Spring 2015

Examining the Use of Mindfulness Meditation to Enhance Attention Regulation Efficiency in Nursing Students

Kathleen Burger

Follow this and additional works at: https://dsc.duq.edu/etd

Recommended Citation

EXAMINING THE USE OF MINDFULNESS MEDITATION TO ENHANCE ATTENTION REGULATION EFFICIENCY IN NURSING STUDENTS

A Dissertation
Submitted to the School of Nursing

Duquesne University

In partial fulfillment of the requirements for
the degree of Doctor of Philosophy

By
Kathleen G. Burger

May 2015
EXAMINING THE USE OF MINDFULNESS MEDITATION TO ENHANCE ATTENTION REGULATION SKILLS OF NURSING STUDENTS

By

Kathleen G. Burger

Approved March 30, 2015

Dr. Joan Such Lockhart
Clinical Professor of Nursing, MSN
Nursing Education Track Coordinator
(Committee Chair)

Dr. Alison Colbert
Associate Professor of Nursing
(Committee Member)

Dr. Ara Schmitt
Professor of Psychology
(Committee Member)

Dr. Mary Ellen Smith Glasgow
Dean, School of Nursing
Professor of Nursing
ABSTRACT

EXAMINING THE USE OF MINDFULNESS MEDITATION TO ENHANCE ATTENTION REGULATION SKILLS OF NURSING STUDENTS

By
Kathleen G. Burger
May 2015

Dissertation supervised by Joan Such Lockhart, PhD, RN, CORLN, AOCN, CNE, ANEF, FAAN

The development of mindfully-attentive nursing graduates is a heightened charge for pre-licensure nurse educators given an increasingly complex healthcare workplace in which nurse’s must detect patient risk among multiple stimuli, distractions, and interruption (Beyea, 2007; Cornell et al., 2010; Ebright, et al., 2006). Novice nurses frequently report symptoms of cognitive overload associated with error and other negative patient outcomes (Ebright, Urden, Patterson, & Chalko, 2004; McGillis Hall et al., 2010; Unver, Tastan, & Akbayrak, 2012) yet standard pre-licensure nursing curricula does not specifically prepare students for the needed attention regulation skills of safe nursing practice. Recent and accumulating neuroscientific research suggests a strong correlation between regular practice of mindfulness meditation (MM) (Eberth & Sedlmeier, 2012) and enhanced attentional capacity. This randomized controlled trial therefore investigated the effect of MM as compared to standard nursing education on the efficiency of attentional processes (alerting, orienting, and executive function) in pre-licensure
registered nursing students (N=52) as well as on accuracy in performance of a nursing skill. It was framed by Posner and Gilbert’s (2002) neuropsychological Model of Attention. Main outcome data were collected using the Attention Network Test (ANT) (Fan, McCandliss, Sommer, Raz & Posner, 2002), and an investigator-developed Medication Administration Task (MAT). Examination of possible confounding influences of perceived stress using the Perceived Stress Scale – 10 (PSS-10) (Cohen, Kamarck, & Mermelstein, 1983) and mindfulness using the Five –Facet Mindfulness Questionnaire (FFMQ) (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) were also included. Nursing students who participated in online training and four weeks of daily MM practice demonstrated improvement to executive attention efficiency as compared to a non-meditating control group $F$ (1, 49) =4.26, $p = .044$, although interpretation was restricted by accompanied low power .53. MAT results on nursing skill accuracy were non-significant, but group differences on posttests of PSS-10 and FFMQ were significant $F$ (2, 47) = 7.16, $p = .002$, power .92. After four weeks of meditation, participants in the MM group scored higher in mindfulness characteristics and lower in perceived stress than control group participants who did not meditate.
ACKNOWLEDGEMENT

I would like to thank my dissertation committee for their guidance and support in this process of doctoral research and dissertation preparation. The insights each of you have brought to my particular journey were beyond helpful, yet the spirit of collegiality in which you shared your knowledge was most of all - that special thing - which drove me ever-forward and invigorated my progress. To my dissertation chairperson, Dr. Joan Such Lockhart, who advanced my dissertation trajectory with her gently-laid down deadlines that, perhaps unknown to her, acted insidiously but brilliantly to keep me on track, enabling my progress through the dissertation phase of doctoral studies. Thank you for helping me achieve my goal as well as your many tips and suggestions aimed at clarifying my writing- for -publication style. To my internal member, Dr. Alison Colbert, whose rigorous attention to my research methodology and statistical analyses broadened my understanding, ability, and comfort level in conducting a randomized control trial study – thank you. Your knowledge of interventional research aided my development of a feasible and successful study. To my external member, Dr. Ara Schmitt, thank you for sharing your rich experiential background in neuropsychology testing and its application to my nursing education study. You broadened my understanding of attention and helped me navigate the intricacies involved in measuring it. I am honored to have worked with all of you and thank you once again for your sharing of expertise!

I would also like to thank all the faculty and staff of Duquesne University School of Nursing who have collectively assisted me in my doctoral study in their facilitation of excellent course work, guidance through college and departmental procedures, and a rigorous but always student-centered learning environment. In addition, the support of my local Alpha Omega
chapter of Sigma Theta Tau International in the form of a research grant and of Suffolk County Community College Foundation for a faculty-development grant is greatly appreciated as it assisted me with needed funding for both the pilot and larger dissertation study.

My many thanks as well to my research project manager, Natalie Dubas RN, whose assistance throughout the implementation of the dissertation study went above and beyond my expectations. Thank you for all the time you dedicated to the recruitment, scheduling, emailing of weekly messages, as well as pre and post-testing proctoring. Your enthusiasm for my project was matched only by my own, and I cannot thank you enough for your dedication. I am also very grateful for my research assistant, Martha Barbara RN, who helped with the testing procedures and in data checking. In addition, thank you to my faculty colleagues at Suffolk County Community College who continually offered their encouragement and supported my progress with their smiles, listening, and patience. I wish to also acknowledge the students who participated in my study. Thank you for volunteering your time and effort in support of this research. It is my greatest hope that you will see lasting personal and professional benefit from incorporating a mindfulness meditation practice into your daily routines.

Last but not least, I offer a loving thank you to my very supportive family and friends. To my parents whose guidance, support, and love strengthen me in all my endeavors, I am so pleased to offer back this accomplishment as testament to your good work. To my children, a special thank you as well. Although often claiming to be inspired by me, you are actually my own deepest inspiration in all that I do – including this doctoral journey. Thank you for helping me achieve this goal which I share with you.
TABLE OF CONTENTS

Abstract ....................................................................................................................................................... iv
Acknowledgement ....................................................................................................................................... vi
List of Tables ............................................................................................................................................... xiv

Chapter 1 INTRODUCTION ....................................................................................................................... 1
  1.1 Problem ............................................................................................................................................... 1
  1.2 Significance ......................................................................................................................................... 3
  1.3 Purpose and Aim ................................................................................................................................. 3
  1.4 Operational Definitions .................................................................................................................... 4
    1.4.1 Mindfulness Meditation .............................................................................................................. 4
    1.4.2 Attention Regulation .................................................................................................................. 5
  1.5 Background ......................................................................................................................................... 9
  1.6 Research Questions ........................................................................................................................... 12
  1.7 Summary ........................................................................................................................................... 13

Chapter 2 REVIEW OF LITERATURE MANUSCRIPT #1 ....................................................................... 14
  2.1 Abstract ............................................................................................................................................. 14
  2.2 Problem ............................................................................................................................................. 15
  2.3 Attention Regulation and Safe Nursing Practice .............................................................................. 15
  2.4 Processes of Attention ..................................................................................................................... 18
  2.5 Meditation and Cognitive (Attention-Regulation) Training ......................................................... 18
  2.6 Purpose and Aims .............................................................................................................................. 21
  2.7 Method .............................................................................................................................................. 21
2.7.1 Search Protocol .......................................................................................... 21
2.7.2 Extent and Quality of Included Studies ............................................... 21
2.8 Results.................................................................................................................. 22
  2.8.1. Alerting Subsystem of Attention ......................................................... 24
  2.8.2 Orienting Subsystem of Attention ........................................................... 25
  2.8.3 Executive Function Subsystem of Attention ............................................ 26
  2.8.4 Other Considerations ............................................................................. 27
2.9 Discussion.............................................................................................................. 28
2.10 Implications for Future Research................................................................. 28
2.11 Limitations ......................................................................................................... 29
2.12 Conclusion ......................................................................................................... 29
2.13 Summary ............................................................................................................. 30
Chapter 3 PILOT STUDY ....................................................................................... 39
  3.1 Introduction ...................................................................................................... 39
  3.2 Purpose ............................................................................................................. 39
  3.3 Research Questions and Hypotheses ............................................................ 39
  3.4 Research Design .............................................................................................. 40
  3.5 Subjects and Setting ....................................................................................... 40
  3.6 Procedures ...................................................................................................... 40
  3.7 Data Analysis .................................................................................................. 41
  3.8 Results ............................................................................................................. 42
  3.9 Discussion ....................................................................................................... 45
  3.10 Summary ........................................................................................................ 46
4.8.5. Multivariate Analysis of Co-Variance MANCOVA ...........................................66
4.8.6. Analysis of Co-Variance ANCOVA ..................................................................66
4.9 Potential Study Limitations ..................................................................................67
4.10 Potential Procedural Problems and Counterbalancing Strategies ......................68
4.11 Timeline of Project .............................................................................................69
Chapter 5 FINDINGS AND DISCUSSION MANUSCRIPT #2 .....................................70

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Abstract</td>
<td>70</td>
</tr>
<tr>
<td>5.2</td>
<td>Problem</td>
<td>71</td>
</tr>
<tr>
<td>5.3</td>
<td>Significance</td>
<td>71</td>
</tr>
<tr>
<td>5.4</td>
<td>Background</td>
<td>72</td>
</tr>
<tr>
<td>5.4.1</td>
<td>Meditation and Neuroscience</td>
<td>72</td>
</tr>
<tr>
<td>5.4.2</td>
<td>Mindfulness Meditation</td>
<td>73</td>
</tr>
<tr>
<td>5.4.3</td>
<td>Attention Regulation</td>
<td>75</td>
</tr>
<tr>
<td>5.5</td>
<td>Purpose</td>
<td>76</td>
</tr>
<tr>
<td>5.6</td>
<td>Research Questions and Approach</td>
<td>76</td>
</tr>
<tr>
<td>5.7</td>
<td>Methods</td>
<td>77</td>
</tr>
<tr>
<td>5.7.1</td>
<td>Study Design</td>
<td>77</td>
</tr>
<tr>
<td>5.7.2</td>
<td>Participants</td>
<td>77</td>
</tr>
<tr>
<td>5.7.3</td>
<td>Data Collection Instruments</td>
<td>78</td>
</tr>
<tr>
<td>5.7.4</td>
<td>Procedures for Data Collection</td>
<td>80</td>
</tr>
<tr>
<td>5.7.5</td>
<td>Mindfulness Meditation Intervention</td>
<td>81</td>
</tr>
<tr>
<td>5.7.6</td>
<td>Waitlist Control Condition</td>
<td>81</td>
</tr>
<tr>
<td>5.7.7</td>
<td>Data Analysis</td>
<td>81</td>
</tr>
</tbody>
</table>
6.9 Additional Comments ........................................................................................................112

6.9.1 Implication of Mindfulness and Stress Outcomes for Empathy Building ...112

6.9.2 Implementation and Future Research ........................................................................113

References ..........................................................................................................................114

Appendix A ..........................................................................................................................131

Appendix B ..........................................................................................................................132

Appendix C ..........................................................................................................................134

Appendix D ..........................................................................................................................135

Appendix E ..........................................................................................................................136

Appendix F ..........................................................................................................................137

Appendix G ..........................................................................................................................138

Appendix H ..........................................................................................................................139
LIST OF TABLES

Table 2.1 Comparison of Findings: Effect of Meditation on Subsystems of Attention ......23
Table 3.1 Demographic Data of Pilot Study Participants .................................................42
Table 3.2 Means and Standard Deviations for Pilot Study Posttests of Attentional Accuracy
........................................................................................................................................43
Table 3.3 ANCOVA Results for Pilot Study Posttest ANT Accuracy Controlling for Covariates
........................................................................................................................................44
Table 5.1 Demographic Data: Total Sample, Control, Experimental Group and Representative
Population ................................................................................................................................84
Table 5.2 Means (SD) Of Outcome Variables at Baseline and Post-Intervention ..............85
Table 5.3 MANCOVA Results for Posttest Attention Network Scores: Alerting, Orienting,
Executive Function ..............................................................................................................86
Table 5.4 MANCOVA Results for Posttests of Perceived Stress and Mindfulness ..........88
Table 6.1 Means (SD) of outcome variables at baseline and post-intervention ..............109
Table 6.2 ANCOVA Results for Posttest Medication Administration Task (MAT) ......110
CHAPTER 1
1.0 INTRODUCTION

1.1 Problem

In response to the ever-increasing complexity of today’s healthcare system and resultant impact on safe patient care much attention has been paid to external causal factors of error. Less, however, has been understood about the role of intrinsic human factors in safe patient care, and in particular, the cognitive attentional processes of the nurse (Holden et al., 2011; Reason, 1995). Nurses frequently report that their capacity for safe practice is challenged by an extreme mental workload (Eisenhauer, et al., 2007; Holden, et al., 2011; Unver et al., 2012) and connections have been drawn between the cognitive attentional lapses of nurses and negative patient outcomes, especially during medication administration (Ebright, et al., 2004; Gabel et al., 2013; McGillis Hall et al., 2010). Of concern in this regard is the requisite attentional focus needed by nurses while working in an increasingly complex and distracting healthcare workplace; one filled with multiple sources of stimuli, perpetually shifting informational cues, and mounting sources of distraction (Armitage, 2009; Cook, O’Connor, Render, & Woods, 2004; Potter et al., 2005). Current strategies in nursing education do not adequately prepare graduates for this level of complexity (Beyea, 2007; Cornell et al., 2010; Ebright, Carter Kook, Moody, & Latif Hassan Al-Ishaq, 2006) and methods for enhancing the attention regulation skills of nursing students are relatively unexplored. As a result, many graduate nurses are ill-equipped for the cognitive demands of nursing practice in today’s fast-paced clinical world (Beyea; Cornell et al.; Ebright et al.) and this gap is problematic to the development of safe healthcare practitioners.

In a seminal work on patient safety, Reason (1995) described the *sharp end* of adverse events to be related to the cognitive human error of healthcare practitioners, albeit, exacerbated by complexity and distraction in the workplace. Hughes (2008) made similar conclusions, noting
that “by definition, errors are a cognitive phenomenon because errors reflect human action that is
cognitive activity” (p.1). He posited that cognitive error, precipitated by environmental factors
of interruption and distraction, was a dominant factor in risks to safety. Nevertheless, the
majority of recent effort toward improving patient safety has been focused on extrinsic
mitigation of environmental contributes of error. One such example is that of wearing
medication safety vests indicating they should not be disrupted during medication administration.
Such techniques, although based on tested “sterile cockpit” strategies used effectively in the
airline industry (Broome et al., 2011), are not practical for nursing work which requires
performance of complex skills amongst, rather than in isolation to, other people, distractions, and
interruption. Unlike the closed setting of an airliner cockpit, the nursing workplace contains
multiple and necessary informational stimuli, which cannot be contained nor ignored, but rather,
requires an exceptional cognitive skill in managing.

Although the recent departure from a past culture of blame focused on individual
performance in providing safe patient care is commendable and entirely appropriate, (Kohn,
Corrigan, & Donaldson, 2000), the intrinsic human factors of error should nevertheless not be
ignored. Safety is achieved through both system effectiveness and individual performance
(Cronenwett, Sherwood, & Gelmon, 2009) and both components require thorough investigation.
Cook, O’Connor, Render, and Woods (2004) proposed that both an understanding of extrinsic
factors as well as intrinsic human cognition is needed in the investigation of safe clinical
practice. Noting the impossibility of entirely eliminating error potential in a complex healthcare
work environment, they recommended instead an alternate approach which targets what they
termed the most “adaptable element” (p.23) of such a system – the human practitioners. A
recommendation of Cook and colleagues (2004) included helping healthcare professionals build
resilience to interruption, distraction, and cognitive error; concluding that this would be a more effective method of enhancing their capacity for safe care.

1.2 Significance

The development of such human cognition skills is therefore a desirable nursing education outcome (Ebright, Carter Kook, Moody, & Latif Hassan Al-Ishaq, 2006) and essential to the critical thinking and clinical reasoning skills of nursing practice as well (Benner, Sutphen, Leonard, & Day, 2011; Rhodes, Morris, & Lazenby, 2011; Zimmerman & Phillips, 2000). Attention regulation has also been identified as a fundamental antecedent to situational awareness (Fore & Sculli, 2013; Sitterding, Broome, Everett & Ebright, 2012), which, in the safety literature of late, has been acknowledged as crucially important. It therefore follows, that a model of safe nursing practice is dependent upon a foundational and exceptional capacity for efficient cognitive attention regulation. However, attempts at developing such skills have been only marginally targeted in nursing curricula, mostly by attention to such things as time management, priority setting, and critical thinking development; all less than successful in preparing graduates for entry into practice and with some resignation to post-graduate development of these skills, as in novice-to-expert theory (Benner, 1984). Although experiential development cannot be denied, the necessity of graduating novice nurses with the cognitive attention regulation skills necessary for safe quality patient care is a crucial charge for pre-licensure registered nurse (RN) education.

1.3 Purpose and Aim

The purpose of this dissertation research study was therefore, to explore the effect of cognitive training as an educational strategy for the development of attention regulation skills in
nursing students. In contrast to current educational methods, this study will investigate the effectiveness of an innovative, yet evidence-based method of cognitive training (focused-meditation) for improving attentional processes of attention. The primary aim was to determine the interventional significance of training in, and practice of, mindfulness meditation (MM) (a form of focused meditation) on the efficiency of attentional processes of pre-licensure nursing students. This was contrasted to delivery of standard nursing education curriculum in time management, critical thinking, and priority setting. Secondarily, this research sought to investigate the effect of MM training and practice on the performance of a nursing skill under simulated workplace conditions of distraction and interruption as compared to standard nursing education. Additionally, it explored the relationships between the perceived stress and pre-dispositional mindfulness characteristics of pre-licensure nursing students with the efficiency of attentional processes as well as nursing skill accuracy.

1.4 Operational Definitions

1.4.1 Mindfulness meditation (MM) Mindfulness Meditation (MM) is a type of focused-style meditation whose outcome is an ability to pay attention in a discerning and concentrated way that allows for sustained and vigilant attention to one’s present moment despite the presence of external and/or internal distractors. The specific techniques of MM involve purposeful engagement and re-engagement of attention to an internal function such as one’s breathe while sitting in a comfortable seated posture with eyes closed. While attempting to closely attend to the breath, it is common and to be expected, that a practitioner will encounter episodes of mind-wandering and/or distractions to their attention. These are briefly and non-judgmentally attended to, filtered for importance, and then purposefully disentangled from to return one’s attentive focus back to the internal anchor of the breath.
MM is based on the concept of mindfulness, inspired by Buddhist teachings, which is described as an ability to “pay attention in a particular way, on purpose, and in the present moment…” (Kabat-Zinn, 1995, p.30) and involves the interplay of two components; the first being self-regulation of attention and increased recognition of internalized thoughts and secondly, a sustained cognitive approach to attentiveness that is characterized by openness, curiosity, and nonjudgmental acceptance (Bishop et al., 2004). In contrast to instinctual awareness, which is one of simple recognition or attention without purpose, mindfulness is characterized by a purposeful self-directed activity that is a learned skill that can be developed with MM training and then persistently improved upon with determined action and self-regulation (Kabat-Zinn, 1995).

In 1979 mindfulness meditation was more fully brought to use in healthcare by Kabat-Zinn who developed a mindfulness-based stress reduction (MBSR) program at the University of Massachusetts Medical Center that incorporated training and regular practice of MM. Today MBSR therapy is often employed in the treatment of patient stress, pain, depression, anxiety, addiction and other mental health disorders. It has also been utilized as a successful intervention for stress, anxiety, and burn-out in studies conducted with nurses and/or nursing students (Beddoe & Murphy, 2004; Mackenzie, Poulin, & Seidman-Carlson, 2006; Newsome, Waldo, & Gruska, 2012). More recently the techniques of MM have gained attention in the field of higher-education and are being explored as a method for improving metacognition and attentional regulation (Hart, 2008; Shapiro, Brown, & Astin, 2011).

