p = .09$; JOI: $G = -.14$, $t(13) = -1.53$ $p = .15$). Similarly, the gamma correlations for participants who rated themselves low-to-average

on Conscientiousness were not significant, both when faced with high time pressure (EOL: G = -.03, $t(47)$ = -.77, p = .45; JOI: G = .02, $t(47)$ = .34, p =.73) and low time pressure (EOL: G = .07, $t(47)$ = 1.60, p = .12; JOI: G =.06, $t(47)$ = 1.23, p = .23). The overall gamma correlations were also not significantly different from zero independent of time pressure for participants high on Conscientiousness (EOL: G = .02, $t(95)$ = .63, p = .53; JOI: G =.04, $t(95)$ = 1.14, p = .26) or participants low-to-average on Conscientiousness (EOL: G = .02, $t(95)$ = .63, p = .53; JOI: G =.04, $t(95)$ = 1.14, p = .26). Overall, these gamma correlations indicate that participants did not show a strong preference for study-time allocation based on their metacognitive judgments regardless of time pressure or degree of Conscientiousness. Table 8 contains the means of the gamma correlations (G) for Conscientiousness separated by condition and degree of Conscientiousness.

Table 8
Mean Gamma Correlation (G) for Conscientiousness by Time Pressure Condition

	High Time Pressure		*Low Time Pressure*		*Total*	
	*High C** (*n* = 13)	*Low C.*** (*n* = 48)	*High C.** (*n* = 14)	*Low C.*** (*n* = 48)	*High C.** (*n* = 27)	*Low C.*** (*n* = 96)
EOL and Study-Time (*G*)	-.02	-.03	-.13	.07	-.07	.02
JOI and Study-Time (*G*)	-.09	.02	-.14	.06	-.11	.04

*Participants high on Conscientiousness had average ratings >3
**Participants low on Conscientiousness had average ratings ≤ 3

Again, many participants did not initially judge the material as varying in difficulty (n = 54). An additional two-way ANOVA using the same independent variables above was conducted to investigate the relationship between EOL and study-time allocation, excluding those participants who did not initially judge any passages as difficult. The ANOVA test was not significant and none of the gammas were significantly different than zero. However, the mean gamma correlations across time conditions suggest that participants high on Conscientiousness

were allocating study-time to judged-easy passages to some degree. This is contrary to the hypothesis that participants high on Conscientiousness would use ineffective metacognitive strategies when faced with time pressure. The results from the ANOVA analysis are presented in Table 9. Table 10 contains the means of the gamma correlations (*G*) separated by condition and degree of Conscientiousness.

Table 9
Univariate ANOVAs Comparing EOLs and Study-Time (Gamma Correlations) Between Time Pressure and Degree of Conscientiousness[1]

	EOLs	
	F-value	*p-value*
Time Pressure	.71	.40
Conscientiousness	1.25	.27
Time Pressure*Conscientiousness	.63	.43

*$p < .05$
[1]Excluding participants with no initial EOL ratings ≥ 7

Table 10
Mean Gamma Correlation (G) for Conscientiousness by Time Pressure Condition[1]

	High Time Pressure		*Low Time Pressure*		*Total*	
	High C (n = 8)*	*Low C.** (n = 27)*	*High C.* (n = 6)*	*Low C.** (n = 30)*	*High C.* (n = 14)*	*Low C.** (n = 57)*
EOL and Study-Time (*G*)	-.14	-.10	-.13	.06	-.14	-.02

*Participants high on Conscientiousness had average ratings >3
**Participants low on Conscientiousness had average ratings ≤ 3
[1]Excluding participants with no initial EOL ratings ≥ 7

Conscientiousness and Test Performance. A two-way ANOVA was conducted to compare the means between time pressure, degrees of Conscientiousness, and their interaction across overall test performance. As previously confirmed, the participants in the low time pressure condition obtained higher test scores than participants in the high time pressure condition, $F(3, 120) = 4.01$, $p < .05$. However, results indicated that neither the degree of

Conscientiousness nor the interaction between Conscientiousness and time pressure impacted test performance. Table 11 contains the results from the ANOVA, and Table 12 contains the mean test performance as function of time pressure and Conscientiousness.

Table 11
Univariate ANOVAs Comparing Test Performance Between Time Pressure and Degree of Conscientiousness

	F-value	*p-value*
Time Pressure	4.01	.04*
Conscientiousness	.01	.91
Time Pressure*Conscientiousness	.03	.87

*$p < .05$

Table 12
Mean Test Performance for Conscientiousness by Time Pressure Condition

	High Time Pressure		*Low Time Pressure*		*Total*	
	High C (n = 13)*	*Low C.** (n = 48)*	*High C.* (n = 14)*	*Low C.** (n = 48)*	*High C.* (n = 27)*	*Low C.** (n = 96)*
% Total Correct	.65	.65	.71	.70	.68	.68

*Participants high on Conscientiousness had average ratings >3
**Participants low on Conscientiousness had average ratings ≤ 3

Implicit Theories of Intelligence, Metacognitive Judgments and Study-Time Allocation. It was also hypothesized that participants who identified with an incremental theory of intelligence would use less effective metacognitive strategies than participants who identified with an entity theory of intelligence when faced with high time pressure. The measure of implicit theories of intelligence was transformed to distinguish participants who identified with an incremental theory of intelligence from participants who identified with an entity theory of intelligence or who did not strongly identify with either theory. As discussed in the previous chapter, participants rated statements that depicted entity theories of intelligence on a scale of 1-6 based on their degree of agreement with each statement (with 1 = Strongly Agree and 6 =

Strongly Disagree). The score was averaged, and an average score less than equal to 3 was classified as having an entity theory of intelligence, where a score greater than or equal to 4 was classified as having an incremental theory of intelligence. Participants who scored between a three and four did not indicate a clear theory.

To test this hypothesis, a two-way ANOVA was conducted to compare the means between time pressure condition (high vs. low), implicit theories of intelligence (incremental vs. entity), and their interaction (Implicit Theory of Intelligence* Condition) for metacognitive strategy-use (gamma correlations (*G*) between EOL judgments and study time and JOI judgments and study-time). For the first ANOVA, participants who did not strongly identify with either theory were excluded from this analysis (n = 32). The ANOVA was not significant, which indicates that there were no significant differences between participants who strongly identified with an incremental theory of intelligence and participants who strongly identified with an entity theory of intelligence for metacognitive strategy-use. Table 13 contains the results from the ANOVA.

A second ANOVA was conducted including participants who did not strongly identify with either theory. Specifically, participants who had an average score of less than or equal to three were in one group (entity theory of intelligence), and participants who had a score greater than three were in another group (incremental theory of intelligence). With the exception of the inclusion of those participants, the independent and dependent variables were the same as those in the first ANOVA. Results from the ANOVA indicate a significant interaction between implicit theories of intelligence and time pressure condition for the gamma correlation between JOIs and study-time, $F(3, 119) = 3.93$, $p < .05$. Under high time pressure, participants who identified with an incremental theory of intelligence were more likely to allocate study-time to judged-

interesting passages compared to participants who did not identify with an incremental theory of intelligence (i.e., identified with an entity theory or no theory), who were more likely to allocate more study-time to judged-boring passages. See Figure 1 for a graph of the interaction.

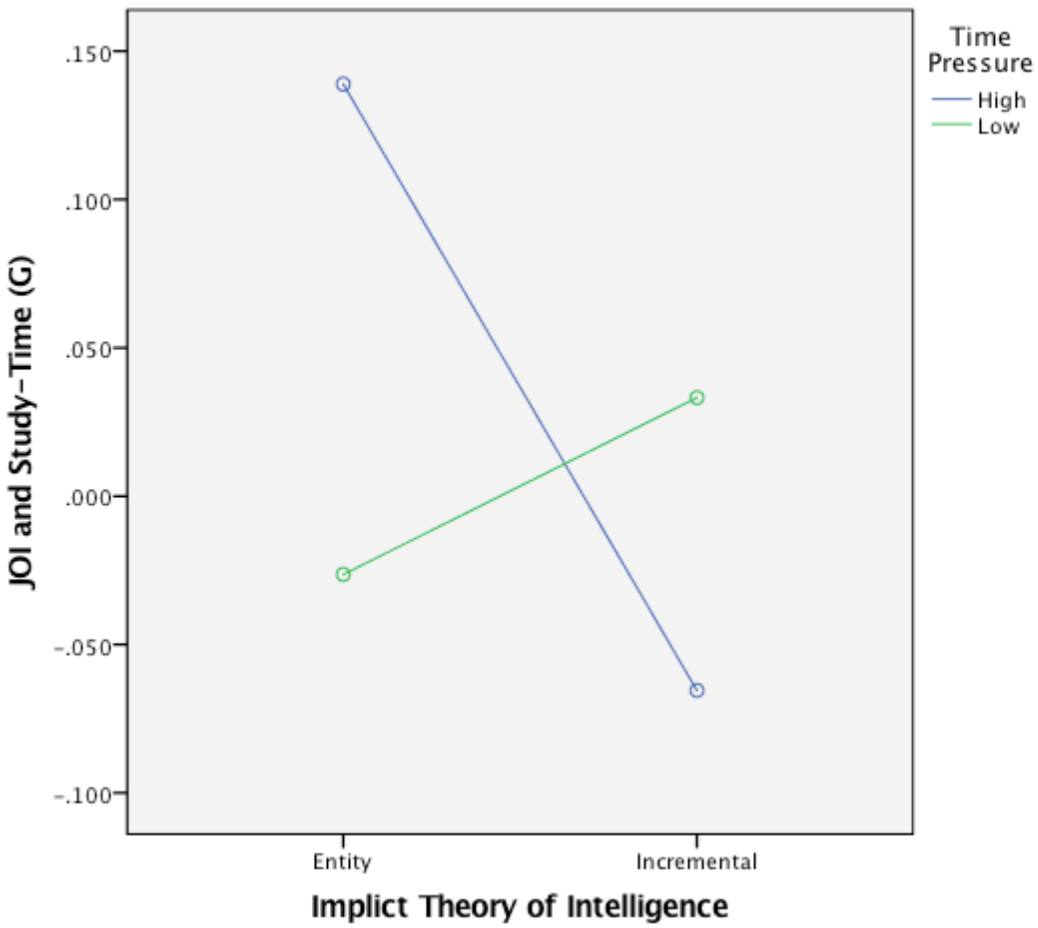
This finding was apparent only when participants who did not identify with a clear theory were included in the analysis. Overall, this finding did not confirm the hypothesis that participants who identify with an incremental theory of intelligence would use ineffective metacognitive strategies compared to participants who identify with an entity theory of intelligence. The results from the univariate ANOVA analysis are presented in Table 13. Further interpretation of the gamma correlations is also discussed below.

Table 13
Univariate ANOVAs Comparing Metacognitive Judgments and Study-Time (Gamma Correlations) Between Time Pressure and Implicit Theories of Intelligence

	Excluding Non-Theory P's (n= 92)				*Including Non-Theory P's (n = 124)*	
	EOLs		*JOIs*		*EOLs*	*JOIs*
	F-value	*p-value*	*F-value*	*p-value*	*F-value*	*p-value*
Time Pressure	.00	.97	.01	.93	.08	.78
Implicit Theories of Intel.	1.82	.18	3.94	.05	1.33	.25
Time Pressure*Intel.	2.47	.12	.47	.05*	1.16	.29

*$p < .05$

Figure 1. *Interaction Between Time Pressure and Study-Time on the Basis of JOIs.*



The mean gamma correlations for participants who identified with an incremental theory of intelligence were not statistically significant from zero, both in the high time pressure condition (EOL: G = -.04, t(37) = -.83, p = .41; JOI: G = -.08, t(37) = -1.49, p =.15), and the low time pressure condition (EOL: G = .00, t(32) = -.01, p = .93; JOI: G = .01, t(32) = .16, p =.87). Similarly, the mean gamma correlations for participants with an entity theory of intelligence were not statistically significant, both in the high time pressure condition (EOL: G = .10, t(8) = .93, p = .38; JOI: G = .12, t(8) = .88, p =.40) and low time pressure condition (EOL: G = .07, t(9) = .87, p = .40; JOI: G = -.01, t(9) = -.05, p =.96). The mean gamma correlations were also not significantly different from zero for participants who did not clearly identify with a theory of intelligence, both in the high time pressure condition (EOL: G = -.08, t(13) = -.76, p = .46; JOI: G = .11, t(13) = -1.15, p =.27), and the low time pressure condition (EOL: G = .06, t(17) = .62, p = .54; JOI: G = .04, t(17) = .48, p =.67). Lastly, the gamma correlations were not significantly different from zero independent of time pressure for participants with an incremental theory of intelligence (EOL: G = -.02, t(70) = -.69, p = .49; JOI: G = -.04, t(70) = -.99, p =.32), an entity theory of intelligence (EOL: G = .03, t(36) = .48, p = .63; JOI: G = .05, t(36) = .83, p =.41), and no clear theory of intelligence (EOL: G = .00, t(32) = -.03, p = .97; JOI: G = .07, t(32) = 1.14, p =.26). Despite mean level differences between varying implicit theories of intelligence, these gamma correlations indicate that participants did not show a strong preference for study-time allocation based on their EOLs or their JOIs regardless of time pressure or their implicit theory of intelligence. Table 14 contains the means of the gamma correlations (G) for implicit theories of intelligence separated by condition and degree of Conscientiousness.

