THE EFFECTS OF DEFENSIVE PESSIMISM AND METACOGNITIVE BIAS ON METACOGNITIVE KNOWLEDGE MONITORING AND ACADEMIC ACHIEVEMENT

A thesis submitted to the Kent State University College of Education, Health, and Human Services in partial fulfillment of the requirements for the degree of Master of Arts

by

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The ability to monitor one’s own knowledge and set reasonable expectations is an important skill for academic success. Defensive pessimism is the tendency to continually set and hold unrealistically low expectations for oneself. To examine the relationships between defensive pessimism and the ability to monitor one’s knowledge, the current study was designed to examine relationships between: metacognitive knowledge monitoring skills, judgments of learning which may be biased by defensive expectations, and classroom performance. Path analysis was completed to model the causal relationships between defensive pessimism, metacognition, metacognitive bias, and their effects on academic achievement in an educational psychology course. The sample was collected from a midwestern public university and consisted of 199 participants. Results showed a positive significant relationship between defensive expectations and pessimism bias, and negative significant relationships between defensive expectations and academic achievement, pessimism bias and academic achievement, and pessimism bias and optimism bias. Future research may focus on whether better use of metacognition could increase accuracy when making judgments of learning, and more efficiently prepare those students who are defensive pessimists for situations that require them to assess their own knowledge.
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CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

Introduction

In the educational environment, students are often expected to be able to make judgments about what they know, and what they do not know. This ability is often described as metacognitive knowledge monitoring, and can provide useful information when learning new topics, studying, or monitoring progress in a particular course. However, this essential skill may be hindered by other strategies, such as defensive pessimism, which is a mechanism used for managing anxiety (Norem, 2011) and involves defensive expectations and reflectivity (Martin, Marsh, & Debus, 2001). The purpose of the study was to examine the relationships between defensive pessimism, metacognition, and academic achievement. Examination of these relationships was integral to provide an opportunity to identify undergraduate students who are biased in their metacognitive judgments, leading to the false belief they know or do not know answers to questions. By identifying these students, it may be possible to more effectively predict academic success for students who are biased in their metacognitive judgments, and then employ an intervention, if necessary, to increase academic success.

In this investigation, knowledge monitoring (or metacognition) was operationalized as accuracy on a simple knowledge monitoring assessment (KMA). Additionally, new measures for pessimistic metacognitive bias and optimistic metacognitive bias were created for this study. Pessimism bias was calculated as the proportion of times a student answered a question correctly after indicating they do not
know the answer, divided by all the correctly answered items. In contrast, optimism bias was calculated as the proportion of times a student answered a question incorrectly after indicating they knew the answer, divided by all the incorrectly answered items. These two measures of bias is referred to as “metacognitive bias” when talking about them together as a unit. Academic achievement is measured by the participants’ scores out of 100 on the course final exam. Three research questions are addressed in this paper:

1. What is the relationship between defensive pessimism (comprised of defensive expectations and reflectivity) and academic achievement?

2. What is the relationship between metacognitive bias (pessimism bias and optimism bias) on final exam scores?

3. Do the separate parts of defensive pessimism have different effects on metacognitive bias and academic achievement?

It was hypothesized that defensive pessimism and metacognitive bias will have a negative correlation with final exam scores, and bias students’ judgments about whether they will answer questions correctly or not, thus, reducing knowledge monitoring accuracy. Defensive pessimism, as a strategy for managing anxiety, involves defensive expectations and reflectivity (Martin et al., 2001). Defensive expectations are the actual negative expectations defensive pessimists will set for themselves about a future event, whereas reflectivity is the act of predicting all possible outcomes and working through them before the actual event. Defensive pessimists are said to differ from typical pessimists, in that they use their defensive pessimism as a strategy to manage anxiety and eventually achieve success in typical life situations (Norem, 2001).
However, empirical research focusing specifically on the effects of defensive pessimism in the academic environment is limited. While a multitude of studies identify the negative effects of pessimism on learning (e.g., Held & Bohart, 2002; Sarason, 1980; Waite, Sarason, Lighthall, & Davidson, 1958), no studies were found that examine the specific relation between defensive pessimism and metacognition, especially leading to success in an academic environment. The available literature on the topics of defensive pessimism and metacognition separate each of these variables from the other. Therefore, after a thorough examination of the existing literature, the need for this type of study became more apparent.

**Review of the Literature**

The topic of defensive pessimism became popular with both the academic community and the general public with the publication of Norem’s (2001) book titled *The Positive Power of Negative Thinking*. This book describes defensive pessimism as an effective strategy for managing anxiety in a variety of settings. Norem supported defensive pessimism as an optimal state for people who have anxiety to manage their emotions and achieve success. On the surface, the nature of defensive pessimism seems to imply that students have an inability to understand what they do and do not know. Specifically, defensive pessimists are typically under-confident, which may imply they would underestimate their knowledge or understanding. No studies were located in the existing literature that provided empirical evidence of the relationships between defensive pessimism, metacognition, and academic performance.
Defensive Pessimism

Defensive pessimism is most commonly defined as a strategy for managing anxiety (Norem, 2001), which involves defensive expectations and reflectivity (Martin et al., 2001). Defensive expectations are the negative outcomes that a person expects to encounter, while reflectivity is the process of coming up with all of these possible outcomes. According to work by Norem and colleagues (e.g., Norem & Cantor, 1986a, 1986b; Norem & Illingworth, 1993), defensive expectations only apply to the top third most competent students, whereas Martin et al. (2001) developed a questionnaire which allows any degree of defensive pessimist to report defensive expectations. Generally, optimism is promoted within the education community as the disposition associated with success; however, research exists that highlights the achievements of defensive pessimists (Elliot & Church, 2003; Norem, 2002; Norem & Cantor, 1986a, 1986b; Norem & Illingworth, 1983). Although defensive pessimists may be successful in certain environments, there is limited empirical research that focuses on defensive pessimism in the academic environment, which was the environment of focus for this study.