1.4.2 Attention regulation. Attention regulation is a condition of sustained and vigilant readiness that includes an ability to maintain purposeful focus while selectively discriminating relevant from extraneous stimuli, re-directing or returning focus promptly, and resisting the
intrusion of distraction. This type of selective focus manifests in behavioral indicators of attention, which is defined by the online Merriam-Webster dictionary (2013), as a condition of readiness involving selective focusing of consciousness and receptivity in the act of applying the mind to something. Attention regulation requires a capacity to distinguish between meaningful information and extraneous cues, maintain one’s focus on a task, and an ability to ward off the incursion of internal and/or external distractions and much has been written about the importance of this type of focused attentional awareness and purposeful situational monitoring (Benner, Sutphen, Leonard, & Day, 2010; Dewey, 1910; Schon, 1982) as an essential cognitive skill for healthcare professionals whose work involves a complex integration of thinking and doing (Ebright, Carter Kooken, Moody, Al-Ishaq, 2006). It should also be noted that, in the context of this study, attention regulation will be interpreted as a dynamic concept which, although malleable as a state in relation to forces of distraction and informational cues, is modulated by an individual’s capacity to maintain it -- a trait of attention regulation. It is this trait of attention regulation which demands increased investigation as a potential nurse competency -- one which is trainable and open to improvement.

Attention regulation demonstrates close alignment to Posner and Gilbert’s (1990) model of attention and its components of attentional processing: alerting, orienting, and executive function. This model is widely referenced in studies of attention regulation (Fan, McCandliss, Sommer, Raz, & Posner, 2002; Jha, Krompinger, & Baime, 2007; Kerr et al., 2011; Lutz, Slagter, Rawling, Francis, Greischar, & Davidson, 2009; MacLean et al., 2010; Tang et al., 2007; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010) and will be used as a theoretical framework to support the constructs of this study. According to Posner & Peterson, attentional processing can be divided into three functional networks - Alerting, Orienting, and Executive
Function – each having discrete functions whose interplay aid one in maintaining purposeful attention, managing information, and reducing susceptibility to distraction and interruption. 

Alerting, alternately termed vigilance, is associated with sustained attentional readiness. 

Orienting helps one select relevant stimuli and redirect focus. Executive function, aids in detecting incongruence, avoiding habitual responses, and prioritizing one’s attention among competing stimuli (Lutz et al., 2009).

The techniques specific to MM–striving to maintain attentive focus to one’s breath, noticing intruding thoughts and distraction, and then purposefully re-directing one’s focus back to the breath–are closely aligned with the components of attention regulation supported by Posner and Gilbert’s model of attention. Both strike an interesting connection to the attentional regulation competencies needed by today’s nurse: purposeful and sustained focus, monitoring filtering of distraction, and discernment of informational cues. These relationships are outlined in Figure 1.1.
Figure 1.1. Relationship between Mindfulness Meditation, Attention Regulation, and Nursing Practice
1.5 Background

In an accumulating body of neuroscientific research the positive effects of focused meditation training and practice, such as MM, on abilities of sustained attention, filtering of informational cues, and regulation of distracting stimuli has been suggested (Eberth & Sedlmeier, 2012). The use of MM for attentional regulatory training has also shown promise for enhancing the behavioral self-monitoring capabilities of healthcare professionals and is posited by Epstein, Siegel, and Silberman (2008) as useful in the education of physicians, social workers, occupational therapists, and psychologists. It is further suggested in the seminal work of Lazar and colleagues (2005) and Davidson and Lutz (2008) that this type of mental training creates structural changes to the brain through a process of neuroplasticity resulting in a sustained improvement to one’s cognitive capacity for attentional regulation.

This position is supported by a growing body of research including the work of Lutz et al. (2009) who investigated the impact of intensive meditation training on attentional processing with significant outcomes for enhanced attentional stability and regulation of competing stimuli in a sample of 14 adults after exposure to a three month meditation retreat. In a similar study, MacLean et al. (2010) demonstrated improvement in perceptual discrimination of stimuli and maintenance of sustained attention in a longitudinal study of adult meditators, also participating in a three month meditation retreat. In a study of subsystems of attention, Jha, Krompinger and Baime (2007) found that an experimental group, composed of adults and college students who completed MBSR training, demonstrated significantly more capacity for attentional readiness and alertness to stimuli as compared to an inactive control group. In a study of 51 adults and college students carried out by Jensen, Vangkilde, Frokjaer and Hasselbalch et al. (2012), results from a meditation intervention were linked to attentional accuracy. Kerr et al. (2011) collected
data from magnetoencephalography measurements of brain Alpha modulations which pointed to a correlation between MM and neural enhancements associated with working memory performance, improved attention to relevant stimuli, and less distraction from competing stimuli. Davidson and Lutz (2008) further posited that cognitive training in the form of focus-style meditative practices such as MM was “fundamentally no different than other forms of skill acquisition” (p.177). It therefore follows that training and engagement in regular practice of MM may be a viable inclusion in nursing education as well.

There have not been, however, any studies specific to nurses and/or nursing students investigating MM, the development of attention regulation skills, and connection to safe nursing practice. In addition, many previous studies were conducted over extended periods of time using either face-to-face or intensive meditative retreats as interventional strategies. These are not easily replicable or feasible for nursing education curricula, which are already time-constrained and content-laden. In contrast, shorter term training was used successfully in the work of Tang et al. (2007) and Zeidan, Johnson, Diamond and Goolkasian (2010) who investigated the effect of focused meditation on the attentional processes of college students. Tang and colleagues found a significant experimental group effect of five days of meditation training and practice on enhanced executive attention as compared to a control group participating in relaxation training. A similar improvement in executive attention as well as sustained attention (alerting) was supported by the research of Zeiden and colleagues who compared participation in four days of meditation to an audio-book listening control group. Such success in short term training supports this research study’s utilization of a four week intervention.

Additional research on the feasibility of online instructional methods for delivery of meditation training and practice (Cavanaugh et al., 2013; McCann et al., 2013; Morledge et al.,
demonstrated participant satisfaction with such modalities. This, in addition to consultation with trained mindfulness meditation experts, substantiated a decision to employ online modules, email, and other electronic approaches to this study’s interventional strategies.

Another consideration in review of the existing literature is that many studies employed participation in an MBSR program as their intervention. MBSR training includes instruction and practice of MM as well as several other mindfulness based practices, creating the possibility of confounding effect on attentional regulation outcomes documented in these studies. In addition, conclusions from a meta-analysis of 39 studies on the effects of mindfulness meditation (Eberth & Sedlmeier, 2012) included suggestions that MBSR programs may have more effect on psychological well-being, whereas interventions of MM alone may produce more effect on attention. These considerations, as well as recommendation for more precise future investigation of the practices of MM (Ebert & Sedlmeier, 2012; Shapiro & Carlson, 2009; White, 2013), supported the dissertation study design decision for isolating the intervention of MM from full MBSR training.

Stress-reduction effects were a reported outcome of meditative interventions in several previous studies (Eberth & Sedlmeier, 2012; Irving, Dobkin, & Park, 2009; Jain et al., 2007; Mackenzie, Poulin, & Seidman-Carlson, 2006) which infers the possibility of a stress-moderating effect on attention regulation. This dissertation study therefore explored participant’s perceived stress for its relationship to attention regulation at baseline and post-intervention. In addition, participant diversity in regards to pre-dispositional mindfulness (an individual’s innate characteristics of mindfulness), may have affected results of some previous studies, although few controlled for this. Measurement of pre-dispositional mindfulness at
baseline and post-intervention was included to investigate its possible correlation to attention regulation as well.

1.6 Research Questions

Two main questions were posed regarding the impact of meditation on attentional efficiency in pre-licensure RN students. Additional exploratory questions regarding possible confounding influences of perceived stress and mindfulness characteristics were also developed.

Research question 1. What is the effect of cognitive training in the form of MM as compared to standard nursing education on posttests of the efficiency of attentional processes (alerting, orienting, executive function) in pre-licensure nursing students while controlling for baseline measurements of attentional efficiency?

Exploratory research question 1a. What is the relationship between the perceived stress characteristics of pre-licensure nursing students and measurements of attentional processes efficiency at baseline and post-intervention?

Exploratory research question 1b. What is the relationship between pre-dispositional mindfulness characteristics of pre-licensure nursing students and measurements of attentional processes efficiency at baseline and post-intervention?

Research question 2. What is the effect of cognitive training in the form of MM as compared to standard nursing education on posttests of accuracy in performance of a nursing skill (simulated medication measurement under conditions of time-constraint, distraction, and interruption) in pre-licensure nursing students while controlling for baseline measurement of nursing skill accuracy?
**Exploratory research question 2a.** What is the relationship between perceived stress characteristics of pre-licensure nursing students on measurements of accuracy in performance of a nursing skill at baseline and post-intervention?

**Exploratory research question 2b.** What is the relationship between pre-dispositional mindfulness characteristics of pre-licensure nursing students on measurements of accuracy in performance of a nursing skill at baseline and post-intervention?

**1.7 Summary**

A cogent argument can be made that safe patient care is dependent upon a nurse’s foundational and exceptional capacity for efficient attention regulation. Yet, there is a need to better understand nursing education methodologies effective in building attention regulation efficiency and resilience to distraction in nursing students. Advances in neuroscience and psychology have provided evidence of a possible interventional impact of focus-style meditation, such as MM, on the development of such skills and this dissertation study was designed to explore MM for this purpose in the context of the nursing discipline. It is also the first-known study to explore the effect of MM on attentional efficiency with a participant population specific to nursing students. The study therefore has potential for knowledge building in the field of nursing education, and may provide a well-needed pro-active approach to the development of inherently safe graduates more adequately prepared for transition to the complexity of today’s nursing practice.
CHAPTER 2
2.0 REVIEW OF LITERATURE
MANUSCRIPT #1
Meditation Training and Practice for Developing Attention Regulation Skills in Nursing

Students: An Integrative Review

Formatted for journal publication and currently under review

2.1 Abstract

Practice in today’s healthcare setting poses extreme challenges to the attention regulation processes of nurses in the form of numerous and shifting sources of information, workflow interruptions, and a multitude of distractions. Many graduate nurses are unprepared for this attentional complexity and current nursing education methods do not adequately prepare them in this cognitive competency. This problem inspired an investigation of the processes of attention, their importance to safe nursing practice, and methods for development. This literature review explored the interventional relationship of cognitive training (focused meditation and practice) on measurements of attention in healthy adult samples. In a majority of findings, a positive effect of meditation on the ability to sustain attention (alerting 64%), reduce reactivity to distraction (orienting 62%), and monitor shifting informational cues (executive function 60%) was demonstrated. The inclusion of attention regulation, developed and supported by meditative practice, is posited as an important and viable nursing competency.
2.2 Problem

It has been posited that cognitive error, precipitated by interruption, distraction, and other complexities of the healthcare workplace, is at the sharp end of adverse events and negative patient outcomes (Armitage, 2009; Hughes, 2008; Potter et al., 2005; Reason, 1995). Although much attention has been given to the mitigation of external causal factors of error, the recent—and appropriate—departure from a past culture of blame focusing on individual performance (Kohn, Corrigan, & Donaldson, 2000) has somewhat lessened the attention given to important intrinsic human factors involved in safe patient care (Cook, O’Connor, Render & Woods, 2004). Clinical practice in today’s health care setting poses an extreme challenge to the attention regulation processes of nurses in the form of multiple and shifting sources of information, interruptions to workflow, and a multitude of distractions. Yet, many graduate nurses are unprepared for this type of attentional complexity (Beyea, 2007; Cornell, et al., 2010; Ebright, et al., 2006; Potter et al., 2005) and current nursing education methods do not adequately prepare them in this cognitive competency (Beyea, 2007; Cornell et al., Ebright et al., 2006). This problematic gap to the development of safe healthcare practitioners motivated an investigation of methodology for development of these skills and an integrative review of neuroscientific studies linking a form of cognitive training (focused-meditation) with increased efficiency of attention regulation processes.

2.3 Attention Regulation and Safe Nursing Practice

Cook and colleagues (2004) noted that, unlike in other workplace settings in which extrinsic safety measures have become the industry norm—for example the sterile cockpit strategies used in the airline industry (Broome et al., 2011)—nursing work requires performance of complex skills among, rather than in isolation to, other people, distraction, and interruption.
Noting the impossibility of entirely eliminating external factors of error potential in this type of work environment, Cook et al. recommended cognitive training for healthcare professionals which included methods of building their resilience to distraction and interruption, positing that this type of educational preparation may be more effective in reducing error.

The work of nurses requires an ability to engage in vigilant situational monitoring while regulating one’s attention amongst multiple stimuli (Ebright, et al., 2006) and the involvement of such cognitive skills in the provision of safe care has been noted by both novice and experienced nurses in connection to critical thinking processes. Deterioration of clinical cognition capacity, exacerbated by time pressures and other factors, was identified by novice nurses (n=12) in a qualitative study conducted by Ebright, Urden, Patterson, and Chalko (2004) whose themes included reports of time constraints, task workload, and cognitive impairments to focused critical thinking. Nurses across all levels of experience (n=113) reported similar impediments to critical thinking abilities in a mixed-methods study by McGillis Hall and colleagues (2010) noting that their ability to concentrate was frequently restricted by interruption and distraction. Extreme mental workload was also associated with delays in treatment and other negative patient outcomes from loss of concentration and focus (McGillis Hall, et al.).

Several other studies have drawn conclusions that cognitive resources for nursing tasks, particularly medication administration, require a heightened ability to concentrate and multitask, noting a connection between an ability, or lack thereof, to regulate one’s attention with mitigation of medication errors and/or medication near-misses. Both new graduate nurses and experienced nurses (n = 169) ranked distraction of attention as a main cause of medication error (Unver, Tastan, & Akbayrak, 2012) and nurses (n=123) who had had a near miss or witnessed a near miss medication error reported inappropriate clinical cognition as a personal-related factor.
(Gabel Speroni, Fisher, Dennis, & Daniel, 2013). Holden and colleagues (2011) investigated connections between human factors, nursing workload, and patient safety, employing two task-level workload scales. Their findings, from this cross-sectional survey of 176 nurses in two hospitals, revealed a strong positive relationship between a nurse’s self-reported medication error likelihood and excessive mental workload described as interruption, distraction, and instances of divided attention. Investigation into the thought processes of experienced nurses was conducted by Eisenhauer and colleagues (2007) with real-time tape recordings of what nurses were thinking about immediately prior to and after administrating medications. Ten descriptive categories were summarized by the researchers as a form of “intellectual complexity” (p.86) involved in the performance of medication administration. They identified vigilance as a common theme among nurses, defining this as “a state of scientifically, intellectually, and experientially grounded attention…” (p.86). Such reports correlate to other qualitative findings from focus group discussions with nursing students (n=13) about their perceptions of effective medication administration education (Krautscheid, Orton, Chorpenning, & Ryerson, 2011). In this phenomenological study, themes were identified naming distraction and information overload as potential contributes to medication error and students expressed a desire to learn ways to manage these factors in preparation “for the real world”(p.9). The researchers acknowledged a gap in their own educational strategies and suggested that nurse educators develop cognitive learning activities to assist students in their development of attentional vigilance.

Skill in attention regulation is therefore a desirable nursing education outcome, yet effective methods for developing such cognitive processes in nursing students is relatively unexplored. This problem inspired an investigation of methodology for improving attention
regulation and prompted an integrative review of recent research exploring the relationship between meditation and attention regulation.

2.4 Processes of Attention

Posner and Gilbert’s (1990) Model of Attention and its components of attentional processing: alerting, orienting, and executive function is the most widely referenced theoretical definition of the concept of attention (Fan, McCandliss, Sommer, Raz, & Posner, 2002; Jha, Krompinger, & Baime, 2007; Kerr et al., 2011; Lutz et al., 2009; MacLean et al., 2010; Tang et al., 2007; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010) and one which has been used to frame studies of attention in other high performance industries such as aviation and nuclear power. Alerting, alternately termed vigilance, is associated with sustained attentional readiness and an ability to achieve and maintain an alert state. Orienting helps one selectively sort relevant stimuli from distracting ones and to efficiently disengage from distraction to return to one’s chosen target of focus. Executive attention, aids one in detecting mind-wandering and prioritizing one’s attention to competing stimuli (Lutz et al., 2009). Posner and Gilbert’s (1990) definition of attention contends that an interplay of all three components aids one in maintaining purposeful attention, managing information, and reducing susceptibility to distraction and interruption. In the context of nursing, this conceptual definition of attention closely aligns with the behavioral indicators of nursing work: purposeful and sustained focus, filtering of distraction, and discernment of informational cues.

2.5 Meditation and Cognitive (Attention-Regulation) Training

The neural correlates of alerting, orienting, and executive function have been the subject of recent studies by cognitive neuroscientists and a plausible link between enhancement of these processes of attention and the practice of focus-style meditation (FM) has been supported by an
accumulating body of empirical evidence. FM is a component of several meditative practices alternatively termed concentrative, mindfulness, or Vipassana; all of which are purported to enhance “intentional deployment and management of attention” (Semple, 2010, p. 121). One common form of FM is mindfulness meditation (MM) which is a component of training programs such as Mindfulness-Based Stress Reduction (MBSR) (Kabat-Zinn, 1995). MM involves purposeful engagement and re-engagement of attention to an internal function (such as one’s breath), while simultaneously noticing and filtering distractions. While striving to attend exclusively to details of their breath such as the rise and fall of the abdomen, practitioners will ultimately and perhaps frequently experience episodes of mind-wandering—a displacement of attention away from the breath to external distractors and/or other internal mental thoughts. The goal of the MM technique is to notice this mind wandering and gently, non-judgmentally, bring one’s attention back to the breath. Initially, excursions to other points of focus other than the breath are frequent, but over time practitioners increasingly gain skill in quickly noticing their mind wandering, and more efficiently returning their focus to the intended target. MM practitioners incorporate their meditation practice into their daily routines much like other regular routines such as a daily walk or time at the gym. Yet, MM requires only an average of 20 minutes daily of sitting comfortably in an erect but relaxed posture either on the floor or in a chair (Kabat-Zinn, 2012). It is purported that with regular practice, MM practitioners gain a heightened trait-ability (Kabat-Zinn, 1995, Nhat-Hanh, 2011) to pay attention in a discerning and concentrated way that allows for sustained and vigilant focused attention despite external and/or internal distractors.

The techniques specific to MM and other forms of FM—engaging attentive focus, noticing intruding thoughts, and re-directing purposeful focus—demonstrate congruency with the Model of
Attention and the processes of alerting, orienting and executive function (Posner & Gilbert, 1990). The MM techniques also strike an interesting similarity to the cognitive self-regulation competencies needed by today’s nurse.

The use of FM for attentional regulatory training has shown promise for enhancing the behavioral self-monitoring capabilities of other healthcare professional (Epstein, Siegel, & Silberman, 2008) and posited as useful in the education of physicians, social workers, occupational therapists, and psychologists. A sustained benefit of focused meditative practice to attention regulation was posited by Davidson and Lutz (2008) whose seminal research comparing novice and expert meditators supports the idea that this type of mental training creates sustained improvement in one’s cognitive capacity for attentional regulation through a process of neuroplasticity and that this training is “fundamentally no different than other forms of skill acquisition” (p.177). In fMRI studies of participants while meditating, Davidson and Lutz were able to demonstrate activation of specific brain regions associated with neural correlates of attention. They noted an increased activation of these brain regions in expert meditators who had an average of 19,000 practice hours in comparison to novice meditators, but a decrease in expert meditators (Buddhist Monks) with an average of 44,000 practice hours. Their results implied a “learning curve associated with skill acquisition in other domains of expertise” (p.177) and the notion that over time with regular practice of meditation, less effort is needed to sustain attentional focus. It therefore follows that training and engagement in regular practice of FM may be a viable inclusion in nursing education as well.
2.6 Purpose and Aims

The purpose of this integrative review was to explore the extent and quality of neuroscientific evidence linking FM and attention regulation. The overall aim of this investigation was to determine whether FM warrants consideration as an educational method for enhancing attention regulation skills of nursing students.

2.7 Method

An integrative literature review was conducted using Whittemore and Knafl’s (2005) framework and included five stages: problem identification, literature search, data evaluation, data analysis, and presentation. This approach was deemed appropriate for a broad review of studies in the neuroscientific, psychology, and nursing education literature without limitation of research methodology.

2.7.1 Search protocol. An initial search protocol was identified which included keywords of: meditation, attention, cognition, cognitive processes, mindfulness with limits set for peer-reviewed literature between 2004 and 2014. The starting year 2004 was considered sufficient for this relatively nascent field of scientific investigation. Relevant peer-reviewed empirical studies were sought through purposive sampling in the computerized databases of CINAHL, ERIC, PsychINFO, and PubMed using keywords in various combinations and employing truncation techniques. In addition, a search of a mindfulness research registry was conducted (Mindfulness Research Guide), as well as a manual search of retrieved research study reference lists. Concept analyses, systematic reviews, and dissertations were excluded.