Table 14

Mean Gamma Correlations (G) for Implicit Theories of Intelligence by Condition

	High Time Pressure			*Low Time Pressure*			*Total*		
	Increm.[1] *(n=38)*	*Entity*[2] *(n=9)*	*None*[3] *(n=14)*	*Increm.*[1] *(n=33)*	*Entity*[2] *(n=11)*	*None*[3] *(n=18)*	*Increm.*[1] *(n=71)*	*Entity*[2] *(n=20)*	*None*[3] *(n=32)*
EOL and Study-Time (*G*)	-.04	.10	-.08	.00	.07	.06	-.02	.08	-.04
JOI and Study-Time (*G*)	-.08	.12	.10	.01	-.01	.04	-.04	.05	-.08

[1]Participants who identify with an Incremental theory of intelligence had scores ≥ 4
[2]Participants who identify with an Entity theory of intelligence had scores < 3
[3]Participants who do not clearly identify with either theory had score between 3 and 4

Another two-way ANOVA using the same variables above was conducted excluding those participants who did not initially judge any passages as difficult (n = 54), as well as those participants who did not clearly identify with either implicit theory of intelligence (n = 32), which resulted in 42 remaining participants. The ANOVA indicated a significant difference between participants who identified with an incremental theory of intelligence and participants who identified with a entity theory of intelligence for the study-time allocation on the basis of EOLs (gamma correlation), $F(3, 38) = 7.00$, $p < .05$. Participants who identified with an incremental theory of intelligence were more likely to allocate study-time to judged-easy passages, where participants who identified with an entity theory of intelligence were more likely to allocate study-time to judged-difficult passages. Though none of the gamma correlations were significantly different from zero, closer examination of the mean gamma correlations indicates that participants who identified with an incremental theory of intelligence allocated study-time to judged-easy passages to a stronger degree under high time pressure. This is contrary to the hypothesis that participants with an incremental theory of intelligence would implement ineffective metacognitive strategies. The results from the ANOVA analysis are presented in

Table 15. Table 16 contains the means of the gamma correlations (*G*) separated by condition and degree of Conscientiousness.

Table 15
Univariate ANOVAs Comparing EOL Judgments and Study-Time (Gamma Correlations) Between Time Pressure and Implicit Theories of Intelligence[1]

	Excluding Non-Theory P's (n= 92)	
	F-value	*p-value*
Time Pressure	.63	.43
Implicit Theories of Intel.	7.00	.01*
Time Pressure*Intel.	1.02	.32

*$p < .05$
[1]Excluding participants with no initial EOL ratings ≥ 7

Table 16
Mean Gamma Correlations (G) for Implicit Theories of Intelligence by Condition[1]

	High Time Pressure		*Low Time Pressure*		*Total*	
	Increm.[*] *(n=17)*	*Entity*[**] *(n=5)*	*Increm.*[*] *(n=15)*	*Entity*[**] *(n=5)*	*Increm.*[*] *(n=32)*	*Entity*[**] *(n=10)*
EOL and Study-Time (*G*)	-.19	.20	.00	.18	-.10	.19

[*]Participants who identify with an Incremental theory of intelligence had scores ≥ 4
[**]Participants who identify with an Entity theory of intelligence had scores < 3
[1]Excluding participants with no initial EOL ratings ≥ 7

Implicit Theories of Intelligence and Test Performance. A two-way ANOVA was conducted to compare the means between time pressure, implicit theories of intelligence, and their interaction across overall test performance. The first ANOVA was conducted excluding participants who did not identify strongly with either theory, and the second ANOVA test was conducted including these participants. Neither test was significant, indicating that neither implicit theories of intelligence nor the interaction between implicit theories of intelligence and time pressure impacted test performance. Additionally, in these ANOVAs there were no significant differences as a function of time pressure. Table 17 contains the results from both

ANOVA tests, and Table 18 contains the mean test performance as function of time pressure and implicit theory of intelligence.

Table 17
Univariate ANOVAs Comparing Mean Test Performance between Time Pressure and Implicit Theories of Intelligence

	Excluding Non-Theory P's (n= 92)		*Including Non-Theory P's (n = 124)*	
	F-value	*p-value*	*F-value*	*p-value*
Time Pressure	.27	.61	2.01	.15
Implicit Theories of Intel.	1.19	.28	.10	.75
Time Pressure*Intel.	1.39	.24	3.19	.08

*$p < .05$

Table 18
Mean Test Performance for Implicit Theories of Intelligence by Condition

	High Time Pressure			*Low Time Pressure*			*Total*		
	Increm.[1] *(n=39)*	*Entity*[2] *(n=9)*	*None*[3] *(n=14)*	*Increm.*[1] *(n=33)*	*Entity*[2] *(n=11)*	*None*[3] *(n=18)*	*Increm.*[1] *(n=72)*	*Entity*[2] *(n=20)*	*None*[3] *(n=32)*
% Total Correct	.64	.65	.66	.72	.63	.72	.68	.64	.70

[1]Participants who identify with an Incremental theory of intelligence had scores ≥ 4
[2]Participants who identify with an Entity theory of intelligence had scores < 3
[3]Participants who do not clearly identify with either theory had score between 3 and 4

Multiple Regression Analyses

Personality Traits, Beliefs About Intelligence, and Study-Time Allocation.

Regression analyses using the enter method were used to determine if any of the Five Factor personality traits or people's implicit theories of intelligence contributed significantly to metacognitive strategy use. Both the Five Factor personality traits and implicit theories of intelligence were treated as continuous variables in the regression analyses.

Interactions were also explored. The interaction between Conscientiousness and time pressure, as well as the interaction between implicit theories of intelligence and time pressure,

were examined. These variables were selected because there is research to support their relationship to metacognitive strategy use. The gamma correlation between EOLs and study-time was regressed on the interaction between Conscientiousness and time pressure and the interaction between implicit theories of intelligence and time pressure. Additionally, the gamma correlation between JOIs and study-time was regressed on the interaction between Conscientiousness and time pressure and the interaction between implicit theories of intelligence and time pressure. None of the interactions were significant so they were not included in subsequent models.

In the first regression analysis, the gamma correlation between EOLs and study-time was regressed on the five personality traits, participants' implicit intelligence, and time pressure (R =.26, R^2 = .07, $R^2_{adjusted}$ = .01, $F(7,115) = 1.11$, p = .35. In the second regression analysis, the gamma correlation between JOIs and study-time allocation was regressed on the five personality traits, participants' beliefs about intelligence, and time pressure condition (R =.21, R^2 = .04, $R^2_{adjusted}$ = -.01, $F(7,115) = .74$, p = .64). Tolerance and variance inflation factor values were within acceptable limits. The regression models were not significant, indicating that none of the dependent variables significantly predicted the relationship between metacognitive judgments (EOL and JOI) and study-time allocation. See tables 19 and 20 for the summaries of the regression analyses.

Table 19
Regression Model Summary Predicting Metacognitive Judgments and Study Time (Gamma Correlations)

	R	*R Square*	*Adjusted R*	*F*
Model 1: EOLs and Study-Time (G)	.26	.07	.01	1.14
Model 2: JOIs and Study-Time (G)	.21	.04	-.01	.74

*$p < .05$

Table 20
Summary of Regression Analysis Predicting Metacognitive Judgments and Study Time (Gamma Correlations)

	EOLs and Study-Time (G)				*JOIs and Study-Time (G)*			
	B	*SE B*	β	*VIF*	*B*	*SE B*	β	*VIF*
Time Pressure	.03	.06	.05	1.01	.01	.07	.02	1.07
Implicit Theories of Intel.	-.02	.03	-.07	1.07	-.03	.03	-.10	1.07
Neuroticism	.01	.03	.04	1.50	-.02	.03	-.08	1.50
Extraversion	.03	.03	.10	1.19	-.00	.03	-.01	1.19
Openness	-.02	.03	-.05	1.10	-.04	.04	-.12	1.10
Agreeableness	-.06	.03	-.20	1.15	-.03	.03	-.09	1.15
Conscientiousness	.01	.03	.04	1.18	-.04	.03	-.13	1.18

*$p < .05$

Personality Traits, Beliefs About Intelligence, and Test Performance. Regression analyses using the enter method were used to determine if any of the Five Factor personality traits or people's implicit theories of intelligence contributed significantly to test performance. Test performance was also regressed on the interactions between time pressure condition and Conscientiousness and implicit views of intelligence, as these were the primary variables of interest. The interactions were not significant so they were included in the model.

Participants' total scores (% correct) on the multiple choice test were regressed on the five personality traits, participants' implicit theories of intelligence, and time pressure. Tolerance and variance inflation factor values were within acceptable limits. The regression equation was significant, $R = .39$, $R^2 = .15$, $R^2_{adjusted} = .10$, $F(7,115) = 2.89$, $p < .01$. The model accounted for 15% of the variance in the data. Openness ($\beta = .22$, $p < .01$), Extraversion ($\beta = -.21$, $p < .05$), and time pressure ($\beta = .23$, $p < .01$) were significant predictors of test performance. Participants who were high on Openness obtained higher test scores on the multiple choice test, and participants who were high on Extraversion obtained lower test scores. Additionally, participants in the low

time pressure condition obtained higher test scores. See tables 21 and 22 for the summaries of the regression analyses.

Table 21
Regression Model Summary Predicting Mean Test Performance

	R	*R Square*	*Adjusted R*	*F*
Model 1 (Test Performance)	.39	.15	.10	2.89**

***p* < .01

Table 22
Summary of Regression Analysis Predicting Mean Test Performance

	B	*SE B*	β	*VIF*
Time Pressure	.06	.02	.23**	1.07
Implicit Theories of Intel.	.00	.01	.04	1.07
Neuroticism	-.01	.01	-.12	1.47
Extraversion	-.02	.01	-.21*	1.19
Openness	.03	.01	.22**	1.10
Agreeableness	.01	.01	.09	1.13
Conscientiousness	.00	.01	-.01	1.18

p* < .05*p* < .01

Chapter V

DISCUSSION

Effective monitoring and control over one's own thinking, or effective metacognition, is a central component to many cognitive tasks (Metcalfe, 1993; Paul, 1992; Reder, 1987; Reder & Ritter, 1992; Schneider & Lockl, 2002; Simon & Newell, 1971; Willingham, 2007) and thus is essential to optimize learning. Previous studies have used a study-time allocation paradigm to demonstrate that under realistic learning conditions, people allocate more time to easy-items they do not know, followed by difficult items, and do not study items they already know, which support a Region of Proximal Learning Model (Ariel, Dunlosky, & Bailey, 2009; Kornell & Metcalfe, 2006, Metcalfe, 2002; Metcalfe, 2009; Metcalfe & Kornell, 2003; Son, 2004). Son and Metcalfe (2000) identified conditions that impact these study strategies, including time constraints, length of materials, and expectation of a test. Although research suggests that people have the capacity to use their metacognitive judgments strategically, many factors impact how strategies are implemented. What affective variables, such as personality traits or beliefs about intelligence, contribute to a person's ability to succeed in learning situations where a person must be efficient with their time?

This dissertation sought to explore and clarify the relationship between the Five Factor personality traits, implicit theories of intelligence, and metacognitive control over study-time allocation and subsequent test performance. In order to build on previous findings and reflect realistic studying conditions, this dissertation used the study-time allocation paradigm similar to the design used in the Son and Metcalfe study. Participants first ranked passages based on difficulty (EOLs) and interest (JOIs), then studied the passages under either high or low time pressure, and, lastly, were tested on their understanding of the material. Participants also

completed a self-report measure of personality, as well as a measure of their beliefs about their intelligence. The dependent variables were the relationship between participants' metacognitive judgments (EOLs and JOIs) and study-time allocation and test performance. Participants' interest is important because it potentially impacts their views as to whether they believe the information is useful and/or relevant. The independent variables were each of the five personality traits contained in the Five Factor model, participants' beliefs about their intelligence, and time pressure. A discussion of the results are provided below, followed by implications, directions for future research, and limitations of the current study.