Defensive pessimism is comprised of two interdependent parts, which could have diverse educational implications. The first part of defensive pessimism is the setting of defensive expectations for one’s self (Martin, Marsh, & Debus, 2003), which involves making pessimistic predictions about future events. Defensive pessimists participate in self-comparisons with other students, and set low expectations for themselves as mechanisms for avoiding future disappointment and mitigating any possible feelings of disappointment (Merz & Swim, 2008). Pessimistic expectations can be derived from a
multitude of sources, such as comparing oneself to others (Gibbons, Buunk, & Eggleston, 2000). Gibbons and colleagues found that presumptions about the future, such as the expectations made by defensive pessimists, led participants to compare themselves with others, whereas those individuals with more optimistic presumptions tend to have higher mean GPAs as opposed to their more pessimistic peers. Additionally, Gibbons and colleagues found that as pessimistic presumptions or defensive expectations increase, as does the desire to compare oneself to others. Consequently, as self-comparisons to other peers increased, there was a negative relationship to GPA, and grades decreased.

In a study about the nature of pessimistic expectations, Taylor and Shepperd (1998) identified possible outcomes as a contributing factor to pessimistic expectations. Data from this study provided evidence that the greatest amounts of optimism are present when future predictions cannot be immediately challenged by facts. Consequences, anticipation, feedback, and grades were all identified as factors that led to increasingly higher pessimistic feelings about future events. Thus, the demands of the academic learning environment, and the emphasis students put on grades, may produce anxiety. This causes students to search for a way to manage or ignore their emotions by possibly becoming more of a defensive pessimist. Due to the fact that academic learning environments can produce anxiety, it is important for students to develop strategies to manage this anxiety. Defensive pessimism is defined by Norem (2001) as a process or strategy used by individuals to harness anxiety and transform it into action. However, the hypothesis for this study was that defensive expectations can actually interfere with achievement. Due to lack of existing research, the relationship between reflectivity and
achievement is still unclear. It is also unclear how defensive pessimism relates to metacognition and academic achievement, and whether or not defensive pessimism is the most effective strategy for managing anxiety.

The second part of defensive pessimism is the process of reflectivity. This process involves a behavior that is unique to defensive pessimists: the use of mental rehearsal as a way to pre-reflect before an event that is causing anxiety. This strategy allows defensive pessimists to feel a sense of control about failure, and may explain why defensive pessimists are less likely to participate in post-event reflection and make attributions directly following a task (Merz & Swim, 2008). Additionally, reflectivity, along with defensive expectations, can influence one’s reaction after completion. Geers and Lassiter (2002) used the Affective Expectation Model (AEM) developed by Wilson, Lisle, Kraft, and Wetzel (1989) to provide evidence that pessimists are more sensitive to discrepancies when compared to optimists, thus making every situation seem more positive to defensive pessimists because of the discrepancies between their low expectations and higher end results. For example, pessimists were more likely to find a greater number of mistakes than optimists when proofreading documents, and notice changes in their affects and opinions (Geers & Lassiter, 2002). By having a constant negative expectation of future events, defensive pessimists will take greater note of the discrepancy of their pessimistic expectations compared to their affect during and after the anticipated event. By using this strategy, defensive pessimists can feel a sense of accomplishment, as long as the event did not turn out as terribly as they originally anticipated. It is worth stating that there is a difference between this type of strategy in
which the defensive pessimists still achieve success, and a self-handicapping strategy in which people limit themselves based on their future expectations.

Another important piece of defensive pessimism research focuses on the relation between defensive pessimism and self-handicapping. According to Vrugt and Oort (2008), self-regulated learners are typically the students who are actively involved in the learning process, and employ goal-setting and metacognitive techniques. However, there are qualitative and quantitative differences in the strategies among self-regulated learners, with some strategies being more effective and efficient than others. Defensive pessimists may possess the ability to employ some self-regulated learning strategies, but they may not be the most effective users of metacognitive knowledge monitoring. It has been found that defensive pessimists typically set performance-oriented goals (those that are focused on demonstrating ability). This type of goal setting can affect academic achievement because students that adopt performance-oriented goals often make use of only surface cognitive skills and ineffective resource management strategies, which can lead to lower exam scores (Vrugt & Oort, 2008). As previously stated, effective metacognition involves goal setting, but the appropriate type of goals must be the target for the most successful learning and anxiety managing strategy.

**Metacognition**

The most common definition of metacognition is “thinking about one’s own thinking.” While this serves as an acceptable general description of the term, Nelson and Narens (1996) appropriately expanded upon it to include the processes of monitoring and control to regulate cognitive activities. More specifically, Dunlosky and Metcalfe (2009)
defined metacognitive monitoring as an informative process involving awareness and assessment of cognitive processes, whereas metacognitive control is described as regulation and modification of ongoing activities. According to Flavell (1979), metacognition is a conscious process relating to many different cognitive experiences. Additionally, Tobias and Everson (2009) explained metacognition as a type of hierarchical process, which builds upon previous skills. The most basic and primary skill individuals must have to participate in higher-level metacognitive activities, such as planning for learning, is metacognitive knowledge monitoring, or knowing what you know, and what you do not know. Having poor metacognitive knowledge monitoring skills often leads to excessive review of familiar knowledge at the expense of learning and mastery of new material (Tobias & Everson, 2009).