2.7.2 Extent and quality of included studies. Critical appraisal of the methodological quality of selected studies was guided by the Joanna Briggs Institute (JBI) tools for systematic
reviews of qualitative research, case control, randomized control trials, and pseudo-randomized trials. Scoring on these instruments produces a quality rating between 0 and 10 points and each study was examined to provide a score of very low (≤ 2), low (<4), medium (4-6), or high (>6) quality. In accordance with recommendations of Whittemore and Knafl (2005), this information was not intended to impose a gold standard, but rather was used to identify extreme outliers (scoring low or very low) that may have been unreasonable for consideration. None such outliers were identified in this examination and all studies scored >4 (medium to high).

2.8 Results

The database search of meditation and attention yielded 214 potentially relevant studies and an additional 118 articles were identified through a review of reference lists and author knowledge of other publications. The total articles (n = 331) were subsequently reduced to 91 abstracts for review and of these, 22 were excluded due to inconsistency with review objectives. A total of 69 relevant papers were examined. Forty-eight were excluded as they were found to not directly measure attention as a dependent variable or investigated neural correlates (brain changes) rather than behavioral indicators of attention. Of the remaining 21 included papers, 15 were randomized controlled trials and 6 were case-controlled non experimental studies; all of which provided findings on one or more outcome measurements of subsystems of attention: \textit{alerting}, \textit{orienting}, and \textit{executive function}. A comparison of findings for each subsystem of attention can be found in Table 2.1.
### Table 2.1
Comparison of Findings: Effect of Meditation on Subsystems of Attention  \( n = 21 \)

<table>
<thead>
<tr>
<th>Study</th>
<th>Alerting</th>
<th>Orienting</th>
<th>Executive function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson et al. (2007)</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Chambers &amp; Chuen Yee (2008)</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chan &amp; Woollacott (2007)</td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Helber et al. (2012)</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Jensen et al. (2012)</td>
<td></td>
<td>-</td>
<td>*</td>
</tr>
<tr>
<td>Jha et al (2007)</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Josefsson and Broberg (2011)</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Kozasa et al. (2012)</td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Larson et al. (2013)</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Lutz et al (2009)</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Maclean et al (2010)</td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Moore et al. (2012)</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Moore &amp; Malinowski (2008)</td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Morrison et al. (2014)</td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Mrazek et al. (2013)</td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Semple (2010)</td>
<td></td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Slagter et al. (2007)</td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Tang et al (2007)</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Van den Hurk et al. (2010)</td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Van Leeuwen et al. (2012)</td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Zeidan et al (2010)</td>
<td></td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>

| Number (percentage) of positive findings | 7 (64) | 8 (62) | 9 (60) |
| Number (percentage) of negative findings  | 3 (27) | 5 (38) | 1 (7)  |
| Number (percentage) of mixed findings     | 1 (9)  | 0 (0)  | 5 (33) |

*Note.* Negative findings - / Positive findings + / Mixed findings*
2.8.1 Alerting subsystem of attention. A large portion of studies (Chambers, Chuen Yee Lo, & Allen, 2008; Jha et al., 2007; Lutz et al., 2009; Maclean et al., 2010; Morrison, Goolsarran, Rogers, & Jha, 2014; Semple, 2010; Zeiden et al., 2010) revealed significant findings in relation to the alerting subsystem of attention which correlates to a capacity for vigilant and sustained alertness. These studies demonstrated positive outcomes in both longer meditation retreat interventions as well as conditions of shorter duration. Research participants in intensive meditation retreats (one week to three months in duration) demonstrated an enhanced ability to achieve and maintain an alert state in four of these studies (Chambers, et al.; Jha et al.; Lutz et al.; Maclean et al.), whereas short-meditation for only seven weeks (Morrison et al.) and four days (Zeiden et al.) were similarly effective. In another study (Semple, 2010), comparison of a group participating in four weeks of MM training was made to a muscle relaxation training group and waitlist control group. Those in the MM group demonstrated more improvement in sustained attention than the other two groups.

In contrast, some studies reported negative findings in the context of the alerting subsystem of attention. Josefsson and Broberg (2011) examined both the alerting and executive functions of experienced meditators recruited from Buddhist meditation centers as compared to non-meditators (college students) with measurements on computerized versions of attention tests. Findings revealed no significant differences between the groups but researchers postulated that an age effect and differences in computer skills may have affected their results. Additionally, Jensen and colleagues (2012) concluded that vigilance may be susceptible to incentive effort in that measurements of the alerting subsystem of attention were significantly higher in an incentive control group that was provided monetary reward for improvements of attention in comparison to those in an MBSR group. Similarly, Tang and colleagues (2007).
failed to find support for an association between meditation and vigilance but, as noted by the researchers, outcomes may have been affected by the short interventional period (five days).

2.8.2 Orienting subsystem of attention. Enhanced capacity for selective attention and more efficient sorting of relevant stimuli from distracting ones (orienting) was a common finding in four controlled trials that compared the interventional effect of FM to a control group (Jensen, Vangkilde, Frokjaer, & Hasselbalch, 2012, Jha et al., 2007; Lutz et al., 2009; Slagter et al., 2007). In the studies by Lutz and colleges as well as Slagter et al., this comparison was between an active group of already experienced meditators who attended a 3-month meditative retreat and an active control group naïve to meditation who received instruction in meditation and was asked to meditate daily for 20 minutes one week prior to post testing. A larger positive correlation between regular meditation practice and heightened orienting capabilities was observed in experienced meditators in contrast to non-meditators in the research findings of four case-controlled studies (Chan & Woollacott, 2007; Moore & Malinowski, 2009; van den Hurk, Giommi, Gielen, Speckens, & Barendregt, 2010; van Leeuwen, Singer, & Melloni, 2012) with meditators exhibiting a heightened orienting capacity to disengage efficiently from irrelevant distractors and redirect attentional focus promptly.

Other findings (Larson, Steffen, & Primosch, 2013; Semple, 2010; Tang et al., 2007) failed to detect differences in the orienting subsystem of attention. In Semple (2010), an MBSR training group was not measurably different than those of a muscle-relaxation group on measurements of selective attention. However, notable to this study’s procedure was the fact that participants in both the MBSR and relaxation groups were instructed to perform their meditation or relaxation techniques just prior to performing their post-tests of attention. The inducement of a situational state effect may have minimized immediate detectable differences. Although both
Tang and colleagues as well as Larson et al. similarly rejected hypotheses that FM training would be more effective than relaxation methods in developing orienting abilities, both studies employed only brief training periods and limited duration of meditative practice of five days (Tang et al.) and one 15 minute session (Larson et al.).

2.8.3. Executive function subsystem of attention. Heightened cognitive flexibility, indicative of enhanced executive attention (executive function) and a superior ability to prioritize one’s attention among competing stimuli, was demonstrated by meditators as compared to an inactive control group in the findings of Moore and Malinowski (2009) and similar positive correlations between meditation and executive attention were also found in the findings of Chan and Woollacott (2007) and Kozasa et al. (2012). A trend toward higher executive function was also noted by van den Hurk et al. (2010) in experienced meditator study participants. Interestingly, the amount of time spent meditating daily, rather than the total number of years of meditation practice, was a predictor of better executive attention in the research findings of Chan and Woollacott, who investigated the long term trait effects of FM. In addition, two recent studies (Morrison et al., 2014 and Mrazek, Franklin, Phillips, Baird, & Schooler, 2013) measured executive function in the form of mind-wandering awareness which is considered an attribute of executive functioning. Findings revealed significant improvements in this element of attention regulation in those participants who took part in MM interventions as compared to a waitlist control (Morrison et al.) and an active control group who received nutrition training (Mrazek et al.).

In contrast, five other experimental studies reported conflicting results regarding the subsystem of executive function in relation to meditation. Although Moore and colleagues (2012) discovered significant EEG correlates to enhanced attentional control in their
experimental group receiving MM training and practicing meditation for ten minutes per day, five times per week for 16 weeks, they found no significant interaction effect on their Stroop test measurements of executive function as compared to an inactive control group. Similarly, Semple (2010) failed to find differences between participants in a MM training group as compared to both a group performing muscle relaxation exercises and an inactive control group. In the study by Jensen et al. (2012), participants in an MBSR group and financial incentive group demonstrated similar enhanced capacity for executive function in post-testing, leading the researchers to conclusions of confounding test effect on this subsystem measurement. Helber and colleagues (2012) found no significant interaction effect between groups of students who did and did not participate in meditation training, yet a positive correlation between the time spent meditating and enhancements to executive function was identified. Anderson, Segal, and Bishop (2007) compared pre posttest measurements of participants in an eight-week MBSR training (described as two hours per week) with those of a waitlist control group. Although findings were reported as non-significant for correlations between MBSR training and attentional processes, Anderson and colleagues did identify an increased self-reported mindfulness in the MBSR group with higher scores on an executive function task.

**2.8.4 Other considerations.** There were no studies that exclusively tested hypotheses of meditation-attention correlation with nurse or nursing student participants although six studies included college students as participants (Chambers, et al., 2008; Jensen et al., 2012; Jha et al, 2007; Morrison et al, ,2014; Mrazek et al., 2013;Tang et al., 2007; Zeidan et al., 2010). One of these studies (Jha et al, 2007), included a combination of medical and nursing students as part of a mixed participant pool to compare participation in an 8-week MBSR course to both an inactive control group as well as a group of experienced adult meditators attending a 3-month meditation
retreat (Jha et al., 2007). The MBSR student group demonstrated significant improvement in the orienting subsystem of attention as compared to the control group. However, enhancement of the alerting and executive function subsystems was most significant in the 3-month retreat groups.

2.9 Discussion

This integrative review revealed a substantive relationship between training and practice of FM and the development of attention regulation skills in adults. The majority of neuropsychology studies demonstrated significant outcomes of enhanced attention following training and practice of some form of FM over both short (four days) and long term (three month) time frames. This improvement was noted across one or more of the subsystems of attention: alerting (64%), orienting (62%), and conflict-monitoring (60%). The positive effect of this type of meditation practice on the brain’s ability to sustain focused attention, reduce reactivity to distraction, and effectively monitor shifting informational cues, fosters a conclusion that training of the mind through regular practice of FM is a plausible way to increase attention. These improvements in attention were noted in both immediate post-intervention measurements as well as longer term follow-up. This provides a degree of confirmation to the notion that FM induces not merely a state-like cognitive improvement, but a sustained heightened capacity for attention regulation as a trait-like characteristic.

2.10 Implications for Future Research

Although a large number of the studies linking meditation and enhanced attention were conducted with college students, only one report, (Jha et al., 2007), utilized a participant pool of healthcare professional students. However, it was not exclusive to nursing students. This gap
indicates a need for further research into the use of FM in nursing education. Feasible applications to be examined are the incorporation of brief sessions of FM into nursing course work (such as prior to exams), as a technique for use prior to entering a simulation exercise and/or the clinical practice, and most importantly as a component of nursing student’s daily personal practice. Future research should also examine the usefulness of FM training for practicing nurses, who, like nursing students, have not been the focus of meditation and attention studies. Also important to building the body of knowledge on quality and safety in nursing practice is further exploration into the causal connections between intrinsic nurse qualities—such as cognitive self-regulation capacities—and the provision of safe patient care.

2.11 Limitations

There were some limitations to this integrative review which must be considered in the interpretation of results. Meditation retreats were employed as an independent variable in a few of the neuropsychological studies examining meditation and attention, which by nature of their intensity may have inflated results. Several others employed a case-control design limiting inferences of causal relationships, yet similarity of their correlational findings does provide a degree of confirmation to those results. Other notable considerations were potential age effect on computerized attention measurements, possible test effect and/or incentive effort, use of self-reports, and/or cultural influences present in non U.S. participants. In addition, all studies were limited by small sample sizes.

2.12 Conclusion

Results of this integrative review contribute to an improved understanding of the usefulness of FM as a method for development of attention regulation skills. It also provides implications for nursing practice and consideration of its inclusion in the education of nursing
students. As previously noted an exquisite capacity for attention regulation is a fundamentally important nursing skill and, as supported by the literature, may possibly be obtained and sustained through regular meditative practices. As part of a new mindset for quality and safety in the education of nurses, the inclusion of cognitive self-regulation skills as a pre-licensure competency may help develop more mindfully attentive nursing graduates, and prove to be an important pro-active approach to improving safe patient care.

2.13 Summary

This chapter, represented by the manuscript Meditation Training and Practice for Developing Attention Regulation Skills In Nursing Students: An Integrative Review, provided important confirmatory evidence of MM’s potential as an interventional modality for improving attentional efficiency, adding validity to the decision to employ MM in the dissertation study of pre-licensure nursing students. Review of measurement tools used successfully in these studies also guided the selection of instruments for the dissertation study, as did success in using a four-week intervention period. Also, baseline participant stress was illuminated as a potential confounding influence on attention and therefore included in the dissertation study analysis design. Importantly, it confirmed a gap in knowledge for nursing education as none of the previous research had been conducted exclusively with nursing students.
References


CHAPTER 3

3.0 PILOT STUDY

Effects of Mindfulness Meditation on Attentional Accuracy of Nursing Students

3.1 Introduction

This chapter outlines the processes of a pilot study conducted in fall 2013 which provided foundational data on the dissertation topic of inquiry by examining the effect of four weeks of mindfulness meditation (MM) training and practice on attentional accuracy in a randomized control trial. It compared pre-licensure RN students assigned to a MM intervention with both a non-meditating control group as well as a group who performed a non-focused style form of mediation – guided imagery. In the implementation of this small nursing education research study, valuable information was also gained on proposed dissertation methods which were incorporated into the research design, interventions, and plan for analysis found in Chapter 4 – Methods.

3.2 Purpose

The primary purpose of this pilot study was to assess the design, methodological approach and measurement tools for use in a future dissertation study and to address the following research questions and hypotheses.

3.3 Research Questions and Hypotheses

Research question 1. Does MM training and practice enhance cognitive attentional regulation accuracy in nursing students? If so, are these improvements independent of pre-dispositional stress perception and mindfulness traits?

Research question 2. Does MM training and practice provide greater improvement to attentional regulation accuracy in nursing students than GIM as controlled for pre-dispositional stress perception and mindfulness traits?
**Hypothesis 1.** Training and practice of a focus-style meditation such as MM will enhance attentional accuracy in pre-licensure nursing students.

**Hypothesis 2.** MM will be more effective than a relaxation-style of meditation (guided imagery GIM).

**Hypothesis 3.** Results will not be mediated by pre-training differences in mindfulness characteristics and/or perceived stress.

### 3.4 Research Design

This randomized-controlled trial study investigated the effect of four weeks of training and practice in MM with 15 pre-licensure nursing students who were randomly assigned to one of three groups: MM, a no-meditation control and a guided-imagery meditation (GIM) group.

### 3.5 Subjects and Setting

A sample was recruited from a population of nursing students (N=230) at a large multi-campus, Northeastern, suburban, associate degree in nursing community-college program. A total of 21 volunteers submitted consent forms and began the study. This pool of participants was primarily female (93%), between the ages of 21-39 years (89%), and diverse in racial/ethnic background. Participants were required to have daily access to a personal computer in their home, be over the age of 18, and currently enrolled in nursing courses.

### 3.6 Procedures

During pre-intervention sessions baseline measurements in attentional accuracy, perceived stress, and mindfulness characteristics were obtained. Attentional accuracy was measured using the *Attention Network Test* (ANT) Cronbach alpha = .87 (Fan, McCandliss, Sommer, Raz & Posner, 2002) which is a 30 minute online functional test using computer screen and keyboard. Other baseline measurements included a researcher-developed demographic survey and two additional measurements - the *Perceived Stress Survey* (PSS-10) whose
reliability was affirmed by Cohen and colleagues (1983) with a demonstrated Cronbach alpha = .86 and the *Five-Facet Mindfulness Questionnaire* (FFMQ) whose reliability was affirmed by Baer and colleagues (2008) with a demonstrated Cronbach alpha average = .82.

Participants were then subdivided into two subsets (first year program level; second year program level) and a stratified random sampling procedure was used to assign equal numbers of first year and second year program level participants to one of three treatment groups; mindfulness meditation (MM), guided-imagery meditation (GIM), or control. Participants were then directed to an investigator-developed webpage containing either instructions in MM, GIM, or explanation of control group purposes. After viewing pertinent online training materials, participants in the MM and GIM interventional groups were directed to access a guided meditation audio file embedded in their online modality. They were instructed to meditate every day (in a space where they would not be interrupted) using the supplied 10 minute audio file for a total of four weeks.

**3.7 Data Analysis**

After four weeks, 15 participants completed a posttest ANT measurement, resulting in a 29% study attrition rate. It was also necessary to remove two extreme outliers from the final analysis resulting in a final N = 13. However, a reasonably even distribution of remaining participants by program level, gender, age, and racial/ethnic background was maintained within the three groups as noted in Table 3.1
Table 3.1
Demographic Data of Pilot Study Participants

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Gender</th>
<th>Age</th>
<th>Race/Ethnicity</th>
<th>Nursing Program Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>5</td>
<td>5 F</td>
<td>21-39</td>
<td>2 Hispanic/2 White/1 Asian</td>
<td>3 Level I / 2 Level II</td>
</tr>
<tr>
<td>GIM</td>
<td>4</td>
<td>5 F</td>
<td>21-39</td>
<td>2 Hispanic/2 White/1 Other</td>
<td>3 Level I / 2 Level II</td>
</tr>
<tr>
<td>Control</td>
<td>4</td>
<td>4 F/1 M</td>
<td>21-49</td>
<td>2 Hispanic/2 White/1 Asian</td>
<td>2 Level I / 3 Level II</td>
</tr>
</tbody>
</table>

Note. MM-Mindfulness Meditation/ GIM-Guided Imagery Meditation/ Control – No Meditation

Analysis included examination of descriptive data and correlations as well as a one-way analysis of variance (ANOVA) to examine the effect of the two meditation interventions on attentional accuracy as measured by pre posttest ANT, and in comparison to no meditation. Output was also examined with an analysis of covariance (ANCOVA) in which the baseline score of attentional accuracy on the ANT was entered as a covariate and group status served as the fixed factor to determine the significance of group differences on posttest attentional accuracy scores. To determine potential effect of perceived stress, baseline PSS-10 scores were added as an additional covariate. F tests were considered significant at $\alpha = .05$ and effect sizes examined using partial eta$^2$ with the standards of small (.01), medium (.06), and large (.14) (Cohen, 1988). A Bonferroni procedure was employed to adjust for the risk of Type I error in multiple comparisons.

3.8 Results

A review of group means, listed in Table 3.2, indicated higher attentional accuracy in the posttests for the two meditation groups (MM and GIM) after four weeks of the interventions as compared to ANT accuracy in the non-meditating control group. The GIM group demonstrated
the highest ANT accuracy, followed by the MM group. However, between group differences on ANT accuracy posttest scores were non-significant $F(2, 10) = 2.16$, $p = .17$.

Table 3.2
*Means*(M) and Standard Deviations (SD) for Pilot Study Posttests of Attentional Accuracy

<table>
<thead>
<tr>
<th>Meditation Method</th>
<th>M</th>
<th>SD</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mindfulness</td>
<td>98.0</td>
<td>1.73</td>
<td>5</td>
</tr>
<tr>
<td>Guided-Imagery</td>
<td>98.5</td>
<td>1.29</td>
<td>4</td>
</tr>
<tr>
<td>No meditation</td>
<td>91.75</td>
<td>9.18</td>
<td>4</td>
</tr>
</tbody>
</table>

Of additional note was the measurement of pre-dispositional mindfulness and perceived stress. The mean FFMQ of participants ($M=136$) was 4% higher than the established standard mean ($M=130$) for this measurement tool, whereas the mean PSS-10 scores of participants ($M=20$) as compared to an established PSS-10 standard mean ($M=14$) were 40% higher. This suggested a participant pool of nursing students with a much higher than average perceived degree of stress.

Bivariate correlations of the two covariates: pretest scores on FFMQ and PSS-10 were assessed for redundancy and the possibility of multicollinearity. Results suggested a strong negative correlation between mindfulness characteristics and perceived stress $r = -.63$, $p = .02$ with higher levels of pre-dispositional mindfulness correlated to lower levels of perceived stress and a 40% shared variance. In addition, an examination of scatterplots demonstrated a strong linear relationship of PSS-10 scores and the DV whereas FFMQ scores did not produce oval-shaped evidence of linearity. Taking this into consideration as well as the higher than average level of stress in study participants and a possibility of multicollinearity, a decision was made to
enter in baseline PSS-10 scores rather than FFMQ scores as a covariate to explore perceived stress for its moderating effect on attention.