Time Pressure, Study-Time Allocation, and Test Performance

The first aim of this dissertation was to replicate the findings in the Son and Metcalfe (2000) study. Based on these findings, it was hypothesized that under high time pressure, participants would allocate more study-time to judged-easy passages, and under low time pressure, participants would not show a preference for study-time allocation on the basis of metacognitive judgments. Participants' mean gamma correlations between EOLs and study-time and between JOIs and study-time were close to zero across both time pressure conditions. This indicates that participants did not use their metacognitive judgments to make decisions about study-time allocation when faced with high time pressure, which failed to replicate the results from Son and Metcalfe, as well as previous studies that support the Region of Proximal Learning model (Ariel, Dunlosky, & Bailey, 2009; Kornell & Metcalfe, 2006, Metcalfe, 2002; Metcalfe, 2009; Metcalfe & Kornell, 2003; Son, 2004). Although participants also did not show a preference for study-time allocation when faced with less time pressure, as was hypothesized and which is consistent with previous findings, this finding holds less significance because

participants who were faced with time pressure also did not show a preference for study-time allocation. It is of note that this study did replicate the finding that participants JOIs were significantly correlated with participants' EOLs, such that passages they perceived as easier were also perceived as interesting**.**

However, upon closer inspection of the data, it was determined one reason that contributed to participants' lack of preference with regard to study-time allocation was that the passages did not vary enough in difficulty for participants to behave systematically. Once this was taken into account and analyses only included participants who did perceive variability in difficulty based on their initial ratings of the how easy the material would be to learn, the expected trend was observed. Participants allocated more study-time to passages judged as easy when faced with time constraints. Though results were only approaching significance, the effect was much stronger than when analyses excluded participants who did not judge any of the passages initially as difficult, which replicates the findings in the Son and Metcalfe (2000) study.

Though the experiment aimed to create a realistic studying and testing conditions, there are limitations to how experiment conditions generalize to actual studying and testing conditions. Therefore, it is also possible that participants did not have enough investment in performing well on the multiple-choice test to put forth adequate effort. Basically, they may not have cared how they did on the test, so they did not study in a strategic manner. This notion is supported by the finding that more than half of participants (n = 68) chose to study the passages in the order they appeared on their computer screen, as opposed to using their judgments to choose which items to study first. Though results indicated that when those participants were removed from the analysis, participants did choose to study judged-easy and judged-interesting items first, which is consistent with previous findings (Dunlosky & Thiede, 1999: Son & Metacalfe, 2000), their

preference to study judged-easy and judged-interesting items first did not vary as a function of time pressure. It is possible these participants were not behaving strategically in order to improve test performance, rather, were making these decisions while studying as a means to make the experiment more enjoyable by choosing material that was not overly difficult or boring. Additionally, it is possible that participants in the high time pressure condition did not experience enough of a time constraint to be forced to make metacognitive decisions while studying. Which, coupled with a general perception that the overall material was not difficult to learn, they did not use their EOL and JOI judgments because they may have felt they had enough time to study all of the passages and they did not have to be strategic.

While it is possible that there was not enough of a perceived time constraint in the high time pressure condition to influence metacognitive strategy use, the discrepancy between the time allotted across conditions was enough to impact test performance. Participants who had more time to study the passages performed better on the multiple-choice test than participants who had less time to study the passages, which is a logical finding and is consistent with findings in the Son and Metcalfe (2000) study. Participants in the low time pressure condition performed better both on memory items, or items based on information explicitly in the passages, and inference items, or items that require inferences or background knowledge to answer. However, the difference between time pressure conditions only approached significance for performance on inference items.

Personality Traits and Study-Time Allocation

Characteristics that describe Conscientiousness include careful, rule-following, reliable, and hardworking. Conscientiousness is the personality trait most consistently associated with better study skills, higher academic achievement, and test performance (Chamorro-Premuzic & Furnham, 2003b; Conrad, 2006; Furnham & Chamorro-Premuzic, 2004; Graziano & Ward, 1992; Noftle & Robins, 2007; Porporat, 2009). However, there might be a negative relationship between effective metacognitive strategies and Conscientiousness under certain circumstances. There is speculation that Conscientiousness serves as a compensatory mechanism for average intelligence, in that individuals who are high on Conscientiousness are high achievers despite average cognitive abilities (Moutafi, Furnham, & Crump, 2003; Chamorro-Premuzic & Furnham, 2004; Wood & Englert, 2009). As such, it is possible that Conscientiousness is also compensatory for higher order cognitive skills, such as metacognition and a person's ability to make judgments about their own learning. Cucina and Vasilopulos (2005) found that very high levels of Conscientiousness were associated with lower grades because high conscientious individuals may take on too much at once or attempt to complete all assigned tasks, rather setting goals and prioritizing tasks. Therefore, it was hypothesized that faced with high time pressure, participants who scored high on Conscientiousness would use *less effective metacognitive strategie*s (i.e., would not choose to allocate more study time to judged-easy passages) compared to participants who scored low on Conscientiousness.

The results of this study did not confirm this hypothesis. When examining the entire sample, participants high on Conscientiousness were more likely to allocate study-time to judged-interesting material, regardless of time pressure. Though the interaction between time pressure and Conscientiousness was not significant, when participants high on Conscientiousness

has more time, they had a tendency to allocate study-time to judged-interesting passages to a greater degree than when they had less time. Though allocating more study-time to judged-interesting material is arguably an effective strategy, this is the opposite of the trend that would be expected if these participants were behaving strategically. As stated earlier, it is again possible that participants high on Conscientiousness were not behaving strategically in order to improve test performance, rather, they were making these decisions while studying as a means to make the experiment more enjoyable by choosing material that was interesting to them.

However, once the participants who did not initially view any of the passages as difficult to learn were removed from the analyses, people high on Conscientiousness actually implemented effective metacognitive strategies, such that they allocated time to judged-easy passages regardless of time pressure. Though this finding was not significant, it suggests a trend that is contrary to the hypothesis. Therefore, this finding coupled with the finding the people high on Conscientiousness allocated more time to passages they found interesting, suggests those high on Conscientiousness had an identifiable approach to the task compared to those lower on Conscientiousness. Firstly, they potentially tried to make the task more meaningful by reading material they found interesting. Secondly, for those participants who were both high on Conscientiousness and perceived the passages as difficult, they implemented an effective metacognitive strategy by choosing to study easy material.

Additionally, Son and Metcalfe (2000) found that participants chose to allocate more study-time to judged-interesting material over judged-easy material when they were not expecting a test. Though participants in this study were expecting a test, it is possible that they approached the task as if they were reading for some other purpose than preparing for an exam and they might not have cared about their test performance, as discussed earlier.

In considering the impact of Conscientiousness on metacognitive strategies in this study, is important to consider the frequency of personality traits in the sample. The sample consisted of undergraduate students from Columbia University, which is a highly selective institution and arguably its students are among the most intelligent in the country. Though the sample was likely highly intelligent, the results from the self-report measure of personality indicates that they were not very conscientious and thus there was a restricted range. A small number of the participants (n = 25) rated themselves as "High" or "Very High" on Conscientiousness, and an even smaller number of participants (n = 11) rated themselves as "Very High." It is possible there were not enough people high on Conscientiousness in the sample to observe any differences in metacognitive strategy use as a function of Conscientiousness.

As stated above, the finding that Conscientiousness is negatively related to performance is only observed with high levels of the trait (Cucina & Vasilopulos, 2005). It is also possible that only people "Very High" on Conscientiousness struggle to use effective metacognitive strategies when faced with time constraints. There were only five participants in the high time pressure condition who rated themselves as "Very High" on Conscientiousness, so this relationship could not be fully explored.

Again, some researchers speculate that Conscientiousness serves as a compensatory mechanism for average intelligence (Moutafi, Furnham, & Crump, 2003; Chamorro-Premuzic & Furnham, 2004; Wood & Englert, 2009). However, as already stated, a sample of Columbia undergraduate students likely have above average intelligence compared to the general population. Therefore, it is possible that people high on Conscientiousness in this sample are also highly intelligent, so they are both high achievers because they are motivated and work hard *and* because they have an aptitude to be successful academically. Intellectual ability, in this sample,

may have compensated for potential ineffective metacognitive strategy for those high on Conscientiousness.

Personality Traits and Test Performance

Openness. Characteristics that describe Openness include intellectual, independent-minded, and imaginative. In addition to Conscientiousness, some studies have also found a relationship between Openness and academic performance (Farsides & Woodfield, 2003; Lounsbury et al., 2003; Lounsbury et al., 2005). However, this association is explained by Openness as being more related to academic ability or aptitude, where the association between Conscientiousness and academic performance is more related to motivation or perseverance (Goff & Ackermann, 1992; Noftle & Robbins, 2001; Conrad 2006). Similarly, some researchers argue that Openness overlaps highly with intellectual ability (Ackerman & Heggested, 1997). The results from this dissertation support the relationship between Openness and intellectual ability, as well as Openness and academic performance. Firstly, Openness was significantly correlated to GPA. Secondly, Openness was a significant predictor of test performance, regardless of time pressure.

Again, when considering the frequency of personality traits in the sample, 91 participants rated themselves as "High" or "Very High" on Openness, and zero rated themselves as "Very Low." If Openness does overlap with intellectual ability, it makes sense that there was such a high frequency of Open participants in a sample of Columbia undergraduate students.

Extraversion. Characteristics that describe Extraversion include sociable, friendly, and dominant. The relationship between Extraversion and academic performance is inconclusive, which may be explained by how academic performance has been operationalized. A positive

relationship between Extraversion and academic performance in MBA students was found when performance was based on participation (Rothstein, 1994), whereas a negative relationship was found when examining GPA (Bauer & Liang, 2003, Furnam et al., 2003, Goff and Ackerman, 1992) and exam grades (Hair & Hampson, 2006; Furnham & Chamorro-Premuzic, 2004). Arguably students high on Extraversion spend more time socializing, both during and outside of class, whereas individuals low on Extraversion (or introverts) spend more time studying (Chamorro-Premuzic & Furnham, 2005).

Findings from this dissertation revealed a negative relationship between Extraversion and test performance, which supports the aforementioned studies that people high on Extraversion have lower GPAs and exam grades. However, in this sample, Extraversion and GPA were not related. While participants in the study did not necessarily have an opportunity to socialize while completing the experiment, it is possible these individuals in general spend more time engaging in social interactions and less time studying, resulting in lower test performance. Either people high on Extraversion self-select into classes or areas of study that rely more on participation, or these individuals spend less time engaging in studying or solitary activities (e.g., reading), which potentially results in less background knowledge, and more time engaging in social activities.

Implicit Theories of Intelligence and Study-Time Allocation

The implicit theory of intelligence states that people's beliefs about their own intelligence potentially alters their judgments of learning when faced with tasks of varying difficulty, which in turn impacts their effort (Dweck,1999; Molden & Dweck, 2006). People's theories about their own intelligence impact their interpretations of how well they understand and comprehend new material, as well as their perception of their capability to understand new material (Dweck, 1999;

Dweck & Leggett, 1988). While there is a supported relationship between implicit theories of intelligence and academic outcomes (Blackwell et al., 2007; Henderson & Dweck, 1990; Dweck & Leggett, 1988), the relationship between theories of intelligence and metacognitive strategies is unclear. However, there is reason to believe there may be a negative relationship between an incremental view and metacognition. A paramount characteristic of incrementalists is increased effort when faced with difficult tasks. As previously discussed, effort to persevere on challenging items is an ineffective study strategy when faced with time pressure. Relatedly, people who scored high on Conscientiousness were more likely to report an incremental theory of intelligence (Furnham, et al., 2003). As such, it was hypothesized that when faced with time pressure, participants who identify with an incremental theory of intelligence would use *less effective metacognitive strategie*s (i.e., would not choose to allocate more study time to judged-easy passages) compared to participants who identified with an entity theory of intelligence. Additionally, it was hypothesized that participants who identify with an incremental theory of intelligence would also rate themselves high on Conscientiousness.

The dissertation did not confirm either of these hypotheses. Participants who identified with an incremental theory of intelligence did not use less effective strategies compared to participants who identified with an entity theory of intelligence when faced with time pressure. Further, when those participants who did not view the material as difficult were removed from the analyses, people who clearly identified with an incremental theory of intelligence actually allocated study-time to judged-easy material compared to people who clearly identified with an entity theory of intelligence, who allocated study-time to judged-difficult material. This finding is the reverse from the hypothesis, in that people with an incremental theory of intelligence

actually used effective metacognitive strategies, and they did so to a stronger degree when faced with time pressure.