Whereas there are many different ways to measure metacognition and collect data, the most common ways to collect data and measure metacognition are through interviews, observations, and self-reports (Tobias & Everson, 2009). One method for measuring metacognition is by using the knowledge monitoring assessment (KMA, cf. Tobias & Everson, 2009), coefficient alpha = .80 (Cronbach, 1951). The KMA has been used in various studies and has been evidenced as a valid and reliable assessment for measuring metacognitive processes. By using the KMA to focus on self-reporting and problem-solving abilities, variance becomes less of a threat to the validity of the study due to the lack of requiring the report of cognitive processes (Tobias & Everson, 2009). Previous studies have identified a high correlation of KMA scores with standardized achievement tests and grades, providing criterion-related validity and leading to the
conclusion that those who have higher metacognitive skills also have higher achievement (Tobias & Everson, 2009).

The two components of defensive pessimism both involve metacognition, but use it in different ways. Specifically, the nature of defensive expectations appears to be an ineffective use of metacognition, considering the expectations tend to be negative while the final outcome may or may not be. Adopting these expectations also causes defensive pessimists to spend significant amounts of time using rehearsal strategies (or reflectivity) to manage their anxiety, and plan for addressing failure before it even happens. The question is whether or not this pre-event reflectivity exemplifies effective metacognitive skills. Defensive pessimists are less likely to reflect upon an event after it has happened (Merz & Swim, 2008), and thus, limit the use of metacognitive skills to pre-reflection as opposed to post-hoc reflection. Therefore, monitoring (in the form of defensive expectations) and control (in the form of reflectivity) happen mostly before an event, and less during or after.

On the surface, it may seem like defensive pessimists are monitoring and controlling their cognition before an event, but the current study examined how they monitor their cognition during an event within the academic environment. Isaacson and Was (2010) found that learners’ abilities to monitor existing knowledge about a topic correlated with higher exam scores and the ability to participate in higher level metacognitive processes such as evaluating and planning. Therefore, it may be a more effective strategy for defensive pessimists to monitor their knowledge about a topic, and control their learning based on their conclusions drawn from monitoring, rather than
monitoring all the ways in which something could go wrong, and trying to imagine how they will control their reactions through pre-reflection.

A possible strategy for monitoring one’s learning is by making judgments of learning (JOLs), or more specifically, feeling-of-knowing (FOK) judgments when completing an assessment. FOK judgments are made when students are considering whether or not they are correctly responding to questions (Dunlosky & Metcalfe, 2009). The KMA used in the current study required the participants to make a judgment of whether or not they felt they knew the correct answer for each item on the exam, in addition to identifying the correct response to each item. Therefore, there are four possible outcomes when making these knowledge-monitoring judgments, classified by the following terms: hits, misses, false alarms, and correct rejections (See Table 1).

Table 1

Knowledge Monitoring Possible Outcomes

<table>
<thead>
<tr>
<th>Know</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>Hit</td>
</tr>
<tr>
<td>Incorrect</td>
<td>False Alarm</td>
</tr>
</tbody>
</table>

Adapted from Dunlosky & Metcalfe, 2009

This unique method of measuring metacognitive knowledge monitoring can give essential information about the defensive expectations made by defensive pessimists and their ability to effectively participate in metacognitive knowledge monitoring. Due to the
fact that defensive pessimists are likely to be under-confident in their knowledge monitoring, it is hypothesized that defensive pessimists will be biased in their responses, and will have frequent “misses” based on their defensive expectations.

When measuring metacognition at the time of a specific task, relative accuracy can be used to understand how well an individual uses metacognitive skills (Dunlosky & Metcalfe, 2009). For computation of relative accuracy, the Goodman-Kruskal gamma (Γ) is used. The correlations from this procedure can range from -1.0 to 1.0, with a correlation of 0 indicating that items relative to another cannot predict each other’s accuracy. As the correlation increases, so does the accuracy of judgments to predict performance on items relative to one another. An important aspect to remember is that relative accuracy is a measure of individual participant’s judgments on an item-by-item basis, not overall performance. However, with existing empirical and anecdotal evidence indicating that students have the ability to increase metacognitive skills (Hacker, Dunlosky, & Graesser, 1998; Hoyt & Sorensen, 2001; Joseph, 2010; Lifford, Byron, & Ziemian, 2000; Moje, 2002; Peverly, Brobst, & Morris, 2002; Williams et al., 2002), it is important to assess whether defensive pessimists are effective users of metacognition, and if this relationship impacts academic achievement.

There is a gap of empirical research in the existing literature that focuses on the relationships between defensive pessimism, metacognition, and academic achievement. This gap indicates a need for the current study, which examined each of the effects of defensive pessimism and metacognitive bias on academic achievement. Previously cited studies provide evidence that the separate parts of defensive pessimism (defensive
expectation and reflectivity) may have different effects on knowledge monitoring and academic achievement. Additionally, metacognition research indicates significant relationships between greater metacognitive skills and higher academic achievement.

The current study used path analysis to examine the relationships between these variables and test the hypotheses that defensive pessimism and metacognitive bias will have a negative correlation with academic achievement, and bias students’ metacognitive knowledge monitoring judgments. More specifically, the current study analyzed whether or not defensive expectations and reflectivity bias students’ judgments about whether or not they will correctly respond to items on an assessment.
CHAPTER II

METHODOLOGY

Participants

The participants in this study were undergraduate students enrolled in an educational psychology course at a public mid-western university in the United States. The total sample consists of 199 participants, 50 males and 149 females. The difference between the number of males and females reflects the typical numbers found in teacher education programs, which have significantly more females than males. All students were of sophomore or junior standing, due to the suggested course progression requirements for teacher education programs.

Description of the Instruments/Materials

Defensive pessimism and metacognition were both continuous variables. Defensive pessimism was measured using questions from Andrew Martin’s (2001) defensive pessimism scale (Martin et al., 2001). The rationale for using Martin’s measure of defensive pessimism is the separation between defensive expectations and reflectivity, and the fact that it is more concentrated on academic performance, as opposed to life experiences when compared to scales developed by Norem (2001) and Garcia (1995). The amount to which a student is a defensive pessimist is considered a continuous variable, which increases as the total score increases. The range for the defensive pessimism scores was from 23 to 79. These scores explain how much defensive pessimism accounts for variance in final exam scores. The survey used prompts developed by Martin and
colleagues (2001), which had a 5-point Likert scale (i.e., Agree to Disagree) on the survey to identify whether students were defensive pessimists or not (See Appendix A).