Analysis by ANCOVA (Table 3.3) of between group differences on posttest attentional accuracy scores in which baseline scores of attentional accuracy on the ANT were entered as a covariate was non-significant $F(2, 8) = .85, p = .46$ as were between group differences when baseline PSS-10 scores were added as an additional covariate $F(2, 7) = 2.05, p = .19$. Pairwise comparisons of posttest ANT accuracy, with baseline ANT accuracy and PSS-10 scores controlled, revealed mean differences between the GIM group and control group to be the greatest $M (SD) = 4.6 (3.6)$, followed by MM and no meditation $M (SD) =3.2 (3.5)$. However, differences between MM and GIM were much lower $M=1.42 (3.4)$ and none demonstrated significance at $p < .05$. Participants in both meditation treatment groups exhibited greater increases in attentional accuracy than non-meditators, but differences in adjusted means of ANT posttests indicated small effect and low power.

Table 3.3
ANCOVA Results for Pilot Study Posttest ANT Accuracy Controlling for Co-variates

<table>
<thead>
<tr>
<th>Pre-Test Covariate</th>
<th>MM Group Mean$^a$ (SE)</th>
<th>GIM Group Mean$^a$ (SE)</th>
<th>Control Group Mean$^a$ (SE)</th>
<th>$F$ Test</th>
<th>$p$</th>
<th>Partial Eta$^2$</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANT Accuracy</td>
<td>97.86 (2.05)</td>
<td>97.80 (3.55)</td>
<td>93.63 (2.40)</td>
<td>.85</td>
<td>.46</td>
<td>.175</td>
<td>.15</td>
</tr>
<tr>
<td>ANT Accuracy + PSS-10</td>
<td>97.86 (2.05)</td>
<td>97.80 (3.55)</td>
<td>93.63 (2.39)</td>
<td>2.05</td>
<td>.19</td>
<td>.467</td>
<td>.33</td>
</tr>
</tbody>
</table>

Note. ANCOVA Results for Pilot Study Posttest ANT Accuracy Controlling for Co-variates

\(^a\)Means adjusted for baseline ANT and PSS-10 scores

\(^b\)Group effect, net of baseline ANT and PSS-10 scores
3.9 Discussion

Increases were observed in attentional accuracy following both MM and GIM meditation training and practice, although these were small and statistically non-significant. Results revealed no significant mean differences between MM and GIM on posttest scores of attentional accuracy or on ANT posttests when baseline ANT scores and characteristics of perceived stress were held constant. Nevertheless, data from this small preliminary study provided some suggestion that meditation in either form may be more effective in enhancing attentional accuracy than no meditation.

Both pre-dispositional mindfulness and perceived stress demonstrated a low correlation to attentional accuracy but results on PSS-10 tests suggested that perceived stress in pre-licensure nursing students may be higher than in average populations. This warranted its inclusion as a covariate in future dissertation investigation and the concomitant consideration of mindfulness measurement as its negative correlate in a multivariate analysis of covariance.

The overall design of this preliminary study was effective and no difficulty was reported or ascertained in the use of online training modules or in the delivery of pre and posttest measurement tools. However, one participant in the GIM group did report a mild degree of boredom with having only a single training module and only one type of meditation audio file available for use. This prompted consideration of adding additional training materials and meditation audio file choices into the design of the dissertation study to maintain participant interest.

Some initial difficulty in recruitment as well as challenges to participant retention were encountered and likely attributable to the timing of the study within the academic semester – November through December - and the increasingly busy schedules of student participants at this
time. Some students may have withdrawn or failed from the nursing program by this point in the semester and therefore were lost to post testing. There was 29% attrition after four weeks. This finding was taken into consideration in the planning of this dissertation study and addressed by earlier scheduling of recruitment and pre-testing (September) and completion of interventions and post testing no later than the first week of November. In addition, encouragement (bi-weekly) from the investigator via email in the dissertation study was added to intervention methods to enhance retention of participants. These measures, along with inclusion of a weekly log of time spent meditating, were considered important for increasing validity of the dissertation study by improving intervention fidelity and dose effect congruency among participants.

3.10 Summary

Results from this pilot study were interpreted with caution due to limitations of a small sample size and low power. Although non-statistically significant, the study’s findings that meditation in either form had some effect on enhancing attentional accuracy, and no meditation did not, were interesting and supported a need for continued research on the interventional effects of meditation upon attention in the dissertation study. Other informative findings in regards to design, analysis, methods, and interventions were taken into account in the planning of the dissertation study.
CHAPTER 4

4.0 METHODS

4.1 Introduction

This chapter outlines the methods ultimately employed in the final dissertation research study which was carried out in the fall of 2014 to assess mindfulness meditation (MM) training and practice for its effectiveness in enhancing measures of attentional efficiency in pre-licensure RN students as an addition to their standard nursing education curriculum. Contents of this chapter were informed by the pilot study results as outlined in Chapter 3 as well as the literature review conducted for the manuscript presented in Chapter 2.

4.2 Research Design

A randomized, controlled trial was conducted to investigate the effect of four weeks of daily meditation as an independent variable on measurements of efficiency of three attentional processes (alerting, orienting, and executive function) – the dependent variables. This study was designed as a two group comparison–experimental and waitlist control–of first semester, pre-licensure nursing students. The experimental group received online training in MM techniques and regularly practiced meditation for a period of four weeks in addition to their usual and standard nursing curriculum in time management, critical, thinking, and priority setting during that time period. The control group received exposure to the four weeks of standard nursing curriculum without the meditation intervention. Measurements of attention were conducted with both groups in pre and posttests of attention using a functional computerized program. A secondary investigation was also conducted to examine the impact of MM on the performance of a nursing skill under conditions of time constraint, distraction, and interruption. This was
measured in pre and posttest measurements of a simulated medication administration task. Additionally, measurements of perceived stress and pre-dispositional mindfulness were included and analyzed for their possible moderating impact on attention and medication administration measurements. This experimental design was selected for its advantage in providing causal relationship evidence (Polit & Beck, 2012) as well as for its control over possible confounding variables. A waitlist control condition was included to address ethical issues of withholding a potentially beneficial intervention. As such, participants randomly assigned to the control group were provided access to the MM training and practice modules after post-intervention data had been collected. The decision to use an inactive control design was supported by literature remarking on its acceptable and indispensable use in randomized control trial studies for evaluating the effectiveness of novel interventions (Freedland, Mohr, Davidson, & Schwartz, 2011), by which this study’s MM intervention could be described, to enhance existing practices. A usual care control condition was also deemed particularly appropriate for behavioral efficacy research (Freedland et al.) and mind-body therapy research (Kinser & Robins, 2013), also descriptive of this study. Randomization to group assignment and control of individual attributes measured at baseline further enhanced the rigor of this design and its ability to draw inferences about cause and effect relationships (Polit & Beck, 2012).

The study was conducted at a large, Northeastern, suburban, associate degree in nursing community-college program which offered access to approximately 230 freshman nursing students. The student population at this site was predominantly White (54%), followed by Hispanic (17%), African American (12%), Asian/Pacific Islander (1%), Native American (1%) and other (15%), diverse in socioeconomic status, ranging in age from 19.5 – 52 years, and with an approximate male-female ratio of 1:5.
Pre and post testing was conducted in a private room on the college campus designated as “Do not disturb” and was quiet, adequately lit, of comfortable temperature. Interventions were delivered electronically via online modules and email communication.

4.3 Sample

Participants were recruited from the above described population (N = 230) of first semester, pre-licensure nursing students. All were enrolled in first year curriculum which included a Fundamentals of Nursing class that included didactic instruction in priority-setting frameworks and other basic nursing theory, skills instruction in a laboratory setting, and clinical rotations as well as a Nursing Success class that included didactic instruction in time-management and critical thinking. Participants were required to have daily access to a personal computer and/or smartphone, be over the age of 18, read and understand English, and be currently enrolled in their first semester of the nursing program. There were no other exclusion criteria.

In this convenience sample the number of women was expected to exceed the number of men due to a predominantly female enrollment at the planned nursing school setting. This disparity was however representative of the general population of associate degree nursing students reported to be 85% female (National League for Nursing, 2013) and to which findings might be generalized. In addition, the projected number of minority participants was likely to be small, but again, representative of minority nursing student enrollment in associate degree programs reported to be 9% African American; 4% Asian or Pacific Islander; 1% American Indian; 6% Hispanic; 7% Other (National League for Nursing, 2013). Although diversity of
Sampling was explored in a demographic analysis, it was unclear whether gender, racial and/or ethnic differences in interventional effect would be able to be examined.

Recruitment of participants was supported by distribution of informational flyers (Appendix A) at short informational presentations in freshman nursing classes by a project manager who was a person outside of the nursing department. During these sessions the project manager explained the study and solicited and answered any questions posed. The project manager supplied a written list of upcoming dates/times/locations for pre-testing sessions and informed potential participants that they would be receiving an email from the project manager with a link for scheduling an appointment for pre-testing if they would like to participate within the next 24 hours.

4.4 Protection of Research Participants

This proposed research, conducted in an established educational setting to investigate the effectiveness of an instructional technique, did not include any of the following: deception of subjects, subjects under the age of eighteen, or vulnerable populations. In addition it did not expose subjects to discomfort or harassment beyond levels encountered in daily life. It made clear to participants that they were under no obligation to participate in the study, were free to withdraw at any time, and would incur no effect on course grade(s) or progression in the nursing program whether or not they participated, withdrew, or decided to not participate.

All identifiable records were stored in a locked cabinet with handling strictly limited to research staff. These were destroyed at the end of the research study. In addition, the project manager and primary investigator were CITI certified.

Those interested in participating in the study submitted consent forms (Appendix B) during the pre-testing session directly to the project manager not associated with the nursing
department. Clear explanation, both in the informational flyer and consent form were included stating that participation was voluntary and names / identifiers were to remain anonymous to the primary researcher throughout the research study. This confidentiality was accomplished by having the project manager collect and retain consent forms in a locked file not accessible to the primary investigator. Furthermore, the project manager transcribed participant names into non-identifiable numerical codes for all data collection purposes of the research study.

Measurement data on the ANT was collected from secure laptop computers to the primary investigator’s flash drive both at the beginning and end of the study. Results from the demographic, PSS-10 and FFMQ surveys was retrieved as tab-delineated data and exported directly into SPSS. Only the primary investigator had access to measurement data which was secured in a password protected computer.

4.5 Power Analysis

Input into G*Power software version 3.0 for an a priori computation of sample sizes was calculated for two planned statistical analyses. For multivariate analysis of variance a recommended sample size of 73 was computed with internal parameters for two groups and three dependent variables, a medium $f^2$ effect size of .25, $\alpha$ error probability of .05, and 1-ß error probability of .95. The recommended sample size for univariate analysis of variance was 82 using the same parameters. These were determined to be feasible sample sizes as approximately 30% of the total accessible population of pre-licensure first year nursing students in the setting.

4.6 Data Collection Instruments

4.6.1 Demographic data form. An author-designed, 6-item demographic survey (Appendix C) was used to gather basic information from participants at the beginning of the
study including gender, age, and ethnicity, email/text messaging technology usage, previous experience in manipulating syringes, and prior experience in meditation.

4.6.2 Post-intervention survey. An author-designed four-item post-intervention survey (Appendix D) was used to gather data on participant perceptions of the MM intervention and delivery modality.

4.6.3 Attention network test (ANT). The ANT (Fan, McCandliss, Sommer, Raz & Posner, 2002) was used to measure the primary dependent variable of attention regulation. The ANT is a 30 minute psychophysical measure of attention administered via computer program and utilizing a computer screen and keyboard. It measures efficiency of the three known subsystems of attention: alerting, orienting, and executive function and was selected for its correlation to study purposes and to the Model of Attention (Posner & Gilbert, 1990) which served as this study’s theoretical framework.

During the ANT, participants were instructed to focus on a central marker (cross +) displayed on a computer screen while additional visual cues were randomly introduced. These cues included a directional arrow which randomly appeared either above or below the central fixation point (cross+). Participants pressed either the left or right button of a keyboard mouse to indicate the direction of the randomly appearing arrow, and were instructed to do so as quickly and accurately as possible. The directional arrow was presented 288 times in three blocks of 96 trials along with the possibility of three types of flanker cues (additional arrows) and four types of possible preceding warning cues (asterisks *) that were randomly inserted into each of 288 presentations of directional arrows (Fan et al., 2002).
The ANT measures how response time (RT) in milliseconds (msec) is affected by error when alerting cues, spatial cues, and distracting flankers are presented in identifying the direction of the arrow. Efficiency of each attention network is calculated by subtractions of RTs during conditions influenced by distracting flanker cues and/or pre-warning cues from reaction times representing control conditions. The alerting network, which is associated with sustained and vigilant readiness, is computed by subtracting the RTs of cued condition from the RTs of non-cued conditions. Orienting, which is a network that helps one selectively sort relevant stimuli and re-direct focus, is measured by subtractions of RTs between conditions where spatially-determinant cues are given to the participant prior to the appearances of an arrow versus spatially-indeterminate cues. Executive function (measured by executive function on the ANT), is considered the regulator of competing and/or unanticipated stimuli, and is calculated by subtractions of RTs during presentation of incongruent flankers from those with congruent flanking conditions. Larger alerting and orienting network scores indicate greater efficiency of those subsystems, whereas lower scores on executive function are indicative of better performance (Fan et al.). In addition, the ANT Java version provides aggregate data in the form of mean RT for correct trials in msec and mean percent accuracy (Fan et al., 2002).

The ANT was designed for practicality of administration (Fan et al., 2002) and described as simple, quick, and easily implemented by numerous researchers (Brunye, Mahoney, Lieberman, & Taylor, 2010; Ishigami & Klein, 2010; MacLeod et al., 2010; McConnell & Shore, 2011). Correlational analyses by Fan and colleagues (2002) revealed a significant ($p<.001$) Cronbach alpha = .87 for mean RT and accuracy, .77 for executive function, .61 for orienting, and .52 for alerting network scores. Fan, McCandliss, Fossella, Flombaum, and Posner (2005) conducted simultaneous measurements of ANT and functional magnetic resonance imaging.
(fMRI) of the brain demonstrating that “specific attention networks …are associated with …specific anatomical regions of the brain” (p.475) that regulate attention, to support criterion-related validity of the ANT. In a subsequent study Fan and colleagues (2007) investigated the three subsystems of attention alongside high-density scalp electrical recordings, demonstrating correlation of each network to their specific oscillatory neuronal function, boosting criterion-related validity further. In 2009, Ishigami and Klein performed a repeated measurement test of the attentional networks of 10 adults (mean age 23) to examine ANT reliability. In ten separate sessions t-tests revealed a robust index of each attentional network with reaction time (RT) data most significant ($p = .01$) followed by error rate (ER) data ($p = .05$). Additional investigation by Ishigami and Klein (2010) for inter-method reliability demonstrated significant correlations for executive function Cronbach alpha = .86 ($p < .001$), orienting = .69 ($p < .05$), and alerting = .86 ($p < .001$). Data from multiple studies and a total sample of 1,129 participants of healthy adults was then used by MacLeod and colleagues (2010) to analyze the psychometric properties of the ANT. Using a split-half reliability approach, their findings indicated high degrees of reliability on measures of the executive network ($r = .65$ RT; $r = .71$ ER), followed by moderate degrees of reliability in the orienting and alerting networks ($r = .20 - .32$ RT; $r = .06 - .14$ ER).

The ANT can be administered using either laboratory computers equipped with E-prime psychological software which provides direct upload of data to SPSS, or on personal computers using a Java applet. In this research plan, the Java applet version of ANT was downloaded onto laptop computers. The ANT software program automatically calculated a network effect score for each of the subsystems of attention representing its efficiency (Fan et al., 2002). The experimental procedure and scoring of the ANT is presented in Appendix E.
4.6.4 Medication administration task (MAT). The MAT was a cognitive-behavioral task designed by the researcher to examine performance of a physical nursing skill requiring focused attention. It involved having participants draw up five simulated medication amounts into five needleless syringes and was selected for its proxy-to-practice application of the attentional demands required of nurses in the workplace. The test was timed (45 seconds) to provide pressures of time constraint and also included distractions (visual and auditory) and interruption, and was scored on a scale of 0-5.

Participants were provided “orders” of medication amounts to be “drawn up” for each of five numbered patients in needleless 3 mL syringes. The five syringes were labeled with a patient number 1-5 using five different colors. The written orders for each patient were in non-corresponding colors (Appendix F). Participants were instructed to draw up the correct amount of air in each syringe corresponding to each patient number and informed that they would have 45 seconds to complete the task. This time frame was selected after conducting MAT testing on RN faculty members who had completion times ranging between 40 and 55 seconds. To induce a time constraint factor typical of workplace conditions, freshman nursing student participants were therefore provided this same time limit.

During the 45 seconds of task time a recording of simulated healthcare setting noises (equipment alarm bells, conversations, overhead pages, etc.) was played as auditory distraction. In addition, research assistants continuously walked around the testing room, coming close to the participant desk to provide visual distraction to the task. Twenty seconds into the task time the participants was momentarily interrupted by an announcement asking them to draw their attention to a message written on poster board and held up by the research assistant stating: “Remember to measure carefully”. Performance was assessed by counting the amount of
accurately drawn up syringes (0-5) at the end of 45 seconds. Incomplete syringes were marked as inaccurate.

4.6.5 Perceived stress scale – 10 item version (PSS-10). The PSS-10 (Cohen, Kamarch, & Mermelstein, 1983) (Appendix G) was used to measure participant characteristics of perceived stress. It is a widely used 5-point Likert scale employed in several research disciplines: health, psychology, sociology in which a series of 10 questions are asked about a person’s thoughts and feelings over the last month in response to stress perception, each framed with the language “how often do you feel…” and possible response ranges from never (0) to very often (4). Participants completed the PSS-10 (total test time = 10 minutes) immediately preceding the ANT testing in the same controlled conditions as described above Reverse scoring (0 = 4; 1 = 3; 2 = 2; 3 = 1; 4 = ) on four positively stated items were added to the scores of six other items and numerical tallies interpreted from low to high perceived stress.

Cohen and colleagues (1983) reported a high internal consistency of the PSS-10 with a Cronbach alpha = .86 which has been supported by subsequent research. As example, in an exploration of its psychometric properties in usage with college students (n = 281), Roberti, Harrington, and Storch (2006) conducted a factorial analysis revealing strong evidence of its internal consistency and construct validity (Cronbach alpha = .89). Convergent validity was also supported with significant correlation of the PSS-10 to other stress perception scales in the work of Roberti and colleagues.

4.6.6 Five-facet mindfulness questionnaire (FFMQ). The FFMQ (Baer et al., 2008) (Appendix H) was employed as measurement of dispositional mindfulness characteristics. The FFMQ (total test time = 15 minutes) assesses the tendencies of individuals to be mindful in daily
life by exploring multiple facets of mindfulness: observing, describing, acting with awareness, non-judging of inner experience and non-reactivity to inner experience on a 5-point Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true). This tool allows for the individual measurement of specific mindfulness constructs and is therefore useful in analyzing specific facets that are strongly related to attentional regulation. In such, the specific FFMQ components of observing (8 items) and acting with awareness (8 items) was scored independently with observing items (positively phrased) ranging from 8 (low) to 40 (high) and acting with awareness items (negatively phrased) reverse scored from 40 (high) to 8 (low).

The FFMQ is based on a factor analysis study of several mindfulness questionnaires resulting in the compilation of five common elements of mindfulness as expressed in daily life: observing, describing, acting with awareness, non-judging of inner experience and non-reactivity to inner experience. Internal consistency of this 39-item measurement tool is high (Cronbach alpha range .72 - .92) and construct validity is supported by research testing in both meditators and non-meditators (Baer, et al., 2008). Internal consistency, construct validity and predictive validity were additionally confirmed in a recent study of its psychometric properties (deBruin, Topper, Jan. Muskens, Bogels, & Kamphuis, 2012) in a sample of meditators and non-meditators. They also found internal consistency of FFMQ total scores to be very good (meditators .90; non-meditators .85) and their confirmatory factor analysis revealed a confirmative fit index above .90. Construct validity testing revealed significant correlations for all items ($p \leq .01$) and significant predictive validity was also established ($p \leq .01$ – $p \leq .05$).
4.7 Procedures

Immediately following recruitment sessions, the project manager emailed freshman nursing students to schedule appointments for pre-intervention sessions using an online scheduler program. A reminder email was sent prior to the assigned pre-intervention session to bolster attendance and enrollment.

4.7.1 Pre-intervention session. Participants were directed to a computer station which had a laptop computer, pen, a Ziploc® bag containing a scoring card with a numerical identifier scoring card and five color-coded and numbered 3 mL needleless syringes, and manila envelope with consent form containing matching numerical identifier. A brief re-description of the study as provided at the informational sessions was provided and it was verbally reiterated that test results would remain confidential to the primary investigator. It was also restated that participation in the study or decision to not participate or withdraw at a later time would have no effect, whether positive or negative, on student’s course grade(s) or status in the nursing program. Consent was obtained and placed in the manila envelope, sealed, and retained by the project manager. Time for this section of the pre-intervention session was approximately 10 minutes.