When the entire sample is considered, there was also a significant interaction between implicit theories of intelligence and the time pressure condition for the relationship between JOIs and study-time allocation. However, this interaction was only apparent when participants who did not clearly identify with either theory were included in the analysis. When faced with time pressure, participants who identified more with an incremental theory of intelligence were more likely to allocate study-time to judged-interesting passages compared to participants who did not identify with an incremental theory of intelligence (i.e., identified with an entity theory of intelligence or did not identify with either theory), who were more likely to allocate more study-time to judged-boring passages. Allocating more study-time to judged-interesting passages when faced with time pressure might also be an effective metacognitive strategy because 1) material perceived as more interesting also tends to be perceived as easier and, 2) selecting material that is believed to be useful or relevant under time pressure might be an effective use of study time.

This finding, coupled with the finding that people who both identified with an incremental theory and initially perceived the passages as difficult further support that these individuals demonstrated effective metacognitive strategy use. In contrast, people who both had a clear entity theory and perceived the initial passages as difficult allocated study-time to judged-difficult passages, regardless of time pressure. Additionally, people who did not identify with an incremental theory, which included people who identified with an entity theory and people who did not identify with either theory, were more likely to allocate study-time to judged-boring passages under time pressure. This indicates that people with an entity theory or without a clear incremental theory if intelligence implemented ineffective metacognitive strategies.

People with an incremental theory of intelligence tend to have learning goals, which focus on increasing competence and are associated with increased effort and adaptation of strategies (Dweck & Leggett, 1988; Elliott & Dweck, 1988). Therefore, it makes sense that a person who identifies with an incremental theory of intelligence would try to study material they thought was easy and interesting, or relevant and useful in order to increase competence (or test scores), especially when they had limited time to read the passages, compared to people who do not identify with an incremental theory of intelligence.

In contrast, people with an entity theory of intelligence tend to have performance goals, which focus on gaining favorable judgments from others of their competence (Dweck & Leggett, 1988; Elliott & Dweck, 1988). Though it was opposite to the trend that was expected, it is possible that people with an entity theory of intelligence in this study chose to study difficult and boring passages because they wanted to be perceived as competent, and mastery of difficult material suggests competency. It is possible these approaches were a result of these individuals attempting to be strategic.

It was also hypothesized that participants who identified with an incremental theory of intelligence would rate themselves high on Conscientiousness. Contrary to this hypothesis, those two constructs were not related. Openness was significantly and positively correlated with an implicit theory of intelligence, such that participants high on Openness were more likely to have an incremental theory of intelligence. Though this was not hypothesized, it makes sense given the relationship between incremental theories of intelligence and academic outcomes. Additionally, similar to the frequency of Open participants in the sample, the majority of participants identified with an incremental theory of intelligence (n = 77). This suggests that

overall, the sample for the study consisted of very Open individuals who also identified with an incremental theory of intelligence.

It is also interesting to note that an implicit view of intelligence was significantly and positively related to age, such that older participants were more likely to have an incremental theory of intelligence. This could be because older students may have had more opportunities to be exposed to ideas that align with an incremental theory of intelligence, or that older students have had more experiences that suggest that intelligence is malleable and effort increases ability and performance.

Implicit Theories of Intelligence and Test Performance

Participant's beliefs about their intelligence were not related to their test performance, despite a tendency for participants with an incremental theory of intelligence tendency to allocate more study time to interesting material under time pressure. However, the interaction between time pressure and implicit theories of intelligence approached significance ($p = .08$). This trend suggests participants in the low time pressure condition who identified with an incremental theory of intelligence obtained higher test scores than participants who identified with an incremental theory of intelligence in the high time pressure condition. Participants who did not clearly identify with a theory of intelligence also obtained higher test scores in the low time pressure condition compared to the high time pressure condition. In contrast, the test scores of participants who identified with an entity theory of intelligence did not change as a function of time pressure. Again, it makes sense that participants test performance increases when they have more time to study. However, it is interesting that this was not necessarily the case for participants who identified with an entity theory of intelligence. This is consistent with previous

findings that people with an entity theory withdraw or give up when faced with challenges since they believe they do not have enough intelligence (Dweck & Leggett, 1988). On this task, it is possible that participants with an entity theory did not put forth effort on test items they did not know, which decreased their performance, where other participants' lower performance was only observed as a function of not having enough time to study. Additionally, as previously mentioned, only a small proportion of participants identified with an entity theory (n = 20). It is possible this interaction would have been stronger with more entity theorists in the sample.

Implications and Future Research

There are many circumstances, both in academic and work contexts, where the ability to use effective metacognitive strategies when faced with real-life time constraints are necessary in order to efficiently complete tasks. The goal of this dissertation was to further explore those traits that might enhance or inhibit an individual's ability to behave strategically in such circumstances. Is the ability to behave strategically under time constraints a skill that can be taught, or is this something that you either have the capacity to do or not? While the results from this study did not clearly answer this question, the findings revealed ways in which this notion can be explored further.

Exploration of Individual Differences. Firstly, in terms of individual differences in metacognition, future studies should continue to focus on the construct of Conscientiousness as it relates to metacognitive strategy use under time constraints. The current study indicated that people high on Conscientiousness allocate more time to material they find interesting, as well as more time to passages they found easy once participants who did not find any of the material challenging were removed from the data. This was opposite to the trend that was expected, but

further research should be conducted with a sample that contains a less restricted range for the variable of Conscientious. Additionally, limitations in passage variability and testing conditions may have impacted participants' approach to the task and restricted the range even further, which will be discussed further in the next section. If participants were more invested in doing well on the test and if the passages varied more in difficulty, then potentially some of these trends would be stronger.

Conscientious individuals in the current study allocated more time to materials they perceived as interesting and easy regardless of time pressure. Moreover, the degree to which these individuals allocated more study-time to interesting materials increased when they had more time. These findings speak to how Conscientious individuals approach academic tasks. While this trait is associated with being hardworking, motivated, and reliable, they may also have more intrinsic motivation to learn than has been previously assumed, which also leads to positive academic outcomes. For instance, people who are Conscientious might be more motivated because they are driven by an internal desire to learn. As such, they make studying choices based on what is interesting and enjoyable to them, and easier, more accessible material is arguably more enjoyable to learn. This notion should be explored further, potentially as it relates to Conscientious individuals having learning-approach goals, another motivational construct (Elliott & Dweck, 1988).

The relationship between incremental theories of intelligence and metacognition needs to be explored further with regard to how these individuals approach novel learning tasks. This study revealed that individuals who identified with an incremental theory of intelligence were more likely to allocate study time to materials they found interesting compared to individuals who did not identify with an incremental theory, but this was seen only when faced with time

pressure. Additionally, when looking at people who initially perceived some of the passages as difficult to learn, those with a clear incremental theory allocated study-time to materials they found easy to a significantly greater degree than people with an entity theory of intelligence, who allocated study-time to materials they found difficult. Similar to those individuals high on Conscientiousness, this finding potentially also suggests that the incrementalists in this study were more intrinsically motivated to learn. However, they arguably acted more strategically than individuals who were high on Conscientious since their tendency to do this increased as a function of time pressure and the findings were significant. In contrast, people who did not identify with an incremental theory, which include people who identified with an entity theory and people who did not identify with either theory, allocated more time to materials they found boring under time pressure and to passages they found difficult regardless of time pressure. It is possible this approach was a result of these individuals attempting to be strategic. Perhaps material perceived as boring was also perceived as unfamiliar, so they exhibited a stronger tendency to study the boring, unfamiliar material under time constraints. Again, it would be interesting to see how this motivational construct relates to learning versus performance goals (Elliott & Dweck, 1988). While the relationship between these two motivational constructs has already been explored (Dweck & Leggett, 1988), this relationship in the context of metacognitive strategy use under time pressure should be further investigated in future studies.

Exploration of Potential Interventions. Given what was found about characteristics associated with people high on Conscientiousness and people who identified with the incremental theory of intelligence, future research should also focus on whether these traits can be taught in a way that impacts people's studying behaviors. There is already research supporting the effectiveness of interventions aimed at teaching an incremental theory of intelligence in the

improvement of academic outcomes (Aronson, Fried, & Good, 2002; Blackwell et al., 2007; Good, Aronson & Inzlicht, 2003). Would a similar intervention be effective in improving students' ability to be efficient with their time when it is not possible to complete all tasks?

In addition to allocation of study-time to interesting materials, findings from this dissertation also revealed that certain personality traits were related to test performance. Specifically, Openness significantly contributed to increased test performance, and Extraversion significantly contributed to decreased test performance. Though there is support for the relationship between Openness and intelligence (Goff & Ackermann, 1992; Noftle & Robbins, 2001; Conrad 2006), it is possible that the characteristics associated with Openness can inform interventions and increase motivation. For instance, people who are high on Openness are open to new experiences and have an appreciation for new and different ideas. As such, it is logical that these individuals are also more intellectual since they engage in a broader and more diverse range of activities. If people were privy to the idea that being open to new experiences and ideas was related to being more intelligent, it would be interesting to see how this knowledge might impact motivation when engaging in academic activities.

Though Extraversion was negatively related to test performance, how can this information be used to better inform learning outcomes? Another interesting idea to explore would be to see if people high on Extraversion perform better on evaluative methods outside of multiple-choice tests, since research supporting a positive relationship between Extraversion and academic achievement were based on grades for participation and not on test performance. It is possible that people high on Extraversion understand the material but are not apt at taking tests, so it would be interesting to use evaluative methods that capitalize on characteristics associated with being extraverted, such as more social, interpersonal tasks. For example, had the studying of

passages been more of a cooperative learning activity, where participants taught each other the material in a group format, would they have performed better compared to people who low on Extraversion?

Though it was not statistically significant, people who identified with an entity theory of intelligence did not improve their test performance when they had more time to study. Given the known association between having an entity theory of intelligence and effort, in that people with an entity theory view academic challenges as indication they lack the innate ability (Dweck & Leggett; Dweck, 1999), as well as the success of interventions aimed at teaching an incremental theory of intelligence (Aronson, Fried, & Good, 2002; Blackwell et al., 2007; Good, Aronson & Inzlicht, 2003), this trend offers more support for the importance of such interventions.

Lastly, beyond using characteristics from the traits themselves to inform interventions, it would be interesting to explore effective metacognitive strategy use in and of itself as an intervention. If people are first taught the Region of Proximal Learning model and the potential advantages of allocating more study-time to easy material, would that influence their actual studying behavior, and would there be observable differences in their subsequent test performance?

In summary, future research needs to be conducted to further explore the primary variables of interest from this study (Conscientiousness and implicit theories of intelligence), as well as the traits that were identified as contributing to test performance (Extraversion and Openness). Research should focus both on the relationship between these traits and learning outcomes, as well as how what we know about these traits informs academic interventions.

Limitations

As with any study, there are a few limitations that potentially impacted the findings. As previously discussed, participants in this study were Columbia University undergraduates. There were a few characteristics of the sample that may have limited the results. Firstly, the sample was skewed in the frequency of personality traits. Secondly, most participants in the sample likely had above average intellectual abilities, which suggests the results might not be generalizable to other adults outside of Columbia. Ideally, the sample should have consisted of young adults with more variability in intellectual and academic functioning.

While the passages varied enough in interest, the passages did not vary enough in difficulty for participants to behave systematically. Though variability in difficulty and interest was a priority in passage selection, it is possible more stringent guidelines to determine variability could have been implemented. For example, objective measures of difficulty could have been used to select passages in terms of difficulty. Though subjective judgments would still be used in the actual experiment, this would have provided a starting point to ensure variability in difficulty. Ensuring passages varied in interest is more difficult to determine. However, instead of using passages that interested graduate students who are all in the same field, we could have recruited a more diverse group of people to select passages. Additionally, they should have been instructed to select passages that are both interesting and *boring* to them.

Another potential limitation in this study was the amount of time allocated to participants in each condition. As previously discussed, it is possible that participants in the high time pressure condition did not experience enough of a time constraint to be forced to make metacognitive decisions while studying, especially given the finding that the passages were not perceived as very difficult. Though there was enough of a difference in time allotted to impact

test performance, it did not appear to impact metacognitive strategy use. Additionally, while there were some findings that suggest people in the high time pressure condition used their metacognitive judgments, this finding was moderated by another variable (JOI), and was not apparent for EOL judgments. The rate at which people study and learn is highly variable, and time allotted to participants in each condition should have been more individualized. More specifically, there could have been an individualized approach to determine what was perceived as a time constraint and what was not for each participant based on rate of learning. For instance, participants could have been timed reading a passage prior to starting the experiment to get a sense of the rate at which they read. A manipulation check at the end of the study regarding perceived time pressure may have been helpful in determining whether this was part of the reason findings did not replicate the Son and Metcalfe (2000) study. Further, time allotted to participants in the study was determined using pilot data. Participants in the pilot study were graduate students, so it is possible that time to read passages observed in the pilot study did not generalize to undergraduate students.