The KMA utilized for this study is an evaluation designed to operationalize metacognition by measuring the difference between students’ estimates of their level of performance, and their actual performance (Tobias & Everson, 2009). The current task was adopted from Tobias and Everson (2009; Tobias, 2000). The specific KMA designed for the current study required participants to respond to a multiple choice vocabulary test and correctly identify the meaning of 50 English vocabulary words. Next, participants were asked to state whether or not they knew the meaning of the same 50 English words. The procedure generated the following four participant responses: (a) known and correctly responded to the item on the vocabulary test (hits); (b) known but responded to the item incorrectly on the vocabulary test (false alarms); (c) unknown but the correct response was given on the vocabulary test (misses); and (d) unknown and responded to the item incorrectly on the vocabulary test (correct rejections). These categories relate to the previously mentioned terms used to describe knowledge monitoring judgments (see Table 1).

Two new measures for pessimistic metacognitive bias and optimistic metacognitive bias were also created for this study based on the KMA. Pessimism bias was calculated as the proportion of items answered correctly on the KMA, after indicating they did not know the answer, divided by all the incorrectly answered items. This variable was calculated using Table 1 and the following formula:
Pessimism Bias = \[ \frac{\text{Misses}}{\text{Misses} + \text{Hits}} \]

It was hypothesized that defensive pessimists would frequently indicate not knowing an answer to an item, and then actually respond to the item correctly. In other words, defensive pessimists were hypothesized to make frequent “misses.” Therefore, the development of the measure for pessimistic bias intended to show whether defensive pessimists were making pessimistically biased knowledge monitoring judgments more frequently than judgments that used accurate metacognition.

In contrast, optimism bias was calculated as the proportion of items answered incorrectly after indicating they knew the answer, divided by all the correctly answered items. This variable was also calculated using Table 1 and the following formula:

\[ \text{Optimism Bias} = \frac{\text{False Alarms}}{\text{False Alarms} + \text{Correct Rejections}} \]

This measure was created to identify students who were making inaccurate metacognitive monitoring judgments, but not in the same way as students with pessimism bias. In fact, this measure is the opposite of pessimism bias, and intended to capture metacognitive knowledge monitoring judgments biased towards indicating knowing an answer to an item, and then incorrectly responding to that item. Students who were optimistically biased in their judgments were hypothesized to make frequent “false alarm” judgments. These two measures of bias are referred to as “metacognitive bias” when talking about them as a unit. Academic achievement was measured as the participants’ scores out of 100 total points on the course final exam.
**Procedures - Data Collection and Analysis**

The current study is a non-experimental correlational study, which examined the relationships between defensive pessimism, metacognition, metacognitive bias, and academic achievement through path analysis. The existing data for the study were collected through a 5-point Likert scale survey administered to students enrolled in an educational psychology course during the spring and fall semesters from 2005 to 2009. The KMA and the defensive pessimism measure were administered within the first two weeks of the semester in which the participants were enrolled in the educational psychology course. The survey consisted of questions relating to both components of defensive pessimism (see Appendix A) and metacognition (see Table 1). Final exam scores were compiled for students following the final semester exam. These data were analyzed using SPSS (version 18.0). Any participants that did not consent to sharing their final exam scores or did not participate in one of the measures were excluded from the study.

Descriptive statistics were analyzed using SPSS version 18.0 software. Table 2 presents the means, standard deviations, skewness, and kurtosis for all observed variables. According to the Kolmogorov-Smirnov test, optimism bias was the only variable that met the normality assumption \((p > .05)\). The Shapiro-Wilk test indicated that defensive expectations was the only variable to meet the normality assumption \((p > .05)\), and all other variables did not \((p < .05)\). The skewness and kurtosis statistic indicated that all variables were significantly skewed, but were not significantly kurtotic.
Table 2

Descriptive Statistics for the Observed Variables (N = 199)

<table>
<thead>
<tr>
<th>Variables</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Achievement</td>
<td>73.54</td>
<td>11.14</td>
<td>-.453</td>
<td>-.235</td>
</tr>
<tr>
<td>Defensive Expectations</td>
<td>21.92</td>
<td>7.63</td>
<td>.477</td>
<td>-.372</td>
</tr>
<tr>
<td>Reflectivity</td>
<td>25.04</td>
<td>5.08</td>
<td>-.08</td>
<td>-.267</td>
</tr>
<tr>
<td>Pessimism Bias</td>
<td>.32</td>
<td>.17</td>
<td>.654</td>
<td>.522</td>
</tr>
<tr>
<td>Optimism Bias</td>
<td>.36</td>
<td>.17</td>
<td>.517</td>
<td>.357</td>
</tr>
</tbody>
</table>

Note. aN = 198

After examination of the descriptives, a theoretical model based on the existing literature was developed. Following the development, correlational analyses were implemented to identify any relationships between defensive pessimism, pessimism bias, optimism bias, and academic achievement (Appendix D). Path analysis was implemented to examine the theoretical relationships between defensive pessimism, pessimism bias, optimism bias, and final exam scores. When completing these statistical procedures, defensive pessimism was examined as two separate components: defensive expectations and reflectivity, which were separately correlated to the measures for pessimism bias, optimism bias, and academic achievement. After the initial model had been tested, modifications were suggested, and a final model was developed with the absence of nonsignificant paths that were present in the initial model.
Model fit was determined using the following fit indices: Chi-Square ($\chi^2$), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Root-Mean-Square Error of Approximation (RMSEA), and Standardized Root-Mean Residual (SRMR).