Once this step was completed, the participant was directed to complete three surveys: Demographic, FFMQ, and PSS-10 using their numerical code as their sole identifier. Surveys required approximately 25 minutes completion time.

When surveys were completed, the participant was asked to read the instructions for the ANT (Appendix A) which had been previously minimized on the computer screen. Following this, an opportunity was provided for participant questions. When assured that instructions were
understood, the participant was instructed to complete the two minute ANT practice test and to then stop, raise their hand, and wait for further instructions. Once again an opportunity for further questions was provided. The participant was then instructed to begin the actual ANT test and to raise their hand once all three five-minute sections were completed. Completion of these ANT components took approximately 30 minutes.

To begin the medication administration task (MAT) component of the testing session, the participant was then asked to draw their attention to written instructions about “How to Read a Syringe” which had been previously presented at the recruitment information session. Opportunity for addressing participant questions was provided, and when it was assured that directions were understood, the participant was instructed to remove the syringes from their Ziploc© bag and to place them on the desk space in front of them. The participant was then directed to open an additional computer window (previously minimized) where they were able to view medication “orders” for five patients and timing of the 45 second testing session began. There were five medication amounts to be drawn up, one for each syringe and the participant was to simulate the ordered medication amount for each patient on the correspondingly numbered needleless syringes by setting the plunger (drawing up air) to the correct point.

During the 45 seconds of task time a recording of simulated healthcare setting noises (equipment alarm bells, conversations, overhead pages, etc.) was played as auditory distraction. In addition the research assistant continuously walked around the testing room, coming close to the participant desk to provide visual distraction to the task. Twenty seconds into the task time the participant was “interrupted” by being momentarily instructed to draw their attention to a message written on poster board and held up for them to see. At the end of 45 seconds, the participant was instructed to stop working and to place their syringes back into their Ziploc© bag
and seal it; whether they had completed the task or not. Scoring was on a scale of 0-5. Uncompleted syringes were scored as zero. MAT testing was completed in 5 minutes.

Participants then randomly selected a sealed card containing an assignment either to the experimental MM group or the wait-list control and this assignment was noted by the project manager. They were thanked for their participation and told to expect an email communication from the project manager with further instructions on proceeding with the study.

Ziplock© bags with MAT data were collected in sealed manila envelopes and delivered to the primary investigator. Data from ANT tests was collected from each laptop and placed on the primary investigator’s flash drive device. Survey data was electronically retrieved after the pre-testing session from an online survey website. The project manager secured consent forms containing email addresses, participant names and numerical code identifiers. Group assignments were recorded by the project manager according to numerical code and these codes were the only identifiers relayed to the primary investigator for coordination with pre-intervention measurements.

4.7.2 Intervention

Mindfulness meditation (MM). Participants in the MM group were contacted via their preferred email method by the project manager and provided an online instructional module on mindfulness meditation techniques developed by the primary investigator. This included definitions of mindfulness, a brief history of mindfulness, and the procedural guidelines for carrying out a 10 minute daily meditation practice. Participants were instructed to review this instructional module and to submit a brief 5-item evaluation to confirm their understanding of the presentation via email to the project manager. Once comprehension was established, an
audio file containing a guided meditation was sent to the MM participant and they were instructed to begin their meditation practice. Participants were instructed to meditate every day for 10 minutes at a time convenient to them for a period of four weeks using the provided audio file. Participants were also asked to keep a daily log of their time spent meditating and to submit it once a week when prompted by an email message from the project manager. They were also asked to review bi-weekly emails sent to them by the project manager with messages and additional instructional materials prepared by the primary investigator. These materials included frequently asked questions on MM, common difficulties of MM practice and suggested solutions, research article summaries, video links, and other items related to MM. Additionally, participants were encouraged to reach out to the project manager if they had any questions, problems, or comments about the meditation procedures or instructional materials. However, none were received the four weeks of intervention.

4.7.3 Control condition

Usual and standard nursing education. During the four week interventional period all participants were exposed to the standard associate degree nursing curriculum in time management, critical thinking, and priority setting frameworks. This was delivered within the context of two courses, Fundamentals of Nursing and Nursing Success, in which all nursing student participants were registered. Content included methods of managing both personal and workplace schedules and the importance of organization and prioritization of tasks. In addition it included instructional modules and exercises in critical thinking and priority setting as well as medication syringe measurement techniques. This served as the control condition for participants randomly assigned to the wait-list control group who did not participate in the aforementioned MM intervention.
In a bi-weekly email from the project manager, the waitlist-control group participants were encouraged to ask questions and/or share comments or concerns that also thanked them for their continued participation. A reminder email was sent to all participants prior to their assigned post-intervention session to bolster attendance and completion of study requirements.

**4.7.4 Post-intervention session.** Each participant attended a post-intervention session in the same setting as previously described. Participants were directed to a computer station which had a laptop computer, a Ziploc® bag containing a scoring card with their numerical identifier scoring card and five color-coded and numbered 3 mL needleless syringes.

Using the same procedures as outlined in the pre-intervention session, participants first completed the FFMQ and PSS-10 surveys using their numerical code as their sole identifier. They were also asked to fill-out the additional post-intervention survey seeking their perceptions of the intervention and delivery modality. Surveys required approximately 25 minutes completion time.

When surveys were confirmed completed, the participant was directed to open the ANT instructions and computer screen (previously minimized) and the same procedures as in the pre-intervention session were carried out. The ANT testing component required 30 minutes.

Following completion of the ANT, as previously operationalized in the pre-intervention session, the participant completed the MAT component of testing. This section was completed in 5 minutes.

The participant was then thanked for their participation in the study and handed a thank you card that provided a short brief explaining the research hypothesis and informed them that they would be receiving a $10.00 Amazon e-certificate sent directly to their email. The
participant was also informed that results of the study, either individual or cumulative would be available to them upon request to the primary investigator after completion of study analysis. Participants in the wait-list control group were reminded that they would be receiving an email with instructions on how to access the online instructional module and materials for the MM intervention. This part of the session was completed in 10 minutes.

Ziplock© bags with MAT data were collected in sealed manila envelopes and delivered to the primary investigator. Data from ANT tests was collected from each laptop and placed on the primary investigator’s flash drive device. Survey data was electronically retrieved after the pre-testing session from an online survey website.

4.8 Data Analysis

IBM SPSS Statistics Version 22.0 was used to analyze the accumulated data and appropriate descriptive statistics provided to summarize participant characteristics and group indicators of central tendency and variability. This was followed by a multivariate analysis of covariance (MANCOVA) in which baseline scores of attention on the ANT were entered as a covariate in an examination of between and within group differences on a composite DV created from three ANT attentional efficiency posttest scores of alerting, orienting, and executive function. Subsequently, an analysis of covariance (ANCOVA) was conducted in which baseline scores of MAT accuracy were entered as a covariate and group status served as the fixed factor to determine the significance of group differences on the secondary dependent variable (MAT). Two potential confounding variables: stress perception and mindfulness characteristics were determined appropriate for inclusion as additional covariates in that stress, as noted in the research literature, has a negative correlation to attention (Irving, Dobkin, & Park, 2009; Jain et
al., 2007) and pre-dispositional mindfulness has a positive effect on attention (Irving, Dobkin, & Park; Jain et al.; Kerr et al., 2011) and were added to the above MANCOVA and ANCOVA procedures.

4.8.1 Data checking. Accuracy of the data file was confirmed by a second-reader to cross-check information within SPSS files to original Excel files as well as ANT score recordings, MAT scores, FFMQ and PSS-10 survey items. Data was scanned for missing values and analyzed for univariate and multivariate outliers. Univariate outliers were identified by standard scores > +/- 3 and/or irregularly patterned box plots and scatterplots and multivariate outliers by Mahalanobis distances computed within SPSS regression and compared to a Chi square tabled critical value of 13.82 for df = 2 (# of variables).

4.8.2 Assumptions testing. Participants were randomly and independently sampled and every effort made toward equal group sizes. Assumptions of univariate normality were examined within histograms and residual scatter plot departures identified by skewness and/or kurtosis indices > +/- 3. Probability plots were inspected within regression and scrutinized for multivariate normality evidenced by even distribution. Bivariate scatterplots were visually inspected for oval-shaped evidence of linearity, and in regression examined for rectangle-shaped evidence of homoscedasticity in residual scatterplots (Polit, 2010).

To assure assumptions specific to MANCOVA, Box M tests were assessed at $\alpha = .001$ and non-significance of the transformed $F$ value was interpreted as non-violation of the assumption of homogeneity of the variance-covariance matrices. Wilks’ Lambda was used for interpretation of MANCOVA results with significance interpreted as $\alpha = .05$ (Tabatchnick & Fidell, 2007).
To assure assumptions specific to ANCOVA, homogeneity-of-regression was tested across the two groups. An interaction term between the dependent variables of attention and covariates of pre-dispositional mindfulness, perceived stress, and pre-test ANT or MAT scores was created and this assumption confirmed by non-significant $F$ statistic ($p > .01$) for interaction term effects and a variance ratio < 2 (Polit, 2010). In addition, reliability of covariates was enhanced by statistically reliable measurement tools (ANT, PSS-10, FFMQ). A non-significant Levene’s test ($p > .05$) was used for affirmation of homogeneity of variance assumptions.

4.8.3 Descriptive analysis. Demographic survey data was analyzed and used to describe the gender, age, ethnicity, and previous experience in manipulating syringes and/or with meditation. T-tests were performed on key background characteristics and these were used to test for selection bias due to confounding variables between groups. In addition, information from post-intervention surveys was used to describe the average number of times per week participants engaged in their training and practice, as well as their opinions of the practicality and usefulness of the cognitive training methodology. Measures of central tendencies were reviewed for all measurement tools: PSS-10, FFMQ, ANT, and MAT.

4.8.4 Group comparisons and correlations. Group comparisons were conducted to detect for sampling errors. Differences between the groups were analyzed by Chi-square for nominal variables, Mann-Whitney U for ordinal variables, and $t$-tests for scale variables.

Correlations between variables were computed to determine the association between all pairs of potential covariates. Pearson’s correlations were conducted between scale level variables; Spearman’s correlation between ordinal measurements, and Chi-square and Fisher’s exact testing for comparisons between nominal level variables. Kruskal-Willis and Mann-Whitney testing were employed for correlational analysis of nominal versus scale variables,
analysis of variance (ANOVA) for scale versus ordinal, and both ANOVA and t-tests for remaining scale versus nominal correlations. Multicollinearity was assessed and considered problematic if bivariate correlations were > .9, indicating redundancy.

4.8.5. **Multivariate analysis of co-variance (MANCOVA).** A multivariate analysis of covariance was conducted to determine the significance of experimental versus control group differences on three dependent variables—efficiency of alerting attentional processes; efficiency of orienting attentional processes; and efficiency of executive function attentional processes—considered simultaneously as a composite dependent variable. Group status—experimental versus control—was considered categorical factor levels of the independent variable and baseline ANT efficiency scores on alerting, orienting, and executive function served as covariates. Based on a review of prior literature, inclusion of pre-dispositional stress perception and mindfulness as confounding variables was included in the analysis. Multivariate analysis output was examined to determine if group differences (with covariates controlled) on a combined dependent variable were statistically significant utilizing Wilks’ Lambda criterion and a significance of \( \alpha = .05 \). Effect sizes were examined using partial \( \eta^2 \) and the standards of small (.01), medium (.06), and large (.14) (Cohen, 1988). Post-hoc pairwise comparisons were also examined to determine differences between means of paired groups as adjusted by Bonferroni procedures.

4.8.6 **Analysis of co-variance (ANCOVA).** Univariate analyses of co-variance (ANCOVA) procedures were carried out on each individual posttest ANT network score (alerting, orienting, executive function) as adjusted for their corresponding pre-test score as well. In addition ANCOVA was employed to determine the significance of experimental versus control group differences on the secondary dependent variable of medication administration task (MAT) accuracy. Group status—experimental versus control—was considered categorical factor
levels of the independent variable and baseline MAT scores served as the covariate. As described in the above MANCOVA procedures, the inclusion of FFMQ and PSS-10 scores were added as additional covariates. ANCOVA analysis output was examined to determine the relationship of each covariate on the DV posttest of MAT. In addition, the overall treatment group variable was assessed with the covariates controlled. The ANCOVA F test was considered significant at $\alpha = .05$. Effect sizes were examined using partial $\eta^2$ and the standards of small (.01), medium (.06), and large (.14) (Cohen, 1988). Parameter estimates were assessed and t statistics, 95% confidence intervals, and partial $\eta^2$ values used to examine the significance ($p=.05$) and magnitude of differences between groups. Estimated marginal means for each group were also examined and lower bound/ higher bound values used to compare differences in group contribution to outcome variance (Green & Salkind, 2007).

4.9 Potential Study Limitations

The pre-posttest design of this study posed some risk of distortion of findings in that participants could potentially carry forward their experiential learning from administration of the pretest, resulting in posttest score inflation. This was partially mediated by the four week time frame between testing sessions, but worthy of consideration in interpretation of results. In addition, it was possible that any observed improvement on the dependent variables of ANT (alerting, orienting, and executive function) and MAT over the four week time period could have been acquired due to general nursing studies rather than the research interventions. However, the fact that participants in both the control group and experimental group were enrolled in the same standard nursing curriculum likely mediated this concern. Timing of the study for first semester curriculum was such that all participants had the same amount of experiential exposure between
pre and post testing. Therefore, any additive effect of experience on either the ANT of MAT would have been the same in both experimental and control groups.

Another potential threat to external validity resided in a possible Hawthorne effect in which subjects, aware of their participation in the study, might have enhanced their efforts to succeed (Polit & Beck, 2012). A possibility of generational and/or cultural influences also warranted consideration when interpreting results as did potential individual variances of skill and comfort level in online instructional modalities. In addition, as previously stated, the research sample was expected to be predominantly women and not diverse. These were explored in the analysis of descriptive statistics to determine whether population differences were correlated to interventional effects. Another known limitation of this study was its convenience sampling from only one school of nursing. This was taken into consideration when interpreting the generalizability of results.

4.10 Potential Procedural Problems and Counterbalancing Strategies

Difficulty in recruiting sufficient volunteers for this study from a limited population of 230 freshman first semester students was considered. The recruitment plan was repeated as necessary to attempt the desired sample size of 84 for maintaining power at .95. However, a calculated sample size of 52 was deemed adequate by G-Power analysis to produce a .80 power rating and this number was achieved. The appeal for enrollment was enhanced by the research design of convenient online participation and a short timeframe (four weeks), token remuneration, and the opportunity to win an iPad Mini®. Additionally, it was expected that the explanation of study purposes would appeal to students as another means of enhancing their learning and achievement of nursing competencies.
It was also possible that nursing students would either avoid participation or feel compelled to participate due to the nature of the educational setting. It was made clear that they were under no obligation to participate, could withdraw at any time, and would incur no effect on course grade(s) or progression in the nursing program whether or not they participated, withdrew, or decided to not participate. It was further explained that participant names and would remain anonymous to the primary investigator.

Attrition was another concern and efforts to keep participants engaged in the four weeks of daily meditation included bi-weekly contact from the primary investigator via emails sent by a project manager, introduction of new and stimulating instructional materials each week, and a requirement of participants to keep a weekly activity log. Bi-weekly contact was also provided to the control group to maintain equal rapport. Attrition due to program failure was not a concern due to the early semester (September-October) timing of the research plan, but attrition due to withdrawal from the nursing program was largely unavoidable.

### 4.11 Timeline of Project

<table>
<thead>
<tr>
<th>Component</th>
<th>Projected Time Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposal defense</td>
<td>July 2014</td>
</tr>
<tr>
<td>Institutional review board approval</td>
<td>September 2014</td>
</tr>
<tr>
<td>Recruitment</td>
<td>September -October 2014</td>
</tr>
<tr>
<td>Pre-intervention testing sessions</td>
<td>October 2014</td>
</tr>
<tr>
<td>Delivery of interventions</td>
<td>October - November 2014</td>
</tr>
<tr>
<td>Post-intervention testing sessions</td>
<td>November 2014</td>
</tr>
<tr>
<td>Data analysis</td>
<td>December 2014 - January 2015</td>
</tr>
<tr>
<td>Write-up of results and discussion</td>
<td>February 2015</td>
</tr>
<tr>
<td>Dissertation defense</td>
<td>March 2015</td>
</tr>
</tbody>
</table>
CHAPTER 5

5.0 FINDINGS AND DISCUSSION

MANUSCRIPT #2

Examining the effect of mindfulness meditation on attentional efficiency of nursing students

To be submitted for publication

5.1 Abstract

The purpose of this randomized control trial study was to examine the effectiveness of online mindfulness meditation (MM) training and practice to enhance nursing students’ attentional efficiency as a potential method of developing self-regulatory skills deemed necessary for safe nursing practice. A convenience sample of 52 nursing students was randomly assigned to experimental (n = 28) and control (24) groups and outcomes on attentional efficiency (alerting, orienting, and executive networks) were measured in a pre-posttest design. Experimental group participants received online training in MM and meditated for ten minutes daily for four weeks. A waitlist control group did not meditate until the conclusion of the study. Individual characteristics of perceived stress and mindfulness were included in statistical analyses as potential confounders and also explored as dependent variables. Although no group differences on alerting and orienting networks were found, executive network efficiency scores did reveal group differences $F (1, 49) = 4.26, p = .044$ with MM demonstrating moderate strength $\eta^2_p = .080$ for enhancing the efficiency of executive attention in those students who meditated. Additional significant outcomes specific to the MM group were reduced stress and increased mindfulness.

Keywords: attention, meditation, mindfulness, nursing students, safety, stress
5.2 Problem

An undisputed and over-arching goal of pre-licensure registered nurse (RN) education is the development of nurse graduates prepared to deliver safe patient care. This clear objective has nevertheless not been fully realized, and in many cases, graduate nurses are under-equipped for what has become an increasingly complex and distracting healthcare workplace known to exacerbate cognitive human error (Institute of Medicine, 2000). In a growing body of healthcare safety studies the mental complexities of nursing work and lapses in attentional focus have been linked with error, and many novice nurses report conditions of cognitive overload impacting their ability to provide safe care, particularly in medication administration (Eisenhauer, et al. 2007; Holden, et al, 2011; Reid-Searl, Moxham, & Happell, 2010; Unver et al., 2012). More than ever, today’s nurse requires a superiorly efficient attentional acuity and flexibility to function safely in complex clinical workplaces which are filled with distraction, interruption, and multiple and fluctuating pieces of information and data. This type of attentional efficiency should, in effect, be considered an essential pre-licensure nurse competency, as it is a well-documented antecedent to situational awareness, a cognitive foundation to safe practice (Fore & Sculli, 2013; Sitterding, Broome, Everett & Ebright, 2012, White, 2012).

5.3 Significance

There is a paucity of known methodology effective in specifically preparing nurses for such attention regulation skills (Beyea, 2007; Cornell et al., 2010; Ebright, Carter Kooken, Moody, & Latif Hassan Al-Ishaq, 2006, White, 2012) with more educational effort given to extrinsic factors as they relate to safety and less to such intrinsic human factors. (Cook, O’Connor, Render & Woods, 2004). Several nurse scholars have noted a need for increased research on nurse cognition (Benner, Sutphen, Leonard, & Day, 2010; Ebright, et al., 2006,
Potter et al., 2005; Rhodes, Morris, & Lazenby, 2011) and Cook and colleagues (2004) noted that formal cognitive training, such as meditation, aimed at improving healthcare professional resilience to interruption and distraction may be a key strategy for improving patient safety. Current attempts at removing external factors of error, such as procedures to minimize interruption to nurse medication administration procedures are commendable, but have not been entirely successful (Mowinski Jennings, Sandelowki, & Mark, 2011). This is likely due to the fact that nursing work by nature must always involve some degree of interruption and distraction which are components of the care environment alongside salient cues and warning signals. All must be monitored and distinguished for importance by the nurse, while simultaneously attending to his/her patient or task. An effort toward improving nurse cognition - a human performance factor - is therefore especially important to nurses functioning in an environment in which external factors of error are impossible to entirely eliminate (Despins, Scott-Cawiezell, & Rouder, 2009).