Lastly, though the experiment aimed to create a realistic studying and testing conditions, there are limitations to how these conditions generalize to actual studying and testing conditions. More specifically, it is possible participants were not invested in the experiment and/or doing well on the test. Motivation could have been increased by involving some sort of incentive to do well on the test.

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Appendix A
Supplementary Figures

Figure 2
Frequency Distribution of Gamma Correlation between EOLs and Study-Time

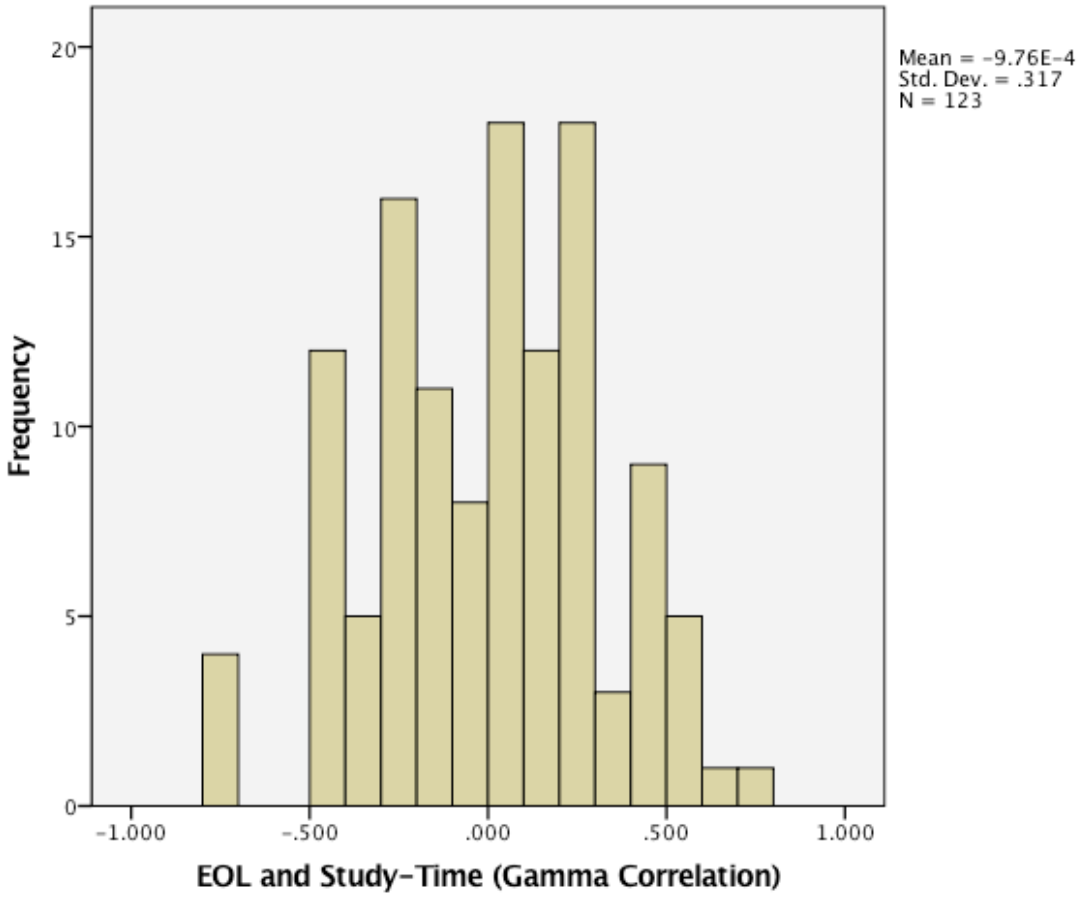


Figure 3
Frequency Disribution of Gamma Correlation Between JOIs and Study-Time

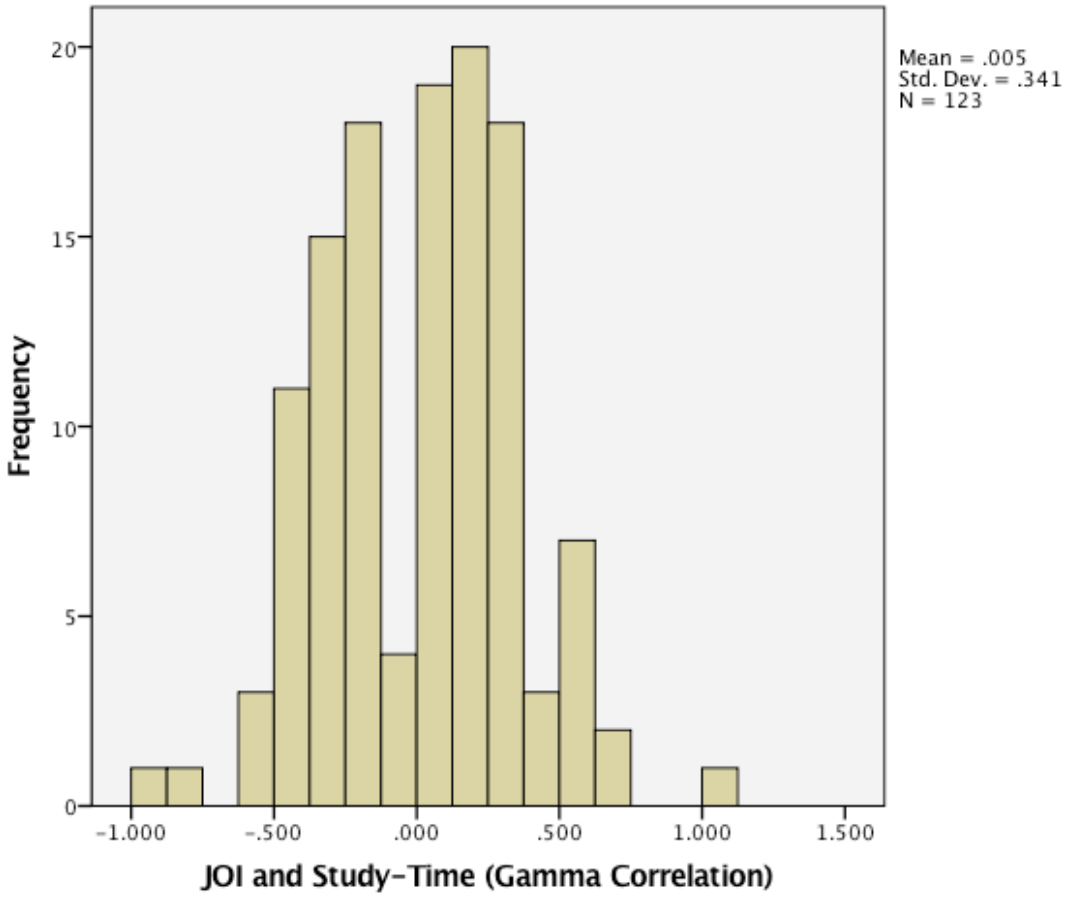


Figure 4
Frequency Distribution of Gamma Correlation Between EOLs and Test Peformance

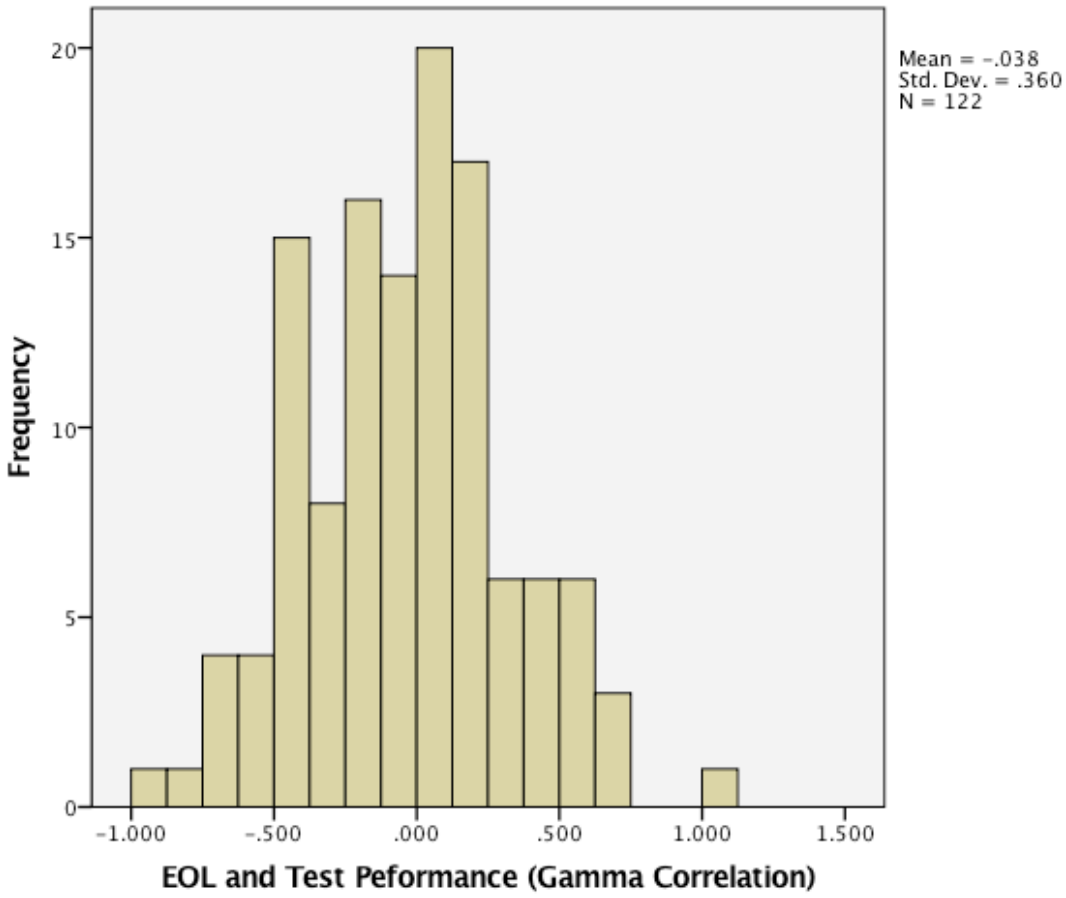
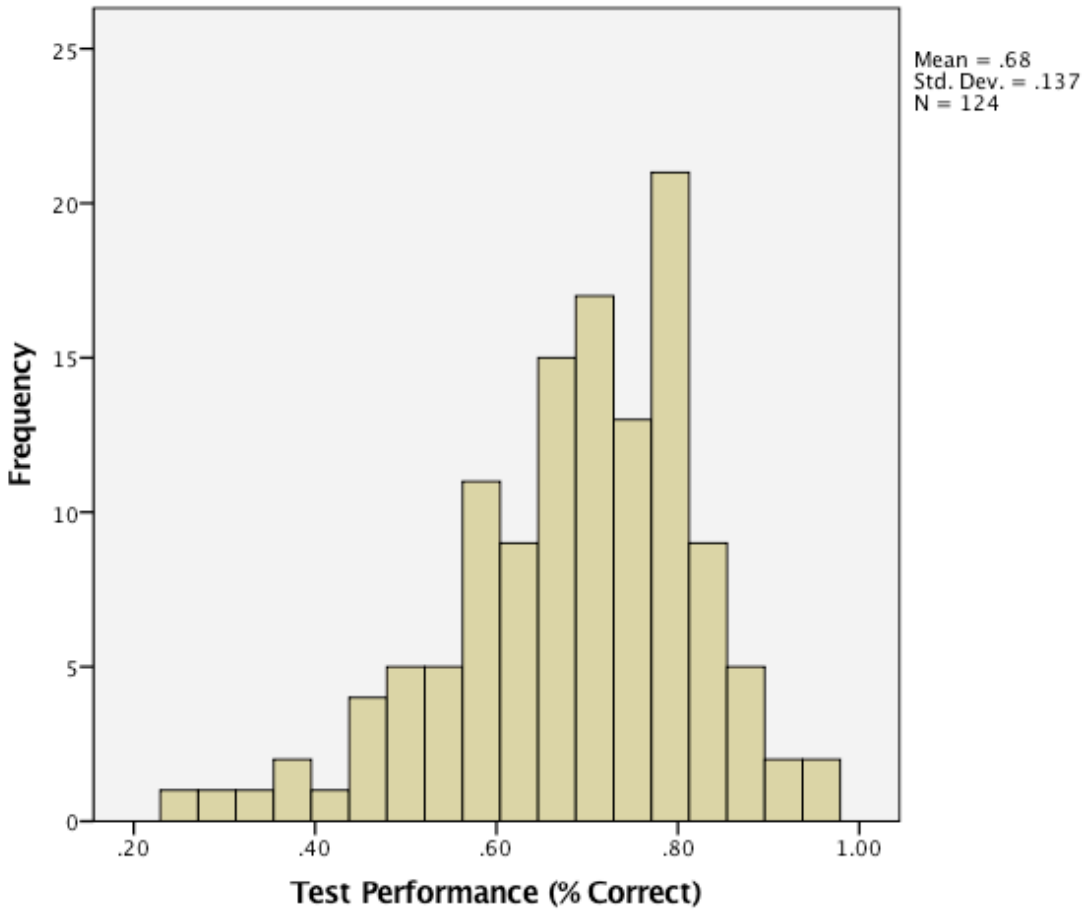


Figure 4
Frequency Distribution of Total Test Performance



Appendix B
Supplementary Tables

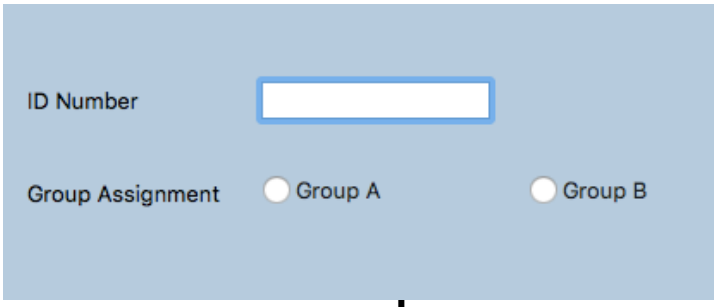
Table 24

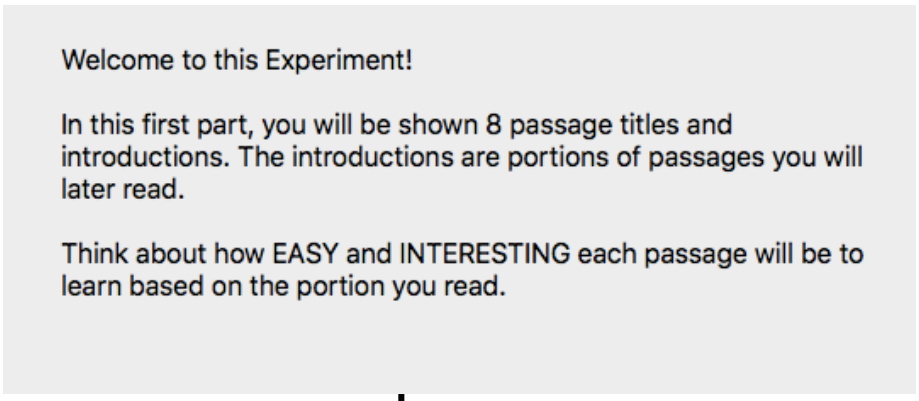
Univariate ANOVAs Comparing Metacognitive Judgments and Study-Time (Gamma Correlations) Between Time Pressure and Degree of Conscientiousness

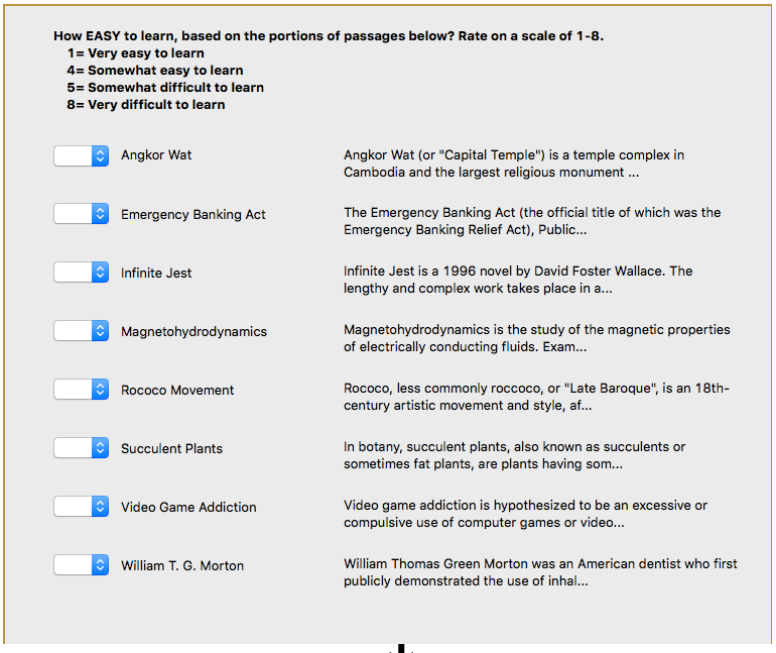
	F-value	*p-value*
JOI and Study-Time (n = 80)	.25	.62
EOL and Study-Time (n = 73)	1.59	.21
EOL and Test Perform. (n = 71)	.12	.730

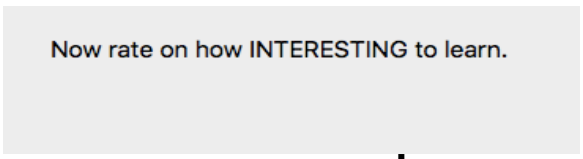
*$p < .05$

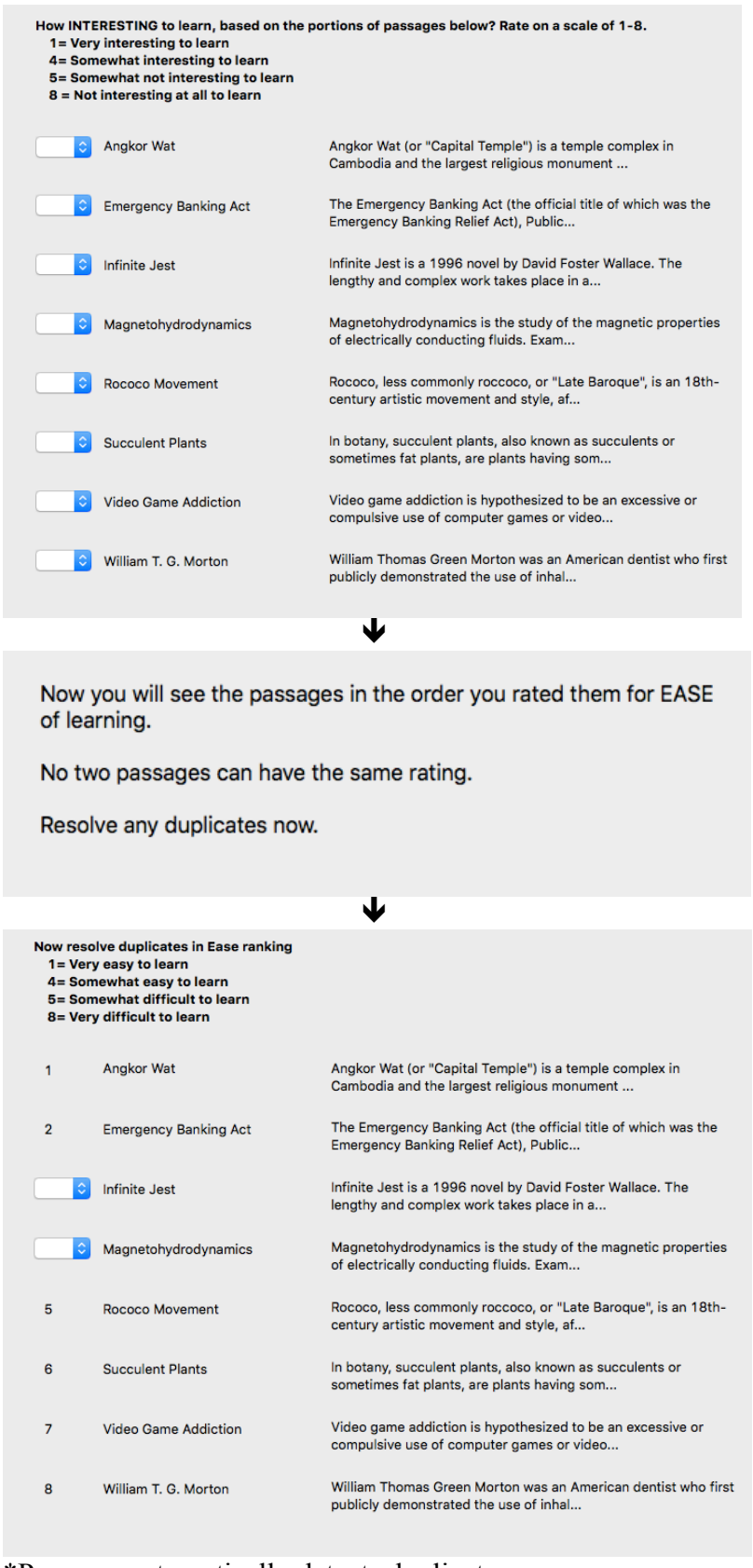
Appendix C
Screen Shots of Procedure in Computer Experiement









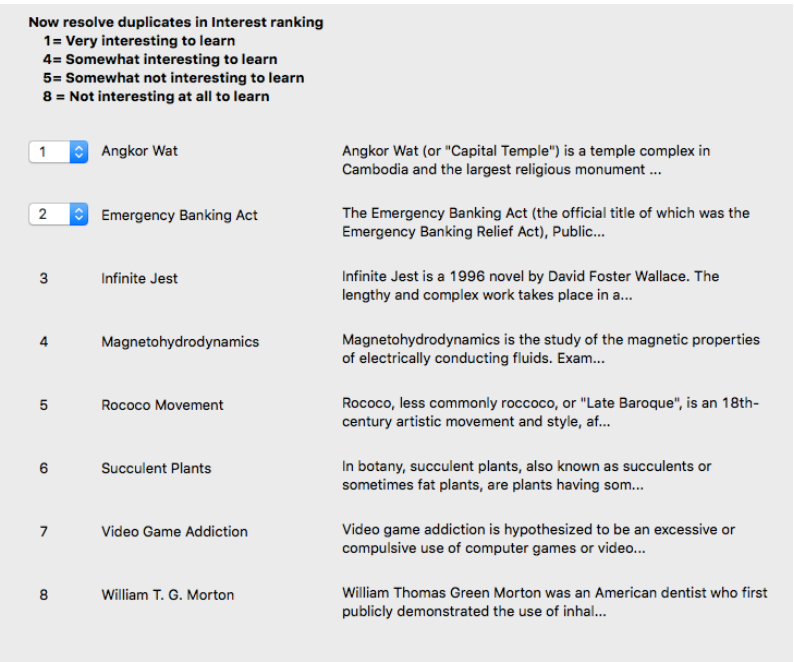


*Program automatically detects duplicates

Now you will see the passages in the order you rated them for EASE of learning.

No two passages can have the same rating.

Resolve any duplicates now.

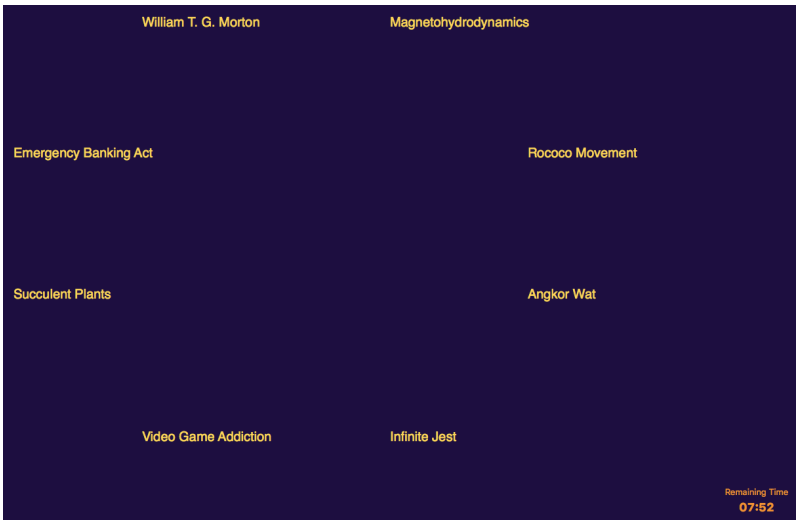


*Program automatically detects duplicates

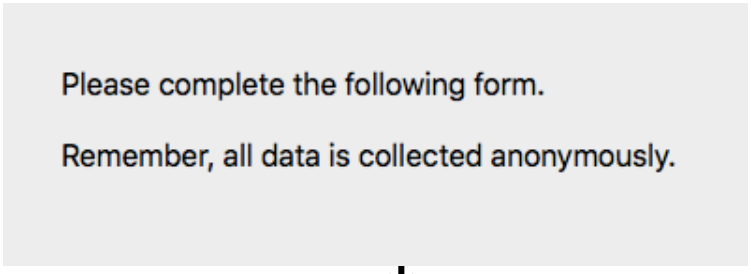
You will now have the opportunity to read through and study the full passages for 8 minutes.

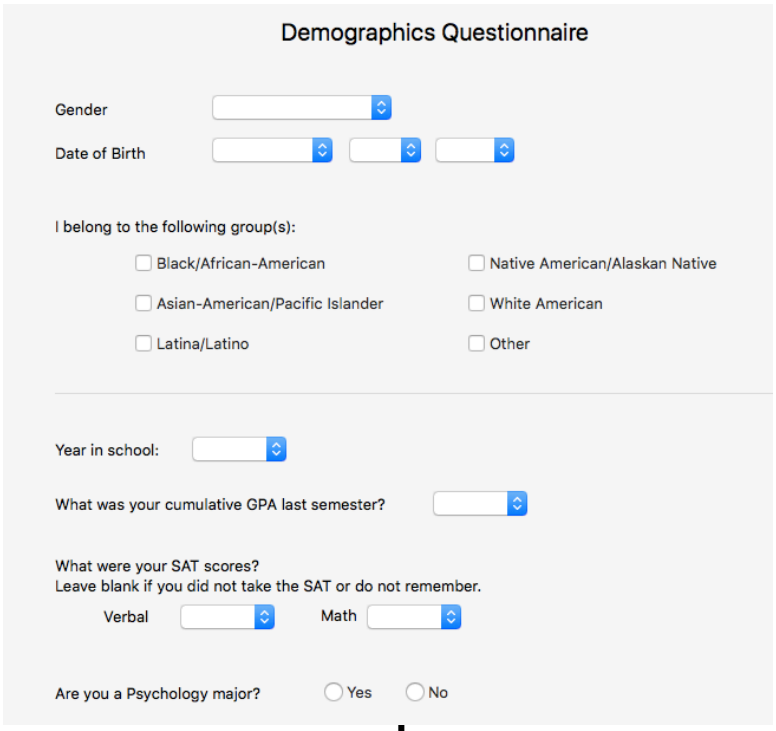
You can always go back to a passage that you've already read, but note taking is not allowed.

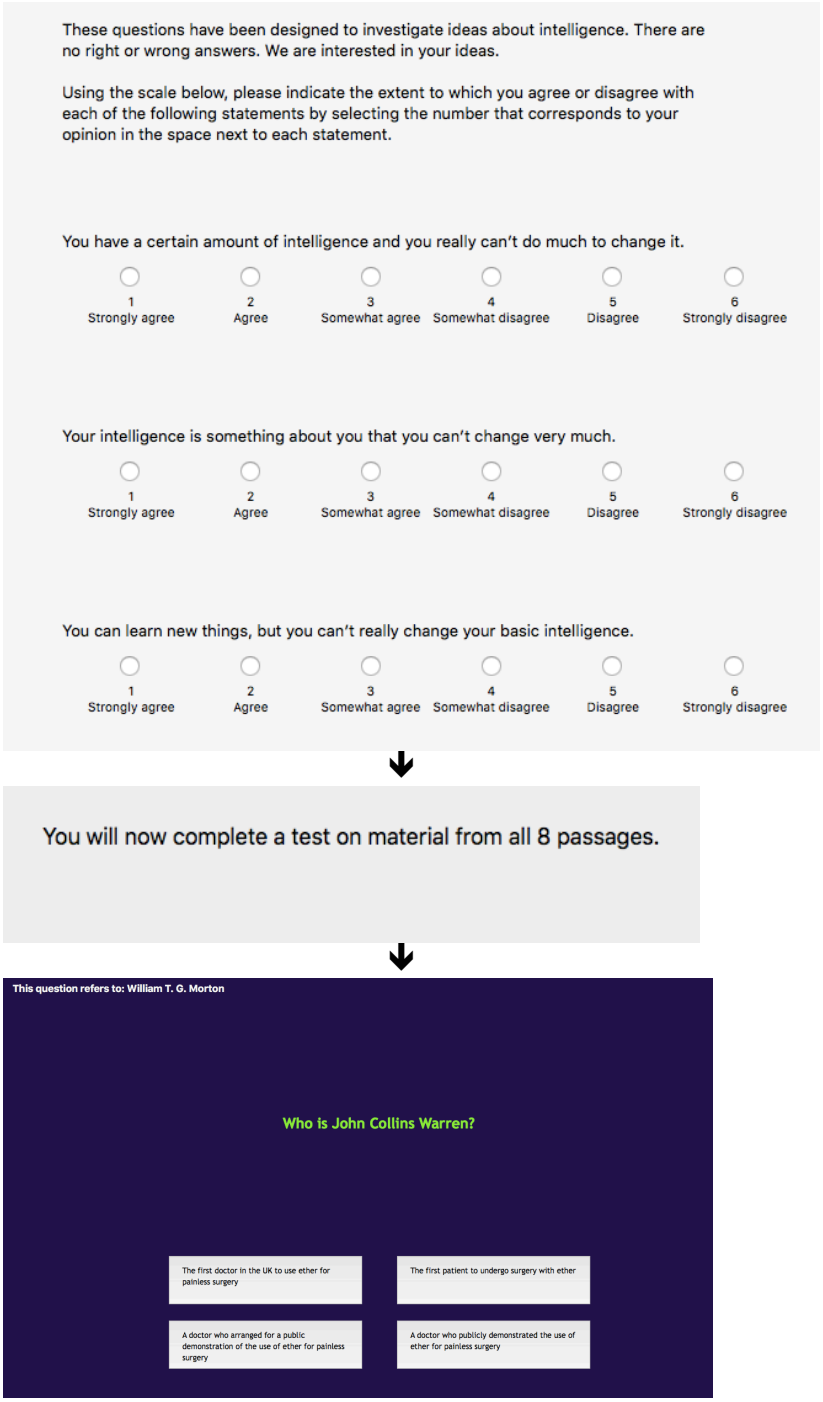
There will be a test after the 8 minutes have ended, and it will be testing material from all 8 passages.



*Order passages titles displayed randomized for each participant







*Example of 1 item from multiple-choice test

Appendix D
Assessment of Implicit Theories of Intelligence[1]

These questions have been designed to investigate ideas about intelligence. There are no right or wrong answers. We are interested in your ideas. Using the scale below, please indicate the extent to which you agree or disagree with each of the following statements by selecting the number that corresponds to your opinion in the space next to each statement.

1=Strong Agree 2=Agree 3=Mostly Agree 4=Mostly Disagree 5=Disagree 6=Strongly Disagree

You have a certain amount of intelligence and you really can't do much to change it.
Your intelligence is something about you that you can't change very much.
You can learn new things, but you can't really change your basic intelligence.

[1]Developed by Henderson, Dweck, & Chiu, 1992

Appendix E
Passages

*All passages are excerpts from Wikipedia articles. Wikipedia is a freely licensed encyclopedia, so its content can be copied and used for any purpose.

Angkor Wat (190 words)
Angkor Wat (or "Capital Temple") is a temple complex in Cambodia and the largest religious monument in the world. It was originally founded as a Hindu temple for the Khmer Empire, gradually transforming into a Buddhist temple toward the end of the 12th century. It was built by the Khmer King Suryavarman II in the early 12th century in Yaśodharapura (present-day Angkor), the capital of the Khmer Empire, as his state temple and eventual mausoleum. Breaking from the Shaiva tradition of previous kings, Angkor Wat was instead dedicated to Vishnu. As the best-preserved temple at the site, it is the only one to have remained a significant religious center since its foundation. The temple is at the top of the high classical style of Khmer architecture. It has become a symbol of Cambodia, appearing on its national flag, and it is the country's prime attraction for visitors. The modern name, Angkor Wat, means "Temple City" or "City of Temples" in Khmer; Angkor, meaning "city" or "capital city", is a vernacular form of the word nokor, which comes from the Sanskrit word nagara. Wat is the Khmer word for "temple grounds."

Emergency Banking Act (193 words)
The Emergency Banking Act (the official title of which was the Emergency Banking Relief Act), Public Law 1, 48 Stat. 1 (March 9, 1933), was an act passed by the United States Congress in 1933 in an attempt to stabilize the banking system. Beginning on February 14 of that year, Michigan, which had been hit particularly hard by the Great Depression, declared an eight-day bank holiday. Fears of other bank closures spread from state to state as people rushed to withdraw their money. Within weeks, thirty-six other states held their own bank holidays in an attempt to stem the bank runs. The banking system seemed to be on the verge of collapse. Following his inauguration in March 1933, President Franklin Roosevelt set out to rebuild confidence in the nation's banking system, first declaring a four-day banking holiday that shut down the banking system, including the Federal Reserve. Prepared by the Treasury staff during Herbert Hoover's administration, the legislation was passed on March 9, 1933. The new law allowed the twelve Federal Reserve Banks to issue additional currency on good assets so that banks that reopened would be able to meet every legitimate call.

Infinite Jest (132 words)
Infinite Jest is a 1996 novel by David Foster Wallace. The lengthy and complex work takes place in a North American dystopia, centering on a junior tennis academy and a nearby substance-abuse recovery center. The novel touches on many topics, including addiction and recovery, family relationships, entertainment and advertising, film theory, United States-Canada relations (as well as Quebec separatism), and tennis. The novel includes 388 endnotes that cap almost a thousand pages of prose, which, together with its detailed fictional world, have led to its categorization as an encyclopedic novel. In 2005 it was included by Time magazine in its list of the 100 best English-language novels published since 1923. By 2006, 150,000 copies of Infinite Jest had been sold, and the book has continued to sell steadily and attract critical commentary.

Magnetohydrodynamics (123 words)
Magnetohydrodynamics is the study of the magnetic properties of electrically conducting fluids. Examples of such magneto-fluids include plasmas, liquid metals, and salt water or electrolytes. The word magnetohydrodynamics (MHD) is derived from magneto- meaning magnetic field, hydro- meaning water, and -dynamics meaning movement. The field of MHD was initiated by Hannes Alfvén for which he received the Nobel Prize in Physics in 1970. The fundamental concept behind MHD is that magnetic fields can induce currents in a moving conductive fluid, which in turn polarizes the fluid and reciprocally changes the magnetic field itself. The set of equations that describe MHD are a combination of the Navier-Stokes equations of fluid dynamics and Maxwell's equations of electromagnetism. These differential equations must be solved simultaneously, either analytically or numerically

Rococo Movement (175 words)
Rococo, less commonly roccoco, or "Late Baroque", is an 18th-century artistic movement and style, affecting many aspects of the arts including painting, sculpture, architecture, interior design, decoration, literature, music, and theatre. It developed in the early 18th century in Paris, France as a reaction against the grandeur, symmetry, and strict regulations of the Baroque, especially of the Palace of Versailles. Rococo artists and architects used a more jocular, florid, and graceful approach to the Baroque. Their style was ornate and used light colors, asymmetrical designs, curves, and gold. Unlike the political Baroque, the Rococo had playful and witty themes. The interior decoration of Rococo rooms was designed as a total work of art with elegant and ornate furniture, small sculptures, ornamental mirrors, and tapestry complementing architecture, reliefs, and wall paintings. The Rococo was also important in theatre. The book The Rococo states that no other culture "has produced a wittier, more elegant, and teasing dialogue full of elusive and camouflaging language and gestures, refined feelings and subtle criticism" than Rococo theatre, especially that of France.

Succulent Plants (123 words)
In botany, succulent plants, also known as succulents or sometimes fat plants, are plants having some parts that are more than normally thickened and fleshy, usually to retain water in arid climates or soil conditions. The word "succulent" comes from the Latin word *sucus*, meaning juice, or sap.[1] Succulent plants may store water in various structures, such as leaves and stems. Some definitions also include roots, so that geophytes that survive unfavorable periods by dying back to underground storage organs may be regarded as succulents. In horticultural use, the term "succulent" is often used in a way which excludes plants that botanists would regard as succulents, such as cacti. Succulents are often grown as ornamental plants because of their striking and unusual appearance.

Video Game Addiction (192 words)
Video game addiction is hypothesized to be an excessive or compulsive use of computer games or video games, which interferes with a person's everyday life. Video game addiction may present itself as compulsive game-playing; social isolation; mood swings; diminished imagination; and hyper-focus on in-game achievements, to the exclusion of other events in life. In May 2013, the American Psychiatric Association (APA) proposed criteria for video game addiction in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM),

concluding that there was insufficient evidence to include it as an official mental disorder. However, proposed criteria for "Internet Gaming Disorder" are included in Section 3, Conditions for Further Study. While Internet Gaming Disorder is proposed as a disorder, it is still discussed how much this disorder is caused by the gaming activity itself, or whether it is to some extent an effect of other disorders. Researchers have found that people who play violent video games for three days have shown an increase with their aggressive behavior and hostility. These findings are disputed by multiple sources however. They have also found that individuals who play nonviolent games showed no difference in their aggression or hostility.

William T. G. Morton (171 words)
William Thomas Green Morton was an American dentist who first publicly demonstrated the use of inhaled ether as a surgical anesthetic in 1846. The promotion of his questionable claim to have been the discoverer of anesthesia became an obsession for the rest of his life. On September 30, 1846, Morton performed a painless tooth extraction after administering ether to a patient. Upon reading a favorable newspaper account of this event, Boston surgeon Henry Jacob Bigelow arranged for a now-famous demonstration of ether on October 16, 1846 at the operating theater of the Massachusetts General Hospital, or MGH. At this demonstration Dr. John Collins Warren painlessly removed a tumor from the neck of a Mr. Edward Gilbert Abbott. News of this use of ether spread rapidly around the world, and the first recorded use of ether in Britain was by Robert Liston at University College Hospital on 21 December 1846. The MGH theatre came to be known as the Ether Dome and has been preserved as a monument to this historic event.

Appendix F
Multiple Choice Test

Angkor Wat

1. The city of Yasodharupura…
    a. Means "Temple City"
    b. Is the capital of Cambodia
    c. No longer exists
    d. Comes from the Sanskrit word "nagara"
2. Angkor Wat was dedicated to...
    a. Vishnu
    b. Shaiva
    c. Yasodharapura
    d. King Suryavarman II
3. Angkor Wat is located in…
    a. Thailand
    b. Cambodia
    c. Vietnam
    d. Sri Lanka
4. What was Angkor Wat?
    a. A state temple
    b. A mausoleum
    c. A residence
    d. A and B
5. The Shaiva tradition...
    a. Is no longer followed in Cambodia
    b. Was not strictly followed during the construction of Angkor Wat
    c. Remains an important cornerstone in Cambodian culture
    d. Was rejected by the people of Cambodia during King Suryavarman II's Reign
6. The word "Angkor" is Khmer for…
    a. "Temple"
    b. "Temple Grounds"
    c. "Temple City"
    d. "City"

Emergency Banking Act

1. How many Federal Reserve banks were allowed to issue additional currency?
    a. 10
    b. 11
    c. 12
    d. 13

2. Why did the Federal Reserve Banks issue additional currency?
    a. To increase the value of the U.S. Dollar
    b. To ensure banks had enough money once they reopened
    c. To create additional jobs
    d. To fund public works projects
3. Fears of bank closures led people to…
    a. Rush to withdraw money from the bank
    b. Hide money and assets from the government
    c. Stop paying taxes
    d. Vote in favor of the Emergency Banking Act
4. Who prepared the Emergency Banking Act?
    a. Franklin Roosevelt's Treasury staff
    b. the Federal Reserve
    c. the U.S. Congress
    d. Herbert Hoover's Treasury staff
5. Which of the following is NOT true about President Franklin Roosevelt?
    a. He was the first to implement a banking holiday anywhere in the US
    b. He relied on work from President Hoover's administration
    c. He prioritized the economic issues of the 1930's
    d. He implemented a plan that increased banks' ability to dispense funds
6. What year was the Emergency Banking Act passed?
    a. 1903
    b. 1930
    c. 1933
    d. 1943

Infinite Jest

1. What feature of the novel led to it being categorized as an encyclopedic novel?
    a. It includes more than 350 endnotes
    b. Discussions of United States-Canada relations
    c. It's unbiased account of Quebec separatism
    d. It includes photographs with detailed captions
2. Which publication gave "Infinite Jest" praise in 2005?
    a. New York Magazine
    b. Wall Street Journal
    c. Times Magazine
    d. New York Times
3. Who wrote "Infinite Jest?"
    a. David Allen Grier
    b. David Foster Wallace
    c. David Hyde Pierce

d. David Mark Wolf

4. "Infinite Jest"…
    a. is widely considered to be the best work of encyclopedic fiction since 1923
    b. has enjoyed relatively successful sales since its release
    c. has endured extended periods of both critical acclaim and rebuke
    d. has only recently seen a surge in sales following critical acclaim
5. What two settings does the novel take place?
    a. A junior tennis academy and a parochial high school
    b. A parochial high school and a substance-abuse recovery center
    c. A substance-abuse recovery center and an all girls preparatory school
    d. A junior tennis academy and a substance-abuse recovery center
6. "Infinite Jest"...
    a. is a work of fiction
    b. is a memoir
    c. is based on 1980s events in North America
    d. is a short novel

Magnetohydrodynamics

1. Which field would find the least application for magnetohydrodynamics?
    a. astrophysics
    b. geophysics
    c. botany
    d. engineering
2. Part of the fundamental concept of magnetohydrodynamics is…
    a. Magnetic fields initiate temperature changes in fluids
    b. Magnetic fields bring about electric currents in fluids that are electrically conducting
    c. Electrical currents in fluids attract and repel magnetic particles
    d. The movement of magnetic particles in water is brought about by polarization
3. Magnetohydrodynamics...
    a. can be modeled with a set of complex equations
    b. operates on physical mechanisms that are still mostly unknown
    c. represents a burgeoning field in physics
    d. has contributed significantly to recent advances in consumer products
4. Hannes Alfven received a Nobel Prize in which field(s)?
    a. Chemistry
    b. Physics and Chemistry
    c. Engineering
    d. Physics
5. Magnetohydrodynamnics is the study of…
    a. Magnetic properties of electrically conducting fluids

b. Magnetic properties of thermal retention in water
c. Movement of magnetic particles through fluids
d. Dynamics of electric magnetic particles

6. Navier-Stokes equations are…
   a. Equations of thermodynamics
   b. Equations of fluid dynamics
   c. Equations of electromagnetism
   d. Equations of magneto-fluids

Rococo Movement

1. The political Baroque would most likely be characterized as having…
   a. Playful themes
   b. Unorthodox themes
   c. Light hearted themes
   d. Strict and stern themes
2. According to the passage, in what country was Rococo theater most influential?
   a. France
   b. Italy
   c. Belgium
   d. England
3. Rococo was a reaction to…
   a. Asymmetrical designs of the Baroque period
   b. The Palace of Versailles
   c. Strict regulations of the Baroque period
   d. Florid and graceful approaches of the Late Baroque period
4. What century was the Rococo Movement?
   a. 16th century
   b. 17th century
   c. 18th century
   d. 19th century
5. Features of Rococo interior design include…
   a. Rooms as a total work of art
   b. Ornate and asymmetrical designs
   c. Symmetrical and precise designs
   d. A and B
6. Rococo Theater...
   a. was known for its topical, scathing satire
   b. was known for its sophistication and humor
   c. was known for its deep dramatic plots
   d. was known for its intricate mysteries

Succulent Plants

1. Succulents are also known as…
    a. Cacti
    b. Fat plants
    c. Flesh plants
    d. Juicy plants
2. Succulent plants' most notable adaptation would be
    a. its effective water management system
    b. its rapid water absorption
    c. its efficient water circulation
    d. its reduced water consumption rate
3. Succulent plants store water in all of the following EXCEPT…
    a. Leaves
    b. Stems
    c. Roots
    d. Petals
4. According to the passage, why are succulents often grown as ornamental plants?
    a. Because they are easy to care for
    b. Because of their scent
    c. Because of their appearance
    d. Because they require little sunlight
5. Succulent Plants can be described as
    a. fragile
    b. tropical
    c. hearty
    d. spiney
6. Why are succulent parts fleshy?
    a. To retain water
    b. To protect against animals
    c. To absorb more sunlight
    d. To attract insects for pollination

Video Game Addiction

1. According to the passage, researchers have found that individuals who play nonviolent games…
    a. Showed an increase in their aggression or hostility
    b. Showed an increase in spatial reasoning ability
    c. Showed a decrease in spatial reasoning ability
    d. Showed no difference in their aggression or hostility
2. Which of the following would NOT necessarily be symptoms of video game addiction?

a. Playing video games with a friend every day
b. Skipping meals to play video games
c. Choosing to play video games instead of attending appointments
d. Throwing a daily tantrum when a parent attempts to end a video game session

3. What year was Video Game Addiction proposed as an official mental disorder by the American Psychiatric Association?
    a. 2011
    b. 2012
    c. 2013
    d. 2014
4. What is true of "Internet Gaming Disorder…"
    a. It it included in the Conditions for Further Study section of the DSM
    b. It is caused exclusively by gaming activity
    c. It is caused by depression
    d. It is included in the Substance-Related and Addictive Disorders section of the DSM
5. The American Psychiatric Association...
    a. is funding Video Game Addiction support groups
    b. is encouraging new research on Video Game Addiction
    c. determined that there is no link between violent behavior and amount of time playing video games
    d. determined that exposure to violent video games should be limited in young adults
6. According to the passage, which of the following is not a way video game addiction presents?
    a. Compulsive game-playing
    b. Mood swings
    c. Acute weight gain
    d. Social isolation

William Thomas Green Morton

1. What is the Massachusetts General Hospital Theater known as?
    a. The Ether Theater
    b. The Painless Dome
    c. The Ether Dome
    d. The Painless Theater
2. All of the demonstrations of the use of ether were done by:
    a. Surgeons
    b. Cardiologists
    c. Dentists
    d. Cannot be determined

3. Demonstrations of the use of ether in 1846 focused on:
    a. Tooth extractions
    b. Tumor extractions
    c. Amputations
    d. Both a and b
4. What county was William Thomas Green Morton from?
    a. France
    b. U.S.A.
    c. Germany
    d. Canada
5. Who is John Collins Warren?
    a. A doctor who publicly demonstrated the use of ether for painless surgery
    b. A doctor who arranged for a public demonstration of the use of ether for painless surgery
    c. The first patient to undergo surgery with ether
    d. The first doctor in the UK to use ether for painless surgery
6. What did William Thomas Green Morton allegedly perform while using ether?
    a. A painless tumor removal
    b. A painless appendix removal
    c. A painless ulcer removal
    d. A painless tooth removal

Appendix G
NEO-FFI-3 Items

Name _____ Age _____ Sex _____ Today's date _____

1. I am not a worrier.
2. I like to have a lot of people around me.
3. I enjoy concentrating on a fantasy or daydream and exploring all its possibilities, letting it grow and develop.
4. I try to be courteous to everyone I meet.
5. I keep my belongings neat and clean.
6. At times I have felt bitter and resentful.
7. I laugh easily.
8. I think it's interesting to learn and develop new hobbies.
9. At times I bully or flatter people into doing what I want them to.
10. I'm pretty good about pacing myself so as to get things done on time.
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.
12. I prefer jobs that let me work alone without being bothered by other people.
13. I am intrigued by the patterns I find in art and nature.
14. Some people think I'm selfish and egotistical.
15. I often come into situations without being fully prepared.
16. I rarely feel lonely or blue.
17. I really enjoy talking to people.
18. I believe letting students hear controversial speakers can only confuse and mislead them.
19. If someone starts a fight, I'm ready to fight back.
20. I try to perform all the tasks assigned to me conscientiously.
21. I often feel tense and jittery.
22. I like to be where the action is.
23. Poetry has little or no effect on me.
24. I'm better than most people, and I know it.
25. I have a clear set of goals and work toward them in an orderly fashion.
26. Sometimes I feel completely worthless.
27. I shy away from crowds of people.
28. I would have difficulty just letting my mind wander without control or guidance.
29. When I've been insulted, I just try to forgive and forget.
30. I waste a lot of time before settling down to work.
31. I rarely feel fearful or anxious.
32. I often feel as if I'm bursting with energy.
33. I seldom notice the moods or feelings that different environments produce.
34. I tend to assume the best about people.
35. I work hard to accomplish my goals.
36. I often get angry at the way people treat me.
37. I am a cheerful, high-spirited person.
38. I experience a wide range of emotions or feelings.
39. Some people think of me as cold and calculating.
40. When I make a commitment, I can always be counted on to follow through.

41. Too often, when things go wrong, I get discouraged and feel like giving up.
42. I don't get much pleasure from chatting with people.
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement.
44. I have no sympathy for beggars.
45. Sometimes I'm not as dependable or reliable as I should be.
46. I am seldom sad or depressed.
47. My life is fast-paced.
48. I have little interest in speculating on the nature of the universe or the human condition.
49. I generally try to be thoughtful and considerate.
50. I am a productive person who always gets the job done.
51. I often feel helpless and want someone else to solve my problems.
52. I am a very active person.
53. I have a lot of intellectual curiosity.
54. If I don't like people, I let them know it.
55. I never seem to be able to get organized.
56. At times I have been so ashamed I just wanted to hide.
57. I would rather go my own way than be a leader of others.
58. I often enjoy playing with theories or abstract ideas.
59. If necessary, I am willing to manipulate people to get what I want.
60. I strive for excellence in everything I do.