According to Bollen (1990), there is a lack of consensus regarding which fit indices are best. While none of these fit indices provide conclusive evidence of model fit in isolation, the examination in combination with each other indicates goodness of fit across a range of measures. Each of these fit indices provides evidence of good model fit when comparing different models to each other.

One of the selected measures of fit was $\chi^2$, which examines the inferential differences between the observed and implied variance-covariance matrices (Schumacker & Lomax, 2010). When using path analysis, a nonsignificant $\chi^2$ value is desirable, so as to indicate that the sample data and theoretical model are similar; thus, the model has good fit with the data (Schumacker & Lomax, 2010). Many factors may influence the results of the $\chi^2$ test. Specifically, larger sample sizes may produce inflated significant $\chi^2$ values, whereas smaller sample sizes may produce low $\chi^2$ values, which increase the risk of a Type II Error (Marsh, Balla, & McDonald, 1988; Tanaka, 1993).

Another index used in the current study was the GFI, which measures the amount and variance and covariance in the data that is predicted by the theoretical model (Jöreskog & Sörbom, 2006; Schumacker & Lomax, 2010). The AGFI measure takes into consideration the degrees of freedom of the theoretical model, relative to the number of variables, and adjusts the GFI based on these specifications. It is suggested that values for
GFI and AGFI should be around .90 or .95, with greater values indicating better model fit (Jöreskog & Sörbom, 2006; Schumacker & Lomax, 2010).

The final fit indices used in the current study were RMSEA and SRMR. The RMSEA index is commonly used based on its consideration of model parsimony (Brown, 2006; Steiger, 1990). More parsimonious models are desired when using path analysis, in order to account for the greatest amount of variance on the dependent variable by using the least amount of independent variables and path coefficients. The SRMR index measures the average difference between the predicted and observed variances and covariances in the model. The average difference as indicated by SRMR is based on standardized residuals from the observed data and the theoretical model. Similar to GFI and AGFI measures, the SRMR has a range from 0 to 1. Suggested values for RMSEA and SRMR should be .05 or lower (Schumacker & Lomax, 2010).
CHAPTER III

RESULTS

Path analysis was conducted using LISREL 8.8 (Jöreskog & Sörbom, 2006) software. The estimated standardized path coefficients for the initial model (Appendix B) and final model (Appendix C) are presented below.

Power

Kline (1998) recommended that the sample size should be at least 10 times as many cases as parameters, and at least 200. For the initial model, there were a total of 13 free parameters that were estimated (i.e., 7 path coefficients, 3 equation error variances, 1 correlation among the independent variables, and 2 independent variable variances). Thus, a total sample size of at least 130 participants was needed to obtain an acceptable .80 power level, at alpha of .05. The total sample size for the current study was 199 participants, thus meeting and exceeding the recommendations.

Path Analysis

A total of two models (initial and final) were used to examine the relationships between academic achievement, defensive expectations, reflectivity, pessimism bias, and optimism bias. The initial model included all direct and indirect relationships of the aforementioned variables, with an addition of an error variance between pessimism bias and optimism bias based on the fact that they were calculated from the same measuring instrument (Schumacker & Lomax, 2010). The only path purposely excluded from the initial model was the path between reflectivity and academic achievement. This path was not included based on theory and previous research about the nature of reflectivity.
Specifically, the process of reflectivity is lacking structure and focus, and instead attempts to predict all possible outcomes, good or bad, and work through them before an event. The “grasping at straws” nature of reflectivity constituted reason for the exclusion of this path. The final model had a total of four direct effects, and one indirect effect. There were also a total of two direct effects, and one indirect effect on the dependent variable of academic achievement (see Table 3 for the standardized effects of the predictor variables on the dependent variable).

Table 3

*Standardized Effects of Predictor Variables on Academic Achievement*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Direct Effects</th>
<th>Indirect Effects</th>
<th>Total Effects</th>
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<tr>
<td>Defensive Expectations</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Pessimism Bias</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
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</table>

From the initial model to the final model, the path from reflectivity to pessimism bias, the path from reflectivity to optimism bias, and the path from optimism bias to academic achievement were removed due to statistically nonsignificant relationships ($p > .05$). See Appendix F for comparison of the initial and final models.

**Initial Model**

The initial model had five significant, and three nonsignificant paths ($\alpha = .01$). The significant paths included: the path from defensive expectations to academic achievement, the path from defensive expectations to pessimism bias, the path from
pessimism bias to academic achievement, the path from defensive expectations to optimism bias, and the path between optimism bias and pessimism bias (which included error variance; $p < .01$). The nonsignificant paths included: the path from reflectivity to pessimism bias, the path from reflectivity to optimism bias, and the path from optimism bias to academic achievement ($p > .01$). Based on the initial model, 19.2\% of the variance in academic achievement can be explained by defensive expectations, reflectivity, pessimism bias, and optimism bias. According to the $\chi^2$ global fit index, which measures the degree to which the sample data ($S$) fit the model ($\Sigma$), there was no difference between $S$ and $\Sigma$, which indicated good fit to the model ($X^2 = 2.124$, $df = 1$, $p = .145$). However, it was not the most parsimonious model. More specifically, there were three nonsignificant parameters to eliminate: the path from Reflectivity to Optimism Bias, and the path from Reflectivity to Academic Achievement, and the path from Optimism Bias to Academic Achievement. Although there were no recommended changes suggested by the software, it was integral to eliminate nonsignificant paths. Having a more parsimonious model is vital in path analysis to ensure that the least amount of independent variables and significant path coefficients are accounting for the greatest possible amount of variance in the dependent variable. In the current study, the initial model accounted for 19.2\% of the variance in academic achievement. After the nonsignificant paths were removed, the model was evaluated again.

**Final Model**

After eliminating the path from reflectivity to optimism bias, the path from reflectivity to academic achievement, and the path from optimism bias to academic
achievement, the model was more parsimonious. Additionally, all other paths in the final model were significant. A third experimental model, which was less parsimonious by including the nonsignificant path from optimism bias to academic achievement, was also tested. The purpose of running the model with the inclusion of this nonsignificant path was to provide a comparison model to run a Likelihood Ratio Test. The experimental, less parsimonious model had a $\chi^2$ value of 2.739, with 3 degrees of freedom. The final, more parsimonious model, with the removal of all nonsignificant paths had a $\chi^2$ value of .845, with 1 degree of freedom ($p = .358$). After completing a Likelihood Ratio Test, the value was not significantly different (the difference between both $\chi^2$ values over the difference of the degrees of freedom did not exceed 5.99, $\alpha = .05$), which would indicate that the more parsimonious model was more appropriate, and thus had a better fit.

Therefore, the final model chosen for the current study was the more parsimonious model with the absence of all nonsignificant paths. The only significant path with a positive direction was the path from defensive expectations to pessimism bias ($p < .01$). The path from pessimism bias to academic achievement ($p < .001$) in addition to the paths from defensive expectations to academic achievement, and the path between pessimism bias and optimism bias were negative ($p < .01$). Similar to the initial model, 18.9% of the variance in academic achievement can be explained by defensive expectations and pessimism bias (i.e., the difference being the absence of optimism bias in the variance of the final model).

Multiple fit indices were examined to determine the goodness of fit for the model. The $X^2$ global fit index for the final model indicated that the fit was good ($\chi^2 = .845$, $df = $
1, \( p = .358 \). Additionally, RMSEA was .0. Schumacker and Lomax (2010) stated that values typically less than or equal to .05 are considered acceptable. The standardized root-mean square residual (SRMR) was .016. The interpretation criterion for this measure is the same as the RMSEA, which provides more evidence that the model is a good fit (Schumacker & Lomax, 2010). Finally, the goodness-of-fit index (GFI) and the adjusted goodness-of-fit index (AGFI) were .998 and .979. For this measure, values are considered to be acceptable if they are above .95 (Schumacker & Lomax, 2010). Therefore, all the abovementioned fit indices suggested good model fit for the final model. There were no suggested modifications for subsequent models.

In conclusion, all parameters in the final model were significant. Based on the modification indices, there were no subsequent models that were suggested. Finally, the standardized residual matrix did not show any unusually large standardized residuals. The largest standardized residual was -.916, and the smallest was 0. Therefore, there is adequate support to indicate that the final model has the best fit as evidenced by all the global fit indices and the fact that the model is more parsimonious than the initial model.
CHAPTER IV
DISCUSSION

The purpose of the present study was to examine the relationships between defensive expectations, reflectivity, pessimism bias, optimism bias, and academic achievement. The study also used the relationships between the variables to develop a theoretical path model (Appendix B). The study attempted to answer three research questions:

1. What is the relationship between defensive pessimism (comprised of defensive expectations and reflectivity) and academic achievement?

2. What is the relationship between metacognitive bias (pessimism bias and optimism bias) on final exam scores?

3. Do the separate parts of defensive pessimism have different effects on metacognitive bias and academic achievement?

It was hypothesized that defensive pessimism and metacognitive bias would have a negative correlation with final exam scores, and bias students’ judgments about whether or not they will answer questions correctly, thus, reducing knowledge monitoring accuracy. In regards to the variables’ effects on academic achievement, the results of the study aligned well with previous metacognition studies, but had different results from previous defensive pessimism studies. However, it is worth noting that previous studies about defensive pessimism mainly focused on comparisons with optimists or self-handicappers, and there is no existing empirical research that examines defensive pessimism and metacognition as was done in the current study.
The rationale for creating the initial path model was based from previous research. Defensive expectations, reflectivity, pessimism bias, and optimism bias were all hypothesized to affect academic achievement. Defensive expectations and reflectivity were also hypothesized to affect metacognitive bias, as opposed to the opposite relationship (metacognitive bias affecting defensive pessimism). Defensive pessimism, being a strategy for managing anxiety, is used in a broad range of life events that cause stress (Norem, 2001). Defensive expectations and reflectivity both happen prior to an anticipated event (Norem, 2001; Martin et al., 2001; Martin, Marsh, Williamson, & Debus, 2003). For these reasons, it was more sensible that defensive expectations and reflectivity would affect metacognitive bias, instead of the opposite relationship. One benefit of using path analysis for the current study was the fact that in addition to the affects of defensive expectations and reflectivity on metacognitive bias and academic achievement, the indirect paths between defensive pessimism and metacognitive bias to academic achievement were examined.

As hypothesized, there was a negative correlation between defensive expectations and academic achievement, pessimism bias and academic achievement, and optimism bias and academic achievement. There was also a positive correlation between defensive expectations and pessimism bias. A surprising outcome of the initial model was the nonsignificant results between reflectivity to defensive expectations, reflectivity to pessimism bias, and reflectivity to optimism bias, which did not coincide with hypotheses made by the author prior to the study. In fact, the final path model had a significantly better fit once the nonsignificant paths from reflectivity to academic achievement,
reflectivity to optimism bias, and from optimism bias to academic achievement was removed. After the removal of these paths, reflectivity was no longer a part of the model. After removing the nonsignificant paths from the model, a final, more parsimonious model was created and is shown in Appendix C.