5.4 Background

5.4.1. Meditation and neuroscience. In an integrative literature review of educational and neuroscientific studies, and in the context of healthcare practitioner work, Epstein and colleagues (2008) drew a theoretical link between the positive outcomes of focused awareness meditation and the requisite thinking-in-action skills needed for clinical healthcare practice, concluding that such practices could be a plausible way to increase attention and build cognitive resilience. Focused awareness meditation is a practice of purposeful self-regulation of attention; a conscious intention to maintain present moment awareness that with consistent practice is suggested to heighten one’s trait-ability to pay attention in a discerning and concentrated way despite external and/or internal distractors (Kabat-Zinn, 1995, Nhat-Hanh, 2011). This position
has been supported by a rapidly accumulating, body of neuroscientific with strong evidence of a positive interventional effect of the regular practice of focused awareness meditation on the ability to sustain attention, filter informational cues, and regulate distracting stimuli research (Jha, Krompinger & Baime, 2007; Lutz, et al. 2009; MacLean, et al., 2010; Zeidan, Johnson, Diamond, David & Goolkasian, 2010; Kerr, et al., 2011; Jensen, Vangkilde, Frokjaer & Hasselbalch, 2012). It has been further suggested that this type of mental training improves attentional efficiency in a permanent way through a process of neuroplasticity by which repeated activation of certain neural circuits strengthen synaptic connections demonstrable on fMRI of the brain as increased cortical thickness’ in specific neural areas associated with attention (Davidson et al., 2003; Lazar, et al. 2005). Improving attention regulation skills is therefore seen by neuroscience as “fundamentally no different than other forms of skill acquisition” (Davidson & Lutz, 2008, p.177) and many experimental studies over the past decade have reported a substantive relationship between training and regular practice of meditation and increased efficiency of one or more subsystems of attention (Chambers, Chuen Yee & Allen, 2008; Chan & Woollacott, 2007; Jensen, Vangkilde, Frokjaer & Hasselbalch, 2012; Jha, Krompinger & Baime, 2007; Kozasa et al., 2012; Lutz, Slagter, Rawlings, Francis, Greischar & Davidson, 2009; Maclean et al., 2010; Moore & Malinowski, 2009; Morrison, Goolsarran, Rogers & Jha, 2014; Mrazek, Franklin, Phillips, Baird & Schooler, 2013; Semple, 2010; Slagter, Lutz, Greischer, Francis, Nieuwenhis, Davis & Davidson, 2007; Tang et al., 2007; Van den Hurk, Giommi, Gielen, Speckens & Barendregt, 2010; Van Leeuwen, Singer & Melloni, 2012; Zeiden, Johnson, Diamond, David & Goolkasian, 2010).

5.4.2. Mindfulness meditation. One common form of focused awareness meditation is mindfulness meditation (MM) which is based on the concept of mindfulness. Although rooted in
Eastern Buddhist philosophy, mindfulness is an emerging concept in healthcare and gaining interest in research fields from a secular perspective. Derived from the Pali word sati, meaning awareness, attention, and remembering (Davis & Hayes, 2011) and more contemporarily defined as “awareness cultivated by paying attention in a sustained and particular way: on purpose, in the present moment, and non-judgmentally” (Kabat-Zinn, 2012, p.1), MM is a practice that involves engagement and re-engagement of attention to one’s breathing while simultaneously noticing other stimuli (internal and external). The goal, and what one gains skill and greater efficiency in over time, is less distractibility, quicker notice of mind-wandering, and stability of the breath focus. Much like other regular routines, such as a daily walk or time at the gym, MM is intended to be a daily formal practice, perhaps sitting for 10-60 minutes daily, yet full embodiment of mindfulness is a continual practice of moment-to-moment awareness informally carried throughout one’s day (Kabat-Zinn, 1990). MM is one component of the Mindfulness-Based Stress Reduction (MBSR) training program (Kabat-Zinn, 1995) that has been effectively used in Western medicine to treat patient stress, pain, depression, anxiety, and other disorders as well as for reducing stress, anxiety, and burn-out in nurses and nursing students (Beddoe & Murphy, 2004; Mackenzie, Poulin, & Seidman-Carlson, 2006; Newsome, Waldo, & Gruska, 2012). Mindfulness has also been suggested as a method for enhancing metacognition in the higher education (Hart, 2008, Shapiro, Brown, & Astin, 2011). The techniques specific to MM—engaging attentive focus, noticing intruding thoughts, and re-directing purposeful focus—are similarly aligned with the attentional processing of typical clinical nursing practice in which the nurse strives to maintain attentive focus on a patient and/or task but is simultaneously noticing the environment, sorting relevant stimuli from distraction and repeatedly re-directing focus back to a patient and/or task.
5.4.3 **Attention regulation.** In the context of this study and nursing work, attention regulation is defined as an ability to maintain sustained and vigilant focus on a patient or task while simultaneously monitoring and distinguishing between meaningful versus extraneous cues, and an ability to ward off the incursion of internal and or external distractions. This definition is guided by Posner and Petersen’s (1990) widely referenced neurocognitive *Model of Attention* which proposes that attentional processing can be divided into three functional components: *alerting, orienting,* and *executive function.* *Alerting,* alternately termed vigilance, is associated with sustained attentional readiness. *Orienting* helps one select relevant stimuli and redirect focus. *Executive function,* aids in detecting incongruence, avoiding habitual responses, and prioritizing one’s attention among competing stimuli (Lutz et al., 2009). Posner and Petersen contend that the networks operate in different areas of the brain but perform interrelated attentional functions. This theoretical proposition has been supported by neuroimaging studies, with the alerting network demonstrating activation in frontal and parietal regions of the brain (Coull, Frith, Frackowiak, & Grasby, 1996), orienting with activity in the superior parietal lobes and frontal eye fields (Corbetta, Kincade, Ollinger, McAvoy, & Shulman, 2000), and executive function showing brain activation in the anterior cingulate cortex, medial lateral, and lateral prefrontal cortex (Bush, Lu, & Posner, 2000) on functional magnetic resonance imaging studies (fMRI).

Research on the mechanisms of attention is an unfolding area of study in both neuroscience and behavioral psychology. Advances in neuroimaging studies, such as those described above confirm some degree of isolability of the networks in that they are illuminated in specific brain regions on fMRI and are correlated to specific neural substrates. An inference derived from such studies is that the three attention networks are independent of one another.
Yet, a review of empirical studies demonstrated significant correlations between at least some of the three networks (MacLeod, McConnell, Lawrence, Eskes, Klein, & Shore, 2010) providing support for a unitary attentional behavior and interrelatedness of the three networks. Whether the three attentional networks are related or not is a topic of continued research and ongoing discovery. This diametric opposition in the unfolding evidence and the continued uncertainty regarding network independence or interdependence impacted the statistical analysis in this study.

5.5 Purpose

Although neuroscientific research has rapidly expanded with numerous studies linking meditation interventions to significant findings on attentional efficiency, both on behavioral as well as physiological measures such as fMRI, electroencephalogram (EEG), and other scans (Kerr et al. 2011; Kozasa et al., 2012; Jha et al., 2007; Lutz et al., 2009), there have been no previous studies within the nursing discipline or from the context of nursing education that have investigated its use for enhancing nurse or nursing student attention. The purpose of this study was therefore to assess the use of MM for its effectiveness in enhancing measures of attentional efficiency in pre-licensure nursing students to determine whether MM warrants consideration as an addition to standard pre-licensure nursing education curriculum.

5.6 Research Questions and Approach

Guided by Posner and Petersen’s (1990) Model of Attention, and paralleling measurement approaches found in recent literature, this study set out to measure attentional outcomes through evaluation of the three attention networks: alerting, orienting, and executive function in two groups (control and experimental) with first-semester pre-licensure nursing
students before and after four weeks of MM training and practice. The primary research question was: *What is the effect of cognitive training in the form of MM as compared to standard nursing education on posttests of attentional network efficiency in pre-licensure RN students while controlling for baseline measurements of attentional efficiency?* Notable from previous studies was the possibility that participant differences in perceived stress (Jha et al., 2007) or pre-dispositional mindfulness traits (Eberth & Sedlmeier, 2012) may partly contribute to attention regulation improvements. This potential for confounding influence was taken into account by inclusion of stress and mindfulness as covariates in statistical analyses and the additional exploratory research question: *What is the relationship between mindfulness characteristics and perceived stress of pre-licensure RN students and measurements of attentional efficiency?*

**5.7 Methods**

5.7.1 **Study design.** This randomized control trial study used a between subject two-group comparison and pretest-posttest design to evaluate the effect of cognitive training in the form of MM on the attentional efficiency of pre-licensure nursing students.

5.7.2 **Participants.** Sixty first-year nursing students were recruited from a large, Northeastern, suburban, associate degree in nursing community-college program with an approximate freshman nursing student population of 230 which was predominantly White (54%), followed by Hispanic (17%), African American (12%), Asian/Pacific Islander (1%), Native American (1%) and other (15%), diverse in socioeconomic status, with ages ranging from 19.5 – 52 years and an approximate male-female ratio of 1:5. Eligible participants were enrolled in the nursing program’s first semester standard curriculum. This included a Fundamentals of Nursing class with didactic instruction in priority-setting frameworks, basic nursing theory, skills
instruction in a laboratory setting, clinical rotations, and a Nursing Success class with didactic instruction in time-management and critical thinking. Participants were required to have daily access to a personal computer and/or smartphone, be over the age of 18, and to read and understand English. There were no other exclusion criteria.

Institutional review board approval was obtained prior to the study. Participants who completed all requirements of the study received nominal remuneration ($10.00 gift certificate and entry into a drawing to win an iPad mini) for their time and effort. Recruitment was supported by informational presentations during freshman nursing classes by a project manager outside of the nursing department, and with subsequent flyer postings and email follow ups. Participants volunteered for the study by contacting the project manager’s email and making an appointment for a pre-testing session. An a priori sample size n=82 was calculated using G*Power for medium effect size of .25, alpha of .05, and power of .95, but ultimately 60 students volunteered, thus reducing post hoc power. All participants provided written informed consent.

5.7.3 Data collection instruments. A Demographic Survey was used to gather baseline participant data including gender, age, ethnicity, and prior experience in meditation. In addition an investigator-designed Post-Intervention Survey was used to gather participant data on amount of time spent meditating and participant perceptions of the MM intervention and delivery modality. Measurements of attentional efficiency, perceived stress, and mindfulness characteristics were taken both pre and post intervention with the following tools:

The Attention Network Test (ANT) (Fan, McCandliss, Sommer, Raz, & Posner, 2002) was used to measure the primary dependent variables of attention efficiency in each of the three
subsystems of attention: alerting, orienting, and executive function. The ANT is a 30-minute psychophysical measure of attention administered via computer program utilizing a computer screen and keyboard and has been used in more than 60 neuropsychological research studies. During the ANT, participants are instructed to focus on a central marker (cross +) displayed on a computer screen while additional visual cues are randomly introduced. These cues include a main target stimulus (directional arrow), which randomly appears either above or below the central marker (cross+) as well as the possibility of three types of flanker cues (additional arrows) and four types of possible preceding warning cues (asterisks). Participants are instructed to press either the left or right button of a keyboard mouse to indicate the direction of the target stimulus (center directional arrow) which is altogether presented 288 times and to do so as quickly and accurately as possible. For each subsystem of attention the ANT creates a measurement of efficiency derived from subtractions of reaction times during conditions influenced by distracting flanker cues and/or pre-warning cues from reaction times representing control conditions. Correlation analyses conducted by Fan and colleagues (2002) determined executive control network scores to be most reliable (.77) followed by orienting (.61) and alerting (.52). Similar reliability findings were produced in this study with Cronbach alphas for executive function = .73, orienting = .60, and alerting = .61. Standard mean network effect scores in milliseconds as reported by Fan and colleagues (2002) are alerting 47, orienting 51, and executive function 84. Larger alerting and orienting network scores indicate greater efficiency of those subsystems, whereas lower scores on executive function are indicative of better performance (Fan et al.).

The Perceived Stress Scale-10 Item Version (PSS-10) (Cohen, Kamarck, & Merelstein, 1983) was used to assess each participant’s perception of their stress level to explore for any
confounding influence of such characteristics on the main attention dependent variables. The PSS-10 is a widely used 5-point Likert scale used in several disciplines: health, psychology, sociology with a high reported internal consistency (Cronbach alpha = .86) (Cohen et al., 1983). The survey consists of ten questions about a person’s thoughts and feelings in response to stress perception and Cohen and colleagues report an established PSS-10 standard mean score of 14. Post hoc reliability measurement of this tool revealed a Cronbach alpha = .73.

The Five-Facet Mindfulness Questionnaire (FFMQ) (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) was used to measure individual variances in pre dispositional mindfulness to evaluate potential effect on the main attention dependent variables. The FFMQ has been used in many recent studies of mindfulness with reported high reliabilities ranging between .92 (Baer et al, 2008) and .90 (deBruin et al., 2012). It is comprised of 39 items, rated on a 5-point Likert scale and assesses several facets of mindfulness: observing, describing, acting with awareness, non-judging, and non-reactivity. Baer et al. (2006) report the FFMQ established standard mean score of 130. In post hoc analysis, Cronbach alpha of the FFMQ for this study = .92.

5.7.4 Procedures for data collection. Training by the primary investigator and detailed instruction manuals were provided to research team members prior to the start of the study to assure congruence with procedures and measurements. Each research participant attended a one-hour pre-testing session in a quiet, well lit private room in which they were seated at a desk with a laptop computer where they completed the Demographic, FFMQ, and PSS-10 surveys, followed by the ANT. The ANT session included one block of 24 practice trials in which they received feedback on their accuracy and had opportunity to ask questions prior to the actual scored measurement of three blocks of 96 experimental trials. After completion of the pretests, each participant was randomly assigned to either the MM or wait-list control group and provided
instructions for the upcoming four weeks of the study. Post-intervention data collection sessions duplicated this process except that a Post-Intervention survey replaced the Demographic survey.

5.7.5 Mindfulness meditation intervention. Participants in the meditation group were provided access to an online platform containing an instructional module (created by the primary investigator) on the techniques of MM and procedural guidelines for carrying out a 10-minute daily meditation practice. Once reviewed and a posttest successfully completed, an audio file link with a guided mindfulness meditation was sent to participants via email for download to their personal computer, smartphone, or other smart device. They were instructed to meditate for 10 minutes every day on their own, for a period of four weeks using the provided audio file. Participants had continual access to the online instructional module for reinforcement of instructions as needed and were also able to download the audio file to their smartphone if desired. Participants were contacted via email bi-weekly to solicit questions, distribute additional practice tips and instructional materials, and for collection of weekly participant practice logs.

5.7.6 Waitlist control condition. Participants in the control group received only the usual and standard nursing curriculum and no meditation intervention over the course of four weeks. However, at the beginning of the study they were informed that they would receive the meditation training after the conclusion of study and were instructed not to participate in meditation practices until then. Control group participants also received bi-weekly emails to solicit comments and questions and to encourage their continued participation.

5.7.7 Data analysis. Data were analyzed using IBM SPSS Statistics Version 22.0. Descriptive statistics were evaluated for group indicators of central tendency and variability.
Correlations and group comparisons were conducted on all variables. Applicable assumptions of homogeneity tests were established for univariate analyses by non-significant \( p > .05 \) Levene’s test and for multivariate analyses by non-significant \( p > .001 \) Box M. A *Wilks* \( p \) criterion < .05 was the measure of significance for multivariate tests and a \( p < .05 \) for *F* tests in univariate analyses. Effect sizes were examined using Cohen’s (1988) standards for partial eta\(^2\) (\( \eta^2_p \)): small (.01), medium (.06), and large (.14).

To determine if the MM intervention resulted in differences among the two groups in regards to attentional efficiency, a multivariate analysis of co-variance (MANCOVA), in which combined ANT attention network baseline scores were entered as covariates on a combined dependent variable of the three ANT network posttest scores. This was performed in consideration of the aforementioned portion of the literature concluding interdependence of the networks. Employing a parallel logic approach, in consideration of converging neuroimaging data providing opposing evidence for the independence of the networks, analyses of co-variance (ANCOVA) procedures were carried out on each of the ANT network scores of attentional efficiency as well.

In addition, a one-way multivariate analysis of co-variance (MANCOVA) was computed across two groups (MM and control) with PSS-10 and FFMQ baseline scores entered as covariates, and their posttest scores collectively considered as dependent variables. This was conducted to explore notable correlations and significant mean group differences.

5.8 Results

5.8.1 Descriptive findings. Sixty nursing students completed pre-tests however eight did not complete the study; four from each group. Two reported being unable to make time to
meditate daily, one withdrew from the nursing program, and five others were unresponsive to requests for post-testing. Fifty two participants; MM group n = 28, Control group n = 24 were ultimately included in the analysis and groups were well-matched on demographics. Table 5.1 provides the baseline characteristics of the final sample and groups.

Although largely female, the approximate male: female ratio (1:5) of the study sample was representative of the overall population of nursing students (National League for Nursing [NLN], 2013) and of the accessible freshman nursing student population at the research setting. In addition, like other ADN nursing populations (NLN, 2013) more than 50% of students in the study sample reported being over the age of 30. A distinguishing characteristic of note is that the study sample was more racially diverse than reported percentages of minority students enrolled in ADN programs (NLN, 2013) with only 57% of study participants reporting their race as White versus 73% identifying their race as White in national surveys. The demographics of the two groups revealed no statistically significant differences in tests of group comparisons although as noted in Table 5.1 a larger percentage of MM group participants were < 30 years old (54%) than participants in the control group < 30 years old (38%). Also there were four participants in the MM group who reported having prior meditation experience versus none in the control group.
Table 5.1

Demographic Data: Total Sample, Control, Experimental Group and Representative Population

<table>
<thead>
<tr>
<th>Variable</th>
<th>MM Group n = 28</th>
<th>Control Group n = 24</th>
<th>Total Sample N = 52</th>
<th>AD RNa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>23</td>
<td>82.1</td>
<td>20</td>
<td>83.3</td>
</tr>
<tr>
<td>Male</td>
<td>5</td>
<td>17.9</td>
<td>4</td>
<td>16.7</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 30</td>
<td>15</td>
<td>53.6</td>
<td>9</td>
<td>37.5</td>
</tr>
<tr>
<td>31-40</td>
<td>6</td>
<td>21.4</td>
<td>6</td>
<td>25</td>
</tr>
<tr>
<td>41-50</td>
<td>5</td>
<td>17.9</td>
<td>7</td>
<td>29.2</td>
</tr>
<tr>
<td>&gt;51</td>
<td>2</td>
<td>7.1</td>
<td>2</td>
<td>8.3</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>14</td>
<td>50</td>
<td>16</td>
<td>66.7</td>
</tr>
<tr>
<td>AfricanAm</td>
<td>3</td>
<td>10.7</td>
<td>3</td>
<td>12.5</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3</td>
<td>10.7</td>
<td>2</td>
<td>8.3</td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
<td>3.6</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>25.0</td>
<td>2</td>
<td>8.3</td>
</tr>
<tr>
<td>Meditation Experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>14</td>
<td>50.0</td>
<td>12</td>
<td>50.0</td>
</tr>
<tr>
<td>Some</td>
<td>10</td>
<td>35.7</td>
<td>12</td>
<td>50.0</td>
</tr>
<tr>
<td>1X&gt;/ wk</td>
<td>4</td>
<td>14.3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note. MM - Mindfulness meditation group / AD RN = Associate Degree Registered Nurse

a National League for Nursing (2013) Annual Survey of Schools of Nursing Fall 2012 Associate Degree

In examination of correlations, an expected strong negative relationship between FFMQ and PSS-10, $\eta = -0.54$, $p = .000$ was noted, with higher perceived stress associated with less mindfulness characteristics and conversely. Age < 30 also emerged in association with average reaction time (RT) with younger participants being significantly faster (mean difference approximating 98 msec) in pressing the computer arrow key on both pretests of ANT ($p = .012$) and posttests of ANT ($p = .001$). RT on posttests of ANT also demonstrated a positive correlation to posttest executive function scores $\eta = .579$, $p = .000$ as well as posttest ANT accuracy $\eta = .286$, $p = .049$. Although these ANT variables (RT and accuracy) were not under direct study, this information was taken into consideration and discussed as a potential limitation to the interpretation of findings.
Mean scores for all dependent variables and covariates under direct examination in this study are presented for each group in Table 2. The MM group exhibited higher executive function efficiency on both the ANT pretest \( t (50) = 2.39, p = .021 \) as well as posttest of the executive network \( t (50) = 3.26, p = .003 \) as compared to the control group. Statistically significant group mean differences were also revealed on posttests of PSS-10 \( t (50) = 3.09, p = .003 \) and FFMQ \( t (50) = 2.11, p = .04 \) with the MM group having lower stress and higher mindfulness characteristics as compared to the control group following four weeks of the MM intervention. In addition, although not under direct study but in consideration of the above mentioned correlations, overall ANT median reaction time in the MM group was significantly lower on both baseline and post-intervention measurement, whereas ANT accuracy demonstrated no significant group differences.

Table 5.2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mindfulness Meditation Group n = 28</th>
<th>Control Group n = 24</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-intervention Mean</td>
<td>Post-intervention Mean</td>
</tr>
<tr>
<td>ANT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alerting</td>
<td>39.5 (23.9)</td>
<td>38.6 (24.7)</td>
</tr>
<tr>
<td>Orienting</td>
<td>32.9 (23.4)</td>
<td>39.9 (21.4)</td>
</tr>
<tr>
<td>Executive</td>
<td>119.4 (40.7)*</td>
<td>95.9 (28.6)**</td>
</tr>
<tr>
<td>PSS-10</td>
<td>20.9 (6.9)</td>
<td>15.9 (6.7)**</td>
</tr>
<tr>
<td>FFMQ</td>
<td>132.3 (16.6)</td>
<td>140.8 (17.8)*</td>
</tr>
</tbody>
</table>

*Note. ANT - Attention Network Test (as measured in milliseconds) / PSS-10 - Perceived Stress Survey / FFMQ - Five-facet Mindfulness Questionnaire

*Significant group differences by t-test \( p < .05 \) ** Significant group differences by t-test \( p < .01 \)

5.8.2. Findings: Meditation effect on efficiency of attentional processes. Post-test

ANT scores of alerting, orienting, and executive function were entered as a combined dependent variable in MANCOVA analysis while controlling for their combined pre-test scores and these
results are presented in Table 5.3. Using Wilk’s criterion, group differences for the combined DV were non-significant $F(3,45) = 1.16, p = .337$ for the interventional effect of meditation training and practice. This was unchanged after adjustments for differences on either the covariate of perceived stress (PSS-10 pre-test scores) $F(1,47) = 1.18, p = .327$ or that of pre-dispositional mindfulness (FFMQ pre-test scores) $F(1, 47) = 1.24, p = .308$; each run separately. Post hoc univariate analysis and pairwise comparisons on alerting and orienting subsystems were similarly non-significant with or without PSS-10 and FFMQ covariates. Also of note is that post-hoc power of this MANCOVA analysis was very low $= .29$.

Table 5.3

**MANCOVA Results for Posttest Attention Network Scores: Alerting, Orienting, Executive Function**

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>MM Group Mean$^a$ (SE)</th>
<th>Control Group Mean$^a$ (SE)</th>
<th>$F(df)$</th>
<th>$p$</th>
<th>Partial Eta$^2$</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alerting</td>
<td>36.4 (4.1)</td>
<td>38.6 (4.4)</td>
<td>.13 (1,47)$^b$</td>
<td>.72</td>
<td>.003</td>
<td>.07</td>
</tr>
<tr>
<td>Orienting</td>
<td>39.9 (3.8)</td>
<td>37.1 (4.1)</td>
<td>.25 (1,47)$^b$</td>
<td>.62</td>
<td>.005</td>
<td>.08</td>
</tr>
<tr>
<td>Executive Function</td>
<td>102.7 (5.7)</td>
<td>117.9 (6.2)</td>
<td>3.1 (1,47)$^b$</td>
<td>.09</td>
<td>.062</td>
<td>.41</td>
</tr>
</tbody>
</table>

MANCOVA test, Wilks’ Lambda $= .928$ $= .34$ $= .072$ $= .29$

*Note. MM – Mindfulness meditation / Control – No meditation*

$^a$ Means adjusted for baseline alerting, orienting, and executive function scores

$^b$ Multiple comparison tests with Bonferroni correction

To further examine the attention network scores in consideration of their possible independent functionality and ongoing discourse in the literature, an ANCOVA analysis was performed on each network score individually. When adjusted for their corresponding pre-test scores, the alerting and orienting networks of attention continued to demonstrate non-significant group differences: Alerting $F(1, 49) = .000, p = .996$; Orienting $F(1, 49) = .79, p = .378$. These were relatively unchanged when PSS-10 or FFMQ baseline scores were entered as additional covariates. However, scores on posttests of executive function efficiency did vary significantly.
by group $F (1, 49) = 4.26, p = .044$, and the strength of the relationship between group assignment and intervention was moderate $\eta_p^2 = .080$. Participants in the MM group had more improvement to executive attention than those in the control group with an adjusted mean difference between of 17.4 (SE= 8.42), and 95% confidence interval (CI) ranging from .462 to 34.3. However, post-hoc power analysis of this computation was low = .53. The addition of PSS-10 and FFMQ scores as covariates produced similar findings on executive function. With PSS-10 pre-tests removed, $F$ tests of executive function were significant at $p = .042$ and with FFMQ removed, $p = .039$. Under all conditions, the MM intervention demonstrated moderate effect on executive function ($\eta_p^2$ ranging from 0.080 – 0.086) but low power (.53 - .55).

5.8.3 Findings: Meditation effect on perceived stress and mindfulness. An additional MANCOVA inquiry into the effect of MM on perceived stress and mindfulness characteristics was undertaken to further explore these negatively correlated variables using pretests as covariates. Using Wilks criterion, the combined DV of PSS-10 and FFMQ posttest scores were significantly related to group assignment $F (2,47) = 7.16, p = .002$ and the strength of this relationship was very large $\eta_p^2 = .234$. Participants in the MM group had significantly higher scores on measurements of mindfulness characteristics after four weeks of meditation and in negative correlation, significantly less perceived stress as outlined in Table 5.4.
Table 5.4.

**MANCOVA Results for Posttests of Perceived Stress and Mindfulness**

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>MM Group Meana (SE)</th>
<th>Control Group Meana (SE)</th>
<th>F(df)</th>
<th>p</th>
<th>Partial Eta2</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Stress</td>
<td>15.8 (1.01)</td>
<td>21.3 (1.09)</td>
<td>14.18(1,48)b</td>
<td>.000</td>
<td>.228</td>
<td>.96</td>
</tr>
<tr>
<td>PSS-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mindfulness</td>
<td>140.3 (2.43)</td>
<td>131.0 (2.62)</td>
<td>6.64 (1,48)b</td>
<td>.013</td>
<td>.121</td>
<td>.71</td>
</tr>
<tr>
<td>FFMQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MANCOVA test</td>
<td>Wilks’ Lambda = .766</td>
<td>7.16 (2,47)</td>
<td>.002</td>
<td>.234</td>
<td>.92</td>
<td></td>
</tr>
</tbody>
</table>

*Note. PSS-10 – Perceived stress survey – 10 item version / FFMQ- Five-facet mindfulness questionnaire

*Means adjusted for baseline FFMQ and PSS-10 scores

*Multiple comparison tests with Bonferroni correction

5.9 Discussion

When the attention network scores were treated as a combined dependent variable in MANCOVA, no significant group differences in attention were detected. This may partially be explained by the study’s small sample size; a large sample being a requirement of the more powerful multivariate analysis, or as noted previously, a condition of statistical choice subsumed in a yet to be resolved uncertainty as to the relative independence or non-independence of the three attentional networks. Also of note are the ANT features, which by design produces separate efficiency scores for each subsystem of attention and was originally created under the premise that the “three networks are uncorrelated” (Fan et al., 2002, p.340). It is possible that a statistical composite approach was incongruent to its design. Confidence in the significant findings on executive function efficiency from separate ANCOVA analysis of the three network scores is similarly limited by the ongoing discourse over possible correlations between the attention networks and conversely strengthened by its fit to the ANT design. Of note is that the observed post-intervention improvement to executive function noted in MM group participants are similar to other experimental studies reporting enhanced ANT executive function scores for healthy adult participants in mindfulness meditation intervention groups (Jha et al., 2007; Tang...
et al., 2007; Van den Hurk et al., 2010) as well as other tests of executive function (Chan & Woollacott, 2007; Kozasa et al., 2012; Zeiden et al., 2010).

An alternative explanation for this significant finding on executive function rather than on alerting or orienting subsystems may somewhat rest in their ANT reliability scores which in this study, as measured by Cronbach alpha were: Alerting .61, Orienting .60, Executive Function .73. Fan and colleagues (2002) noted similar Cronbach alphas: Alerting .42, Orienting .61, Executive Function .84. Also, although group differences were not statistically significant ($p = .013$), the demographics of the meditation group contained four participants who, prior to the start of the study, reported being experienced in meditation (meditated at least once per week). Some possibility of inflation of results should be taken into consideration in that experienced meditators may possibly have had higher intervention fidelity. Also to note is the previously mentioned correlation between age < 30 and faster overall ANT reaction time. Approximately fifty-four percent of the MM group were <30 in contrast to thirty-eight percent of age <30 control group participants. Although group differences for age were determined not to be statistically significant $p = .256$, and exploration of age as an additional covariate maintained the significance of ANCOVA findings, it bears mentioning in light of other positive correlational findings between overall RT, posttest executive function scores and overall posttests of ANT accuracy. In essence, a greater percentage of younger participants in the MM group, reacting faster and more accurately, may have been reflected in observed group differences in executive attention scores.

Overall, this first study, specific to nursing students, of meditation and attention provides some beginning suggestive evidence of the benefits of cognitive training in the form of MM as compared to standard nursing education for enhancing the efficiency of executive functions of
attention. In that the study sample was small and therefore under-powered, this interpretation is not considered confirmative, but rather, informative and useful in preparing further investigation into the interventional effect of meditation on attention regulation outcomes in nursing students.

5.9.1 Implications for executive attention outcomes and safety. Enhanced efficiency of executive attention may be an important finding to consider in the context of nursing work and safe patient care. Executive control is the type of cognitive processing that occurs during decision-making, trouble-shooting, and for planning actions that help one notice novelty and error in situations, and reduce the tendency toward habituated routine responses. It is known to be an important attentional operator under technically difficult conditions and is described as having purposeful, supervisory characteristics that are in contrast to other attentional components like alerting and orienting known to be more automatic (Norman & Shallice, 1980). This type of conscious management of attention forms a corollary between executive functions and the situational awareness (SA) used in the cognitive work of nursing, which as previously noted, is closely linked to safety. In the context of nursing, SA has been defined by Sitterding and colleagues (2012) as the perception of relevant patient and/or environmental cues, comprehension of their meaning and salience, and mental planning of needed actions based on those cues. It has also been described as the “ability to be aware of the local and meta-environment of the workplace while operating within it…” (Fryer, 2012). This cognitive flexibility, necessary for monitoring, noticing, and prioritizing attention efficiently among multiple and different sources of stimuli, are components of both executive attention and situational awareness. These features assist nurses to manage cognitive load and avoid attention tunneling (Sitterding et al., 2012) and to instead remain vigilantly watchful of both patient as well as the care environment. The supervisory functions of the executive network seem to
underlie the cognitive open-monitoring and keen mental acuity needed for situational awareness and the attention to complexity required in the delivery of safe patient care.

5.9.2 Implications for mindfulness outcomes and safety. The statistically significant group differences and moderate sized increase in mindfulness characteristics found in the experimental group may have bearing on the preparation of safe healthcare practitioners as well. At its core, the trait of mindfulness carries with it a heightened monitoring ability and its tenets: intention, attention, openness, curiosity, and non-judgment are similar to the features of executive functioning and situational awareness in that they all require a conscious purposeful attention to both internal and external stimuli, an open-monitoring of the environment, noticing of distraction (or error), and cognitive flexibility. Interestingly, heightened present moment awareness—descriptive of mindfulness practitioners— is also known to stimulate similar regions of the brain (prefrontal cortex) that are activated by executive attention functions (Epstein, Siegel, Silberman, 2008).

Of further note are recent nursing studies which have begun to examine the impact of training healthcare workers in mindfulness meditation on outcomes of patient safety. Brady and colleagues (2012) noted a decrease in patient safety events on a behavioral health unit after MBSR training of a group (n = 16) of nurses and other healthcare workers. A similar upward trend in patient safety was observed by Hallman and colleagues (2014) who, after MBSR training of nursing staff (n=13) reported decreased violent patient behaviors as evidenced by less 1:1 staffing needs and reduced use of restraints.
Improving the mindfulness characteristics of healthcare workers may have a positive correlation to improved indicators of patient safety. These interactions are an interesting topic for further inquiry in both nurse and nursing student populations.

5.9.3 Implications for perceived stress outcomes and safety. The notable reduction in perceived stress by students in the experimental group coincides with the above mentioned increase in mindfulness and may have implications for safety as well. The effect of stress on human performance is well-studied, and in a seminal review of literature, Cohen (1980) outlined multiple research findings demonstrating the impact of stress on error-making, as well as its possible mediation by perceived personal control. Evidence from several studies suggested that participants with a higher self-belief in being able to manage their stress were indeed able to do so, and were more accurate in the performance of cognitive and technical tasks (Cohen). Stress is associated with patient errors in that it impedes accurate decision making and cognitive processing, yet has been historically downplayed as something that healthcare workers are expected to somehow, and independently, become accustomed to (Sexton, Thomas, & Helmreich, 2000). This is an untenable notion however, and as Sexton and colleagues note a “healthy recognition of stressor effects” (p.747) is necessary to effectively reduce error.

This study’s findings on the positive interventional effects of MM in reducing stress are consistent with those of other studies involving nursing students such as one conducted by Beddoe and Murphy (2004) in which 16 students improved on dimensions of stress following an eight week MBSR course and that of Jain and colleagues (2007) who in a mixed sample of 104 healthcare students (including nursing) reported significant decreases in distractive and ruminative thoughts associated with decreased stress after MBSR. More recently Song and
Lundquist (2014) reported significant outcomes for decreased stress in a randomized controlled trial of 44 nursing students post MBSR.

In addition to obvious self-care stress-reduction health benefits for nursing students, an intervention such as MM that shows promise as a means of gaining self-regulatory control of stress may be a useful tool for improving patient safety. This connection is in need of further study.

5.10 Limitations of the Study

A recognized limitation of this study was its small sample size. Observed power on non-significant MANCOVA tests was low indicating an average 70% risk of Type II error and the potential of a false negative conclusion on those results. Power analyses on significant executive attention ANCOVA results were also low (.53 -.55), limiting the probability of those results reflecting true group differences to approximately 50%. This should be taken into consideration when interpreting the moderate effect size demonstrated on those $F$ tests ($\eta_p^2 = .080 - .086$) possibly truncated by small sample size.

An additional concern for statistical conclusion validity was treatment adherence by the meditation group participants. Although 86% of MM participants reported meditating five to seven days per week (indicating satisfactory treatment adherence), 14% of the MM group reported meditating only three to four days per week. Although even brief (three to four times / week) meditation training is supported in the literature as effective for enhancing attention outcomes (Tang et al., 2007; Zeidan et al., 2010), the possibility of some restriction on study results is possible. Also of note were possible issues of treatment fidelity in that the intervention was an online learning module with independent meditation practice. Factors of variance beyond
anticipation or researcher ability to control may have occurred that were unpredicted or unknown.

Additionally, although a testing effect was unlikely with the functional task of the ANT, a potential for sensitization from pre-test-posttest sessions on self-report measurement tools such as the PSS-10 and FFMQ poses a possible threat to internal validity. In addition, as with many interventional studies, a Hawthorne effect should also be considered in the interpretation of results. Also, in terms of external validity, this study was carried out with a demographically specific first year associate-degree nursing student population which may limit its generalizability of findings.

5.11 Suggestions for Implementation and Future Research

For future students a hybrid online course integrating occasional face-to-face meetings may be a good way to carry-out implementation of this MM intervention in nursing curriculum going forward. This would allow for improved treatment fidelity and was something that participants expressed a desire for in a post-intervention survey. This design would also allow for the use of a more comprehensive MBSR training program as the interventional modality which was not available in online format at the time of this study. Future research using this longer (eight week) intervention and expansion on training could yield additional data on the benefits of a full mindfulness meditation program for enhancing attention in nursing students. Additional research on the impact of MM on safety in nursing practice at the point of care – perhaps in simulation exercises – is also necessary to further investigate the correlation between attentional efficiency and direct patient-related outcomes.
5.12 Conclusion

The results of this study suggest cognitive training in the form of MM may possibly hold promise as a method of enhancing the executive attention efficiency of pre-licensure RN students. These preliminary findings, from a first-known study of the interventional effect of MM on attentional efficiency in a specific population of pre-licensure nursing students, will require further investigation and replication. Other significant study findings support the integration of MM training into nursing curriculum for the development of mindfulness characteristics as well as for a self-regulating stress reduction benefit that may have implications for patient safety as well. A convergence of these three outcomes may help nurse educators in their quest to cultivate more intrinsically safe nurses of the future.
References


CHAPTER 6

6.0 ADDITIONS

6.1 Introduction

In this chapter some additional components of the dissertation study are discussed: exploration of research question #2, medication administration task (MAT) results, post-intervention survey results, additional implications, and closing procedures. Results from the pre-post-testing on MAT were not included in the Chapter 5 manuscript of the study findings and discussion due to notable limitations to this researcher-designed tool. Reliability concerns, combined with non-significant MAT findings, were taken into consideration when deciding to omit research question #2 and MAT results from the manuscript as potentially confounding to the reader. Similarly, discussion of some components of the post-intervention survey and inclusion of closing procedure details were edited from the manuscript as non-essential to readers. Discussion on these elements of the dissertation study is provided in the following sections.

6.2 Research Question 2

In this proxy-for-practice situation, the effect of meditation training and practice on measurements of accuracy in performance of a medication administration task (MAT) under conditions of distraction, time constraint, and interruption was explored as a secondary variable in this study to answer the research question: What is the effect of cognitive training in the form of MM as compared to standard nursing education on posttests of accuracy in performance of a nursing skill (simulated medication measurement under conditions of time-constraint, distraction, and interruption) in pre-licensure nursing students while controlling for baseline
measurement of nursing skill accuracy? Also, what effect, if any would the influence of pre-dispositional mindfulness or perceived stress have on accuracy outcomes was explored for potential confounding influence on MAT outcomes.

6.3 Instruments

The Medication Administration Task (MAT) was a cognitive-behavioral task designed by the researcher to examine performance of a physical nursing skill requiring focused attention. It involved having participants draw up five simulated medication amounts into five needleless syringes and was selected for its proxy-to-practice application of the attentional demands required of nurses in the workplace. The test was timed (45 seconds) to provide pressures of time constraint and also included distractions (visual and auditory) and interruption, and was scored on a scale of 0-5.

Participants were provided five syringes labeled with a patient number 1-5 using five different colors. Written orders for each patient were in non-corresponding colors and participants were instructed to draw up the correct amount of air in each syringe corresponding to each patient number. During the 45 seconds of task time a recording of simulated healthcare setting noises (equipment alarm bells, conversations, overhead pages, etc.) was played as auditory distraction. In addition, research assistants continuously walked around the testing room, coming close to the participant desk to provide visual distraction to the task. Twenty seconds into the task time the participant was momentarily interrupted by an announcement asking them to draw their attention to a message written on poster board. Performance was assessed by counting the amount of accurately drawn up syringes (0-5) at the end of 45 seconds.
Incomplete syringes were marked as inaccurate. Reliability scoring for this tool in post hoc analysis was low Cronbach alpha = .29.

The *Perceived Stress Scale-10 Item Version* (PSS-10) (Cohen, Kamarck, & Mermelstein, 1983) was used to assess each participant’s perception of their stress level to explore for any confounding influence of such characteristics on the main attention dependent variables. The PSS-10 is a widely used 5-point Likert scale used in several disciplines: health, psychology, sociology with a high reported internal consistency (Cronbach alpha = .86) (Cohen et al., 1983). The survey consists of ten questions about a person’s thoughts and feelings in response to stress perception and Cohen and colleagues report an established PSS-10 standard mean score of 14. Post hoc reliability measurement of this tool revealed a Cronbach alpha = .73

The *Five-Fact Mindfulness Questionnaire* (FFMQ) (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) was used to measure individual variances in pre dispositional mindfulness to evaluate potential effect on the main attention dependent variables. The FFMQ has been used in many recent studies of mindfulness with reported high reliabilities ranging between .92 (Baer et al, 2008) and .90 (deBruin et al., 2012). It is comprised of 39 items, rated on a 5-point Likert scale and assesses several facets of mindfulness: observing, describing, acting with awareness, non-judging, and non-reactivity. Baer et al. (2006) report the FFMQ established standard mean score of 130. In post hoc analysis, Cronbach alpha of the FFMQ for this study = .92.

### 6.4 Data Analysis

Data were analyzed using IBM SPSS Statistics Version 22.0. Descriptive data were evaluated for group indicators of central tendency and variability. Correlations and group comparisons were conducted on all variables. Applicable assumptions of homogeneity tests were
established for univariate analyses by non-significant \( p > .05 \) Levene’s test. The measure of significance for \( F \) tests was \( p < .05 \). Effect sizes were examined using Cohen’s (1988) standards for partial \( \eta^2 \): small (.01), medium (.06), and large (.14). To determine if the MM intervention resulted in differences among the two groups in regards to nursing skill accuracy, analysis of covariance (ANCOVA) was carried out with baseline MAT scores entered as covariates and MAT posttest scores as the dependent variable.

6.5 Results

6.5.1 Descriptive findings. Sixty nursing students completed pre-tests however eight did not complete the study; four from each group. Two reported being unable to make time to meditate daily, one withdrew from the nursing program, and five others were unresponsive to requests for post-testing. Fifty two participants; MM group \( n = 28 \), Control group \( n = 24 \) were ultimately included in the analysis and groups were well-matched on demographics.

Both groups improved in MAT performance as visible in Table 6.1 but this change was statistically non-significant. In the analysis of normality, both pre and post MAT scores were identified as strongly non-normal with pre-MAT scores skewed and post MAT scores having extreme outliers as visible in Figure 6.1. There were no statistical options deemed appropriate for transformation of this non-normality so continued analysis was approached with that violation under consideration.
Table 6.1.

*Means (SD) of outcome variables at baseline and post-intervention*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mindfulness Meditation Group n = 28</th>
<th>Control Group n = 24</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-intervention</td>
<td>Post-intervention</td>
</tr>
<tr>
<td>MAT</td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>2.9 (1.7)</td>
<td>4.1 (1.7)</td>
</tr>
<tr>
<td>PSS-10</td>
<td>20.9 (6.9)</td>
<td>15.9 (6.7)**</td>
</tr>
<tr>
<td>FFMQ</td>
<td>132.3 (16.6)</td>
<td>140.8 (17.8)*</td>
</tr>
</tbody>
</table>

*Note.* MAT – Medication administration test / PSS-10 – Perceived stress survey 10-item version / FFMQ – Five-facet mindfulness questionnaire

Figure 6.1.

*Medication Administration Task Pre and Post Test Scores*

6.5.2 Findings: Meditation effect on accuracy in performance of a nursing skill.

Post-test MAT scores were analyzed by ANCOVA controlling for pre-test MAT scores and results outlined in Table 6.2. No statistically significant main effect of meditation was found nor was there a significant interaction between group status and meditation. This held true even when adjusted for PSS-10 or FFMQ scores.
Table 6.2
ANCOVA Results for Posttest Medication Administration Task (MAT)

<table>
<thead>
<tr>
<th>Pre-Test Covariate</th>
<th>Mindfulness Meditation Group Meana (SE)</th>
<th>Control Group Meana (SE)</th>
<th>$F$ (df)</th>
<th>$p$</th>
<th>Partial Eta$^2$</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT</td>
<td>3.99 (.29)</td>
<td>3.59 (.31)</td>
<td>.842 (1,49)</td>
<td>.363</td>
<td>.017</td>
<td>.15</td>
</tr>
<tr>
<td>MAT + PSS-10</td>
<td>3.98 (.29)</td>
<td>3.61 (.31)</td>
<td>.701 (1,48)</td>
<td>.407</td>
<td>.014</td>
<td>.13</td>
</tr>
<tr>
<td>MAT + FFMQ</td>
<td>4.01 (.28)</td>
<td>3.57 (.31)</td>
<td>1.10 (1,48)</td>
<td>.300</td>
<td>.022</td>
<td>.18</td>
</tr>
</tbody>
</table>

Note. PSS-10 – Perceived stress survey 10 item version / FFMQ – Five-facet mindfulness questionnaire

Means adjusted for associated pretest covariate(s)

6.6 Discussion on Limitations of MAT Findings

Due to the limitations of MAT data as described above as well as questions regarding its reliability as a researcher-designed measurement tool (Cronbach alpha analysis = .291), a decision was made to not include its results in the Chapter five manuscript as it was uninformative and possibly confounding to readers. There was also unexpected variability introduced into the implementation of MAT testing sessions in that research assistants reported having sporadic problems with supplied speakers to play the required audio of hospital sounds and on at least 4 occasions had to use their personal smartphone speaker to play that audio file. The difference in volume would have supplied a lower degree of distraction to participants than intended. Also of note was the distinct possibility that students, in their natural progression of nursing studies, gained skill in syringe manipulation and medication order interpretation more than was expected in the planning of this study and this contributed to a practice effect on posttests. A compensatory or novelty effect should also be considered in that the unique challenges of the MAT skill were met by many students with a degree of surprise when presented during pretest session, possibly motivating them to enhance their efforts during post-testing. Although this measure did not produce significant results, a future study might be
designed with a more complex proxy for practice simulation to re-investigate the impact of MM on accuracy in performance of a nursing skill and to also explore other behavioral measures of thinking in action skills of nurses and nursing students.

6.7 Post-intervention Survey: Participant Comments

Through post-interventional surveys the majority of participants in the MM group reported satisfaction with the intervention and the online training modality using the guided audio file stating it was easily accessible, practical, and convenient. Common impressions of the perceived usefulness of MM were that it helped with achieving better “focus” before class and clinical, “control” of attention and regulation of distractions, and that it helped participants to feel “more relaxed”, “calm” and “less stressed”. Only one MM participant reported not liking the meditation but offered no elaboration. Two participants expressed interest in having face-to-face meditation sessions and one suggested having more variety of choice in meditation audio file options. Many participants in the MM group expressed enthusiasm about continuing their MM practice. An information sheet prepared by the primary investigator on ways to extend their practice of mindfulness and MM was therefore distributed to them.

6.8 Closing Procedures

All participants in the waitlist control group were contacted and provided access to the online MM training module, guided meditation audio file, and all materials provided to the MM group. They were encouraged to contact the primary investigator with questions and/or comments. Following the close of the study all 52 participants received a $10.00 Amazon e-certIFICATE sent directly to their email. In addition a random drawing was conducted and two participants were each awarded an iPad Mini®.
6.9 Additional Comments

6.9.1 Implication of mindfulness and stress outcomes for empathy building. As noted in the review of literature manuscript discussion in Chapter 2, enhanced mindfulness and decreased stress may play a part in improving patient safety and are topics in need of additional research. Another purported benefit of integrating mindfulness based practice into healthcare education is its possible implications for increasing empathetic attitudes – this also framed as caring or compassion. These outcomes have been observed in several interventional studies of mindfulness practices. (Cohen-Katz et al., 2005; Jain et al., 2007; Newsome et al., 2012; Oman et al., 2008; Shapiro, 2005) and deserve mention. The nurse or nursing student who works to build a regular daily routine of MM and a genuine embodiment of mindfulness tenets may simultaneously cultivate a more therapeutic caring practice toward others and also have a positive method of restorative self-care for themselves as well. Indeed, the principles and techniques of MM and mindfulness practices seem acutely aligned with an image of the nurse, as described in Jean Watson’s Theory of Human Caring (2002), as a caring agent in attentive presence with patients as well as self.

Similarly stress and empathy appear intertwined, with Cohen (1980) noting that persons with higher levels of perceived stress also “have a decreased sensitivity to others” (p.95) and a link between reduction of stress through mindfulness practices and enhanced caring attitudes is supported by other nursing research (Beddoe & Murphy, 2004; Cohen-Katz et al., 2005). Mindfulness practices for the reduction of stress, has been associated with improved feelings of well-being and compassion as noted by Rajagopal and colleagues (2012), and also for its possible mental-health benefit useful in mediating the frequently reported stress (Moscaritolo, 2009; Shirey, 2007) of students enrolled in rigorous nursing studies. The importance of such
self-care correlates have been highlighted in the Quality and Safety Education for Nurses (QSEN) learning module (Ironside, n.d.) as well as in the Agency for Healthcare Research and Quality publications (Rich, 2008) in description of exemplary nurse practice. In guiding the development of new nurses, educators can help students envision the importance of self-care practices like MM, not only for personal benefit, but also for the equated value it extends to their care of others.

6.9.2 Implementation and future research. As noted in the findings and discussion manuscript in Chapter 5, a hybrid online course for integration of mindfulness practices into nursing curriculum may be a feasible inclusion for nursing education and be suitable for the type of personal integration into daily practice most beneficial to its embodiment. The online modality and use of smartphone technology was well-accepted by nursing students and one that would not add excessive burden to nursing curriculum’s already content-laden nature. Other feasible applications to be examined are the incorporation of brief sessions of MM into nursing course work (such as prior to exams), as a technique for use prior to entering a simulation exercise and/or the clinical practice, and most importantly as a component of nursing student’s daily personal practice. Future research should also examine the usefulness of MM training for practicing nurses, who, like nursing students, have not been the focus of meditation and attention studies. Findings linking MM with enhanced attention as well as other outcomes such as decreased stress, caring, self-compassion, empathy, and mindfulness deserve further investigation in both participant groups. Also important to building the body of knowledge on quality and safety in nursing practice is further exploration into thinking-in-action skills and measuring nurse cognition and attention at the point of care.
References


dissociated from target detection in human posterior parietal cortex. Nature Neuroscience
3(3), 292-297. doi:10.1038/73009

Shephard, G. (2010). Transforming nursing workflow, part I: The chaotic nature of nurse
activities. Journal of Nursing Administration, 40(10), 432-439. doi:
10.1097/NNA.0b013e3181f2eb3f

for rapid visual information processing: A PET study of sustained attention and working

Cronenwett, L., Sherwood, G., & Gelmon, S. B. (2009). Improving quality and safety education:
The QSEN learning collaborative. Nursing Outlook, 57(6), 304-312. doi:
10.1016/j.outlook.2009.09.004

Davidson, R.J., Kabat-Zinn, J., Schumacher, J., Rosenkranz, Muller, D., Santorelli, S.,...Sheridan,
J.F. (2002). Alterations in brain and immune function produced by mindfulness
meditation. Psychosomatic Medicine 65(4)564-70. doi:
10.1097/01.PSY.0000077505.67574.E3

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2944261/?_escaped_fragment_=po=81.2
500


Sexton, J., Thomas, R., & Helmreich, R. (2000). Error, stress, and teamwork in medicine and


Appendix A
Informational Flyer

Volunteers Needed for Research Study

Participants needed for a research study: “Enhancing nursing skills through cognitive training”

Description: We are researching the effects of four weeks of online cognitive training on the development of nursing skills deemed necessary for clinical practice.

This training will consist of online modules delivered via email and/or text messaging and participants will conduct all training asynchronously on their own personal computer and/or smartphone during times convenient to them. It will also require 10 minutes of meditation daily for a period of four weeks.

At the beginning and end of the four week period, participants will be asked to participate in a 70-minute session in which they will complete a functional task using a computer monitor and keyboard, carry out a one-minute nursing skill, and complete two to three online surveys.

To participate: You must be a currently enrolled in Fundamental of Nursing and Nursing Success classes at Suffolk County Community College, read and understand English, and be 18 years or older. You also must have daily access to a personal computer and/or smartphone with reliable internet access.

You will be receiving an email from the project manager within the next 24 hours with a list of dates, times, and location of pre-testing session. If you decide to participate, please sign up for one of them as soon as you receive that email.

All participants who complete the study requirements will receive a $10.00 gift certificate to Amazon.com and be entered for a chance to win one of two Ipad Minis®

This research has been reviewed and approved by the Suffolk County Community College and Duquesne University Institutional Review Boards.
Appendix B
Consent Form

DUQUESNE UNIVERSITY
600 FORBES AVENUE ♦ PITTSBURGH, PA 15282

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE: “Enhancing nursing skills through cognitive training”

PRIMARY INVESTIGATOR: Kathleen G. Burger MS Ed, MSN, RN, CNE
Suffolk County Community College
Michal J. Grant Campus - HSE MA200
Brentwood, NY 11717 (631) 851-6439

ADVISOR: Joan Such Lockhart PhD, RN, CORLN, AOCN, CNE, ANEF, FAAN
Professor and Associate Dean for Student Affairs- Nursing
Duquesne University School of Nursing- 542C Fisher Hall
600 Forbes Avenue, Pittsburgh, PA 15282 (412) 396-6540

PROJECT MANAGER: Natalie Dubas, RN
1407 Brooklyn Blvd
Bay Shore, NY 11796 (631) 894-2405

SOURCE OF SUPPORT: This study is being performed as partial fulfillment of the requirements for the doctoral degree in nursing at Duquesne University.

PURPOSE: You are being asked to participate in a research project that seeks to investigate the effects of online cognitive training on the development of nursing skills. You will be randomly assigned to either a group in which you will learn cognitive skills deemed necessary for clinical practice and meditate daily for a period of four weeks or be assigned to a wait-list control group which will be offered the cognitive training modules at the end of the study. At the start and end of the four week period you will be asked to participate in a 70-minute session to complete a functional task using a computer monitor and keyboard, a one-minute nursing skill, and two to three online surveys. All training components of this study will be completed using online modalities such as email and/or text messaging and during times convenient to you and using your home computer and/or your smartphone. These are the only requests that will be asked of you.

RISKS AND BENEFITS: Participation in this study poses minimal risk to you but no greater than that encountered in everyday life such as fatigue. A positive benefit from the training modules is a possible outcome. In addition, your
participation in this study may also help identify and enhance the instructional strategies employed in nursing curriculum.

**COMPENSATION:** Participation in this study will require no monetary cost to you. Upon completion of all components of the study you will receive a $10.00 gift certificate to Amazon.com in appreciation of your time and four week participation and your name will be entered for a chance at winning an iPad Mini®.

**CONFIDENTIALITY:** A project manager (outside the department of nursing) will collect and retain this consent form containing your name. These will be stored in a locked file in the project manager’s office and not accessible to the principal investigator. You will be given a non-identifiable numeric code for the purposes of this project and your name will remain anonymous to the principal investigator throughout the research study. Your name will not appear on any research instruments, data analysis, or in publication and this consent form and any name-identifiable records will be destroyed at research completion.

**RIGHT TO WITHDRAW:** You are under no obligation to participate in this study and free to withdraw your consent to participate at any time. Regardless of whether you participate in this study, decide not to participate, or withdraw from the study at a later time, there will be no effect on your course grade(s) or your progression in the nursing program.

**SUMMARY OF RESULTS:** At the conclusion of the study a summary of the results of this research will be supplied to you, at no cost, upon request.

**VOLUNTARY CONSENT:** I have read the above statements and understand what is being requested of me. I also understand that my participation is voluntary and that I am free to withdraw my consent at any time, for any reason. On these terms, I certify that I am willing to participate in this research project. I understand that should I have any further questions about my participation in this study, I may call:

- Kathleen Burger; Principal Investigator (631) 851-6439
- Dr. Joan Such Lockhart; Advisor (412) 396-6540
- Natalie Dubas; Project manager (631) 894-2405
- Dr. Linda Goodfellow; Chair of the Duquesne University Institutional Review Board (412) 396-6548

Participant's Signature ______________________ Date ______________________

Kathleen Burger

Researcher's Signature ______________________ Date ______________________
Appendix C
Demographic Survey

1. Are you currently enrolled in your 1st semester of nursing courses and taking the nursing course entitled: Fundamentals of Nursing?
   - Yes
   - No

2. Are you male or female?
   - Male
   - Female

3. Which category below includes your age?
   - 18-30
   - 31-40
   - 41-50
   - 51 or older

4. Which of the following options best describes your race/ethnicity?
   - White
   - Black or African-American
   - Spanish, Hispanic, or Latino
   - American Indian or Alaskan Native
   - Asian
   - Native Hawaiian or other Pacific Islander
   - From multiple races

5. Which of the following best describes your experience with syringes?
   - None. I have never learned how to use a syringe.
   - I have learned how to draw up medication in a syringe but do not regularly do so
   - I know how to draw up medication in a syringe and do it at least once a month.

6. Which of the following best describes your previous experience with meditation?
   - None. I have never meditated
   - I’ve tried it but do not regularly meditate
   - I meditate at least once a week
Appendix D
Post-Intervention Survey

I was assigned to:
☐ The mindfulness meditation group
☐ The control group

1. How many times per week (on average) did you meditate?
   ☐ None. I did not meditate
   ☐ 1-2 times per week
   ☐ 3-4 times per week
   ☐ 5 times per week
   ☐ Every day

STOP HERE if you were a participant in the control group

2. What were your impressions of the usefulness of mindfulness meditation in preparing you for clinical nursing practice?

3. What were your impressions of the practicality on the online mindfulness meditation training program?

4. What other comments do you have about the mindfulness meditation training and practice?
Appendix E
Attention Network Test – Experimental Procedure and Scoring

Mean network effect scores in msec:
Alerting 47
Orienting 51
Executive 84

Retrieved from Jin Fan PhD website http://icahn.mssm.edu/research/labs/neuroimaging-laboratory/facilities with permission to use.
Appendix F
Medication Administration Test – Procedural Components

Patient A: 2 mL
Patient B: 0.8 mL
Patient C: 1.2 mL
Patient D: 2.6 mL
Patient E: 1.4 mL
Appendix G
Perceived Stress Scale – 10

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling how often you felt or thought a certain way.

0 = Never / 1 = Almost Never / 2 = Sometimes / 3 = Fairly Often/ 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly? ..............................0 1 2 3 4

2. In the last month, how often have you felt that you were unable to control the important things in your life?.........................0 1 2 3 4

3. In the last month, how often have you felt nervous and “stressed”? ..........................................................0 1 2 3 4

4. In the last month, how often have you felt confident about your ability to handle your personal problems? .........................0 1 2 3 4

5. In the last month, how often have you felt that things were going your way?.......................................................0 1 2 3 4

6. In the last month, how often have you found that you could not cope with all the things that you had to do? ......................0 1 2 3 4

7. In the last month, how often have you been able to control irritations in your life?........................................... ..............0 1 2 3 4

8. In the last month, how often have you felt that you were on top of things?.........................................................0 1 2 3 4

9. In the last month, how often have you been angered because of things that were outside of your control? ......................0 1 2 3 4

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? ..........0 1 2 3 4

Scoring: PSS scores are obtained by reversing responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1 & 4 = 0) to the four positively stated items (items 4, 5, 7, & 8) and then summing across all scale items. A short 4 item scale can be made from questions 2, 4, 5 and 10 of the PSS 10 item scale.

The PSS Scale is reprinted with permission from Cohen, S., Kamarck, T., and Mermelstein, R. (1983)
Appendix H
Five Facet Mindfulness Questionnaire

Please rate each of the following statements using the scale provided:

1 never or very rarely true / 2 rarely true / 3 sometimes true / 4 often true / 5 very often or always true

Write the number in the blank that best describes your own opinion of what is generally true for you.

_____ 1. When I’m walking, I deliberately notice the sensations of my body moving.
_____ 2. I’m good at finding words to describe my feelings.
_____ 3. I criticize myself for having irrational or inappropriate emotions.
_____ 4. I perceive my feelings and emotions without having to react to them.
_____ 5. When I do things, my mind wanders off and I’m easily distracted.
_____ 6. When I take a shower or bath, I stay alert to the sensations of water on my body.
_____ 7. I can easily put my beliefs, opinions, and expectations into words.
_____ 8. I don’t pay attention to what I’m doing because I’m daydreaming, worrying, or otherwise distracted.
_____ 9. I watch my feelings without getting lost in them.
_____ 10. I tell myself I shouldn’t be feeling the way I’m feeling.
_____ 11. I notice how foods and drinks affect my thoughts, bodily sensations, and emotions.
_____ 12. It’s hard for me to find the words to describe what I’m thinking.
_____ 13. I am easily distracted.
_____ 14. I believe some of my thoughts are abnormal or bad and I shouldn’t think that way.
_____ 15. I pay attention to sensations such as the wind in my hair or sun in my face
_____ 16. I have trouble thinking of the right words to express how I feel about things
_____ 17. I make judgments about whether my thoughts are good or bad.
_____ 18. I find it difficult to stay focused on what’s happening in the present.
_____ 19. When I have distressing thoughts or images, I “step back” and am aware of it without getting taken over by it.
_____ 20. I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.
_____ 21. In difficult situations, I can pause without immediately reacting.
22. When I have a sensation in my body, it’s difficult for me to describe it because I can’t find the right words.

23. It seems I am “running on automatic” without much awareness of what I’m doing.

24. When I have distressing thoughts or images, I feel calm soon after.

25. I tell myself that I shouldn’t be thinking the way I’m thinking.

26. I notice the smells and aromas of things.

27. Even when I’m feeling terribly upset, I can find a way to put it into words.

28. I rush through activities without being really attentive to them.

29. When I have distressing thoughts or images I am able just to notice them without reacting.

30. I think some of my emotions are bad or inappropriate and I shouldn’t feel them.

31. I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow.

32. My natural tendency is to put my experiences into words.

33. When I have distressing thoughts or images, I just notice them and let them go.

34. I do jobs or tasks automatically without being aware of what I’m doing.

35. When I have distressing thoughts or images, I judge myself as good or bad, depending what the thought/image is about.

36. I pay attention to how my emotions affect my thoughts and behavior.

37. I can usually describe how I feel at the moment in considerable detail.

38. I find myself doing things without paying attention.

39. I disapprove of myself when I have irrational ideas.

Scoring:
