Differential Effectiveness of Sitting Meditation Program and Movement Meditation Program in Reducing College Students' Cognitive and Somatic Trait Anxiety

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ABSTRACT

A quasi-experiment was carried out to examine a possible aptitude-treatment interaction in eight-week meditation programs for college students’ anxiety reduction. A total of 42 college students were assigned to either sitting meditation program (21) or moving meditation program (21) and an additional 39 college students to a comparison group without treatment. Two outcome variables (cognitive trait anxiety and somatic trait anxiety) were measured four times by using on-line self-report questionnaires. It was hypothesized that moving meditation program would be more effective than sitting meditation program for those whose cognitive trait anxiety is dominant over somatic trait anxiety at the baseline and vice versa. The statistical method of Multilevel Modeling (MLM) was used to analyze the longitudinal data. Expected aptitude-treatment interaction was not supported, while significant beneficial effects of overall meditation programs were present. However, post hoc analyses revealed that previous meditation experience was a higher-order moderator differentiating the results. The interaction hypotheses were supported within the non-meditator subgroup, but not within the meditator subgroup. For individuals with previous meditation experience, two meditation programs had no difference in reducing both cognitive and somatic trait anxiety regardless of the baseline measures of both types of anxiety. With regard to the post hoc findings, implications of characteristics of the two meditation programs and attitudinal aspects of meditation practice are discussed.
DIFFERENTIAL EFFECTIVENESS OF SITTING MEDITATION PROGRAM
AND MOVEMENT MEDITATION PROGRAM IN REDUCING
COLLEGE STUDENTS’ COGNITIVE AND SOMATIC TRAIT ANXIETY

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CHAPTER 1. INTRODUCTION

Aptitude-Treatment Interaction in Meditation Instruction

Patients are not all treated equally even if they take the same medicine, because the effects of the medicine differ depending on the patient’s mental and physical condition. Likewise, all students do not learn equally well, even if they take the same instruction, because the effectiveness of the instruction differs depending on a student’s cognitive, emotional, and other conditions. Instruction in meditation would not be an exception to this principle. If so, what kinds of learner characteristics should be considered when teaching meditation, and how can meditation instruction be adapted to such learner characteristics? The current study project will attempt to make a contribution in answering this question using the Aptitude-Treatment Interaction (ATI) approach.

According to the definition used by Cronbach and Snow (1969), aptitude refers to “any characteristic of the individual that increases (or impairs) his probability of success in a given treatment” (p.5). ATI research takes such individual characteristics into account systematically in treatment evaluation (Snow, 1991). ATI is also considered a special case of the conditions-methods-outcomes framework of instructional design (Reigeluth, 1983). Instructional conditions are “factors that influence the effects of methods and are therefore important for prescribing methods” (Reigeluth, 1983, p.14). Aptitude and treatment belong to the category of instructional conditions and methods, respectively. In order for a condition to have value in instructional design, the condition should interact with the methods. If not, the condition has no implication in decision making for method selection. Figure 1.1 displays such relationships among aptitude (condition), treatment (method) and learning outcome.
Learning Outcome in Meditation Instruction

Meditation can be defined as “the conscious training of attention aimed at modifying mental processes so as to elicit enhanced states of consciousness and well being” (Walsh, 1984, p.28). Traditionally, meditation has been practiced in Asian religious or spiritual traditions. However, since it was introduced in the West, its psychological and physiological benefits have been drawing clinical professionals’ attention and its efficacy has also been widely supported (Baer, 2003; Greeson, 2009; Kabat-Zinn, 1982; Lee, Ahn, Lee, Choi, Yook, & Suh, 2007). Among the psychological symptoms or traits improved by meditation, trait-anxiety was shown to be a mediating factor between meditation and other improved symptoms such as depression, state anxiety, spirituality and empathy (Shapiro, Schwartz, & Bonner, 1998), suggesting that reduction in trait-anxiety can be an indicator of a meditation program’s success. According to Spielberger (1983), trait-anxiety can be defined as “relatively stable individual differences in … the tendency to perceive stressful situations as dangerous or threatening and to respond to such situations with elevations in the intensity of their state anxiety reactions” (p.5) whereas state anxiety
is an emotional state characterized by subjective feelings of tension, apprehension, nervousness, and worry at a given moment in time and at a particular level of intensity. As it is defined, trait anxiety is an individual’s relatively stable disposition. Also, it is modifiable with a systematic intervention as well (Eppley, 1989; Jorm, 1989). Considering that learning can be defined as “a process that leads to a change in a learner’s disposition and capabilities that can be reflected in behavior,” (Gagné, Wager, Golas, & Keller, 2005, p.3) change (reduction) in trait-anxiety will be regarded as a learning outcome of meditation programs in this study.

*Alternative Methods for Meditation Instruction*

A traditional and widely used meditation technique is sitting meditation with one’s attention on the breathing, lower abdomen or counting. However, sitting without movement for a long time may be challenging for beginners. Based on the author’s personal meditation instruction experience, continuous guidance of students with slow movement was expected to reduce such challenges of sitting meditation. In fact, movement meditation such as Taichi has been reported as effective in improving diverse psychological symptoms and health (Li, Hong, & Chan, 2001). On the other hand, it is equally possible that some students may feel that it is difficult for them to follow the slow movements. With these two alternative meditation techniques in mind, the type of meditation will be considered as the treatment or method variable. As far as classification of these two meditation techniques is concerned, sitting meditation will be considered a cognitive technique because it involves more cognitive types of activity such as constantly directing one’s attention to the breath or lower abdomen, and emphasis will be placed on attention itself (Kabat-Zinn, Chapman, & Salmon, 1997). In contrast, movement meditation will be considered more a somatic technique than cognitive because the activity consists largely of
coordinated movements of the body in harmony with diaphragmatic breathing (Kabat-Zinn et al., 1997).

Aptitudes for Meditation Learning

The aptitude for meditation learning in this study is the learners’ entrance level of trait anxiety, with the distinction of cognitive versus somatic type. Cognitive anxiety components are more directly associated with thought processes such as worry, intrusive thoughts, and lack of concentration (Ree, French, MacLeod, & Locke, 2008). On the other hand, symptoms of the somatic type of anxiety include hyperventilation, sweating, trembling, and palpitations (Ree et al., 2008). According to the results of a meditation program evaluation by Kabat-Zinn and his colleagues (1997), the program participants with predominant cognitive anxiety preferred the somatic meditation technique (i.e., Hatha Yoga), whereas those with relatively higher somatic anxiety preferred the cognitive technique (i.e., sitting meditation). With the reasonable assumption that the preferred technique would better facilitate meditation learners' progress, resulting in better learning outcomes, it can be expected that more cognitively but less somatically anxious individuals would get more benefit from the somatic technique whereas more somatically but less cognitively anxious individuals would get more benefit from the cognitive technique. Since they have the potential to modify the relative effectiveness of different types of meditation, both cognitive and somatic anxiety can be considered aptitudes for meditation learning in a negative sense. For example, high cognitive anxiety may impair the probability of a meditation learner’s success with a cognitive type of meditation technique.

There may be other aptitudes that moderate the differential effectiveness of the meditation techniques. For example, a series of studies have reported that participants’ level of absorption or hypnotic responsivity was a predictor for effect of meditation in
reducing anxiety (Heide, Wadlington, & Lundy, 1980; Qualls & Sheehan, 1979; 1981; Smith