This finding would imply that the two pieces of defensive pessimism (i.e., defensive expectations and reflectivity) as defined by Norem (1986a, 1986b) and Martin et al. (2001) and Martin et al. (2003) have different effects on academic achievement. The findings of the current study are harmonious with the previous studies by Martin and colleagues (2001, 2003) by providing evidence that defensive expectations and reflectivity, which were previously thought of as having congruent effects, impact academic factors in different ways. Additionally, Martin et al. (2001) study found that reflectivity was more success orientated, whereas defensive expectations were not. In the current study, reflectivity did not have any effect on academic achievement or metacognitive bias, whereas defensive expectations had a moderate negative effect on academic achievement and pessimism bias. The curious lack of correlation between reflectivity and pessimism bias, and reflectivity and academic achievement may be explained by the nature of the type of reflections made by defensive pessimists. Based on previous literature, the path between reflectivity and academic achievement was purposefully not included in the initial model, because of the lack of relationship between the two in previous research. As previously stated, defensive pessimists participate in a great deal of pre-event reflection that does not have a specific focus. Instead, these reflections are about any possible outcomes of an anticipated event, and how to handle
the situation if one of the predicted outcomes should be true. These reflections could include imagining a positive outcome, negative outcome, or more often both types of outcomes. Thus, reflectivity may not correlate with pessimism bias or academic achievement because it is not often accurate, and focuses on a plethora of outcomes as opposed to one specific outcome.

In both the initial and final models, there were also many negatively correlated relationships between the variables that were correctly hypothesized. Firstly, the path between defensive expectations and academic achievement had a low-moderate relationship. This would indicate that as defensive expectations increase, academic achievement decreases. There was also a negative relationship between pessimism bias and academic achievement. This would also indicate that as pessimism bias increases, academic achievement decreases. Additionally, the positive relationship between defensive expectations and pessimism bias created a path from defensive expectations, to pessimism bias, and finally to academic achievement. This path had a moderate correlation with academic achievement, suggesting that defensive expectations and pessimism bias together have an even greater negative effect on academic achievement. Therefore, since defensive expectations often coincide with pessimism bias, defensive pessimists are at an even greater risk for lower academic achievement. This finding is different from the findings of a study by Norem and Cantor (1986b) in which defensive pessimists made defensive expectations that differed from optimists, but still performed as well as optimists when solving puzzles. Additionally, these findings go against
previous statements by Norem (2001) that defensive pessimists are typically very successful individuals who perform well.

The measures of optimism and pessimism bias were unique, and created by the author specifically for this study. Although optimism bias did not have a statistically significant relationship with academic achievement, the relationship between pessimism bias and academic achievement is worth some discussion. Pessimism bias measured the percentage of times a subject indicated they did not know the answer, when in fact they answered correctly. This measure was created from the KMA by using the basic principles of Goodman-Kruskal gamma scores, with slight modifications. Previous studies have evidenced the importance of metacognitive knowledge monitoring skills in the academic environment (e.g., Flavell, 1979; Hoyt & Sorenson, 2001; Hartwig, Was, Isaacson, & Dunkosky, 2011; Isaacson & Was, 2010; Lambert, 2000; Lifford et al., 2000; Loizdou & Koutselini, 2007; Peverly et al., 2002; Tobias & Everson, 2009). The current study provides evidence that students can be biased in their metacognitive judgments, specifically those students identified as defensive pessimists. In accordance with previously cited studies focusing on the importance of self-regulation and metacognitive judgments, making metacognitive judgments that are biased towards optimism or pessimism have a negative relationship with academic achievement. One final path of the model included the path from defensive expectations to optimism bias. The weak negative correlation between defensive expectations and optimism bias indicates that as defensive expectations increase, optimism bias decreases. Even though this correlation was not as strong as the relationship between defensive expectations and pessimism bias,
it makes sense that it would be the opposite correlation, thus providing more support of the good model fit.

**Implications**

In addition to the model being a good fit for the data, the findings of the study have important implications on the educational environment. Overall, the final model indicated that 18.9% of the variance in academic achievement was explained by defensive expectations and pessimism bias. Although the initial model accounted for more variance (19.2%), which was due to the inclusion of optimism bias, the final model was still a better fitting model. More importantly, the small percentage increase that was due to optimism bias was nonsignificant when compared to defensive expectations and pessimism bias. The final model accounting for 18.9% variance in academic achievement demonstrates a noteworthy effect size, especially when considering the multiple other factors that contribute to students’ exam scores (such as: study methods, exam preparation, life events, motivation, etc.). One implication that the model has on the educational environment is the importance of identifying students who exhibit behaviors of being a defensive pessimist, or more specifically, make defensive expectations. The model provides evidence to suggest that as defensive expectations increase, academic achievement decreases. Thus, identifying students who are making defensive expectations also becomes a process of identifying students who are at risk for lower academic achievement. The path model also showed that students who make defensive expectations, in addition to having a metacognitive knowledge monitoring bias towards pessimism, are at even greater risk for lower academic achievement.
The path model provided evidence that metacognitive knowledge monitoring judgments can be biased towards pessimism or optimism. The model also supports that defensive pessimists are more likely to make judgments biased towards pessimism, which has a greater negative effect on academic achievement, when compared to optimism bias. After identifying these students, an intervention could be implemented to teach students to make unbiased metacognitive knowledge monitoring judgments. Empirical evidence exists that supports the idea that metacognitive skills can be increased through instruction (e.g., Hacker et al., 1998; Hoyt & Sorensen, 2001; Joseph, 2010; Lifford et al., 2000; Moje, 2002; Peverly et al., 2002; Williams et al., 2002). Admittedly, the appropriate intervention strategy is a topic necessary of further research that was not addressed in the current study. In a previous study by Spada, Nikcevic, Moneta, and Ireson (2006), an intervention strategy was created to use increased metacognitive monitoring skills to alleviate test anxiety. Since Norem (2001) identified defensive pessimism as a reason to manage anxiety, it may be more beneficial for defensive pessimists to use metacognitive knowledge monitoring skills to manage anxiety, rather than defensive expectations. This information provides an opportunity to continue examining the data of the current study and add to the educational implications based on the current conclusions that can be drawn from the path model.

**Potential Limitations**

The purpose of the study was to identify the relationships between defensive pessimism, metacognition, and academic achievement. The results of the study are intended to be generalized to the academic community, specifically undergraduate
students who display defensive pessimistic characteristics; thus, limiting the external validity of the study. However, this limitation is compensated for through understanding the relationships between the variables of the study, which may lead to future studies that identify stronger learning strategies for defensive pessimists. Future research studies meant to build on the current study should be aware of this potential limitation and may benefit from using a more diverse sample. Although random sampling techniques were unfeasible, due to the fact that the study focuses on a specific population, the external validity of the study should not be compromised by generalizability. However, it is worth stating that the current study is meant to generalize to undergraduate students in teacher education programs. In addition to external validity, internal validity is also important to address (Wiersma & Jurs, 2009). With any study that uses self-reporting measures for data collection, there is always the threat that data will be inaccurately reported. While the specific KMA measure used for the current study attempted to reduce this threat, it should still be mentioned. Nevertheless, this issue is something that affects nearly all metacognition studies, and other studies that use self-reporting methods, but is not a serious threat to internal validity.

**Future Directions**

The conclusions drawn from this study state that 18.9% of the variance in academic achievement can be explained by defensive expectations and pessimism bias. This significant amount of variance provides evidence that as defensive expectations and pessimism bias increased, academic achievement decreased. The next step to addressing this issue is to engage in future research examining why defensive pessimism leads to
lower academic achievement. Future research should include a study to examine the relationships between defensive pessimism and various study strategies. This could be accomplished by collecting data using the Motivated Strategies for Learning Questionnaire (MSLQ), Andrew Martin’s Defensive Pessimism Scale, and measures of academic achievement. By examining these relationships, it may be possible to indentify precise causes for lower academic achievement in defensive pessimists, and provide intervention to increase achievement. Another reason for future research on this topic is the potential limitations of the current study, which are not detrimentally threatening to internal or external validity, but are important to discuss.

Conclusion

Many factors contribute to the variance in academic achievement scores. After thorough examination of the literature, the need for a study, which examined the relationships between defensive pessimism and metacognition, became apparent through the lack of existing empirical research combining the two topics. The current study examined the relationships between reflectivity, defensive expectations, pessimism bias, optimism bias, and academic achievement. Using path analysis, an initial path model was developed. After addressing suggested modifications and removing nonsignificant paths, a final model was developed which indicated that defensive expectations and pessimism bias account for 18.9% of the variance in academic achievement. Statistically significant relationships between defensive expectations and academic achievement, pessimism bias and academic achievement, and defensive expectations and pessimism bias provided evidence that as defensive expectations and pessimism bias increased,
academic achievement decreased. The imperative educational implications of these findings include the importance of identifying and providing intervention strategies for students considered to be defensive pessimists, and who more specifically, make defensive expectations and are biased in their metacognitive knowledge monitoring judgments. By implementing an intervention, it may help to prevent decreased academic achievement in defensive pessimists.
APPENDIX A

ANDREW MARTIN’S DEFENSIVE PESSIMISM SCALE
Appendix A

Andrew Martin’s Defensive Pessimism Scale

Defensive Expectations:

1. No matter how well I have done in the past, I go into academic situations expecting to do worse

2. No matter how well I have done in the past, I often expect I will do more poorly in the future.

3. No matter how well I have done in the past, I generally have negative expectations about how I will do in the future

4. No matter how well I have done in the past, I often expect that in upcoming tests or assignments I won't be able to do what is required of me

5. No matter how well I have done in the past, in upcoming tests or assignments, I think if something can go wrong for me, it will

6. No matter how well I have done in the past, I'm pessimistic about my future performances

7. No matter how well I have done in the past, I hardly ever expect things to go my way in the future

8. No matter how well I have done in the past, in future performances, I rarely expect good things to go my way

Reflectivity:

1. I carefully consider all possible outcomes before tests and assignments

2. I often think about how I will feel if I do very poorly in tests and assignments
3. I often think about how I will feel if I do very well in tests and assignments.

4. I often try to figure out how likely it is that I will do very poorly in tests and assignments.

5. I spend a lot of time thinking through possible outcomes when a test or assignment is coming up.

6. I often try to figure out how likely it is that I will do very well in tests and assignments.

7. Considering what can go wrong in tests and assignments helps me to prepare.
APPENDIX B

INITIAL PATH MODEL WITH STANDARDIZED PATH COEFFICIENTS
Appendix B

Initial Path Model With Standardized Path Coefficients
APPENDIX C

FINAL PATH MODEL WITH STANDARDIZED PATH COEFFICIENTS
Appendix C

Final Path Model With Standardized Path Coefficients
APPENDIX D

CORRELATIONS OF OBSERVED VARIABLES (N = 199)
Appendix D

Correlations of Observed Variables (N = 199)

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<td>1. Academic Achievement</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Defensive Expectations</td>
<td>-0.326**</td>
<td>--</td>
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<td></td>
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<tr>
<td>3. Reflectivity</td>
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<td>4. Pessimism Bias</td>
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<td>0.180*</td>
<td>0.88</td>
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<td>5. Optimism Bias</td>
<td>0.156*</td>
<td>-0.161*</td>
<td>-0.036</td>
<td>0.550**</td>
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Note: *p < .05 **p < .01
APPENDIX E

MAXIMUM LIKELIHOOD ESTIMATES AND SELECTED FIT INDICES FOR THE INITIAL AND FINAL MODELS (N = 199)
Appendix E

Maximum Likelihood Estimates and Selected Fit Indices

for the Initial and Final Models (N = 199)

<table>
<thead>
<tr>
<th>Description</th>
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<th>Final Model</th>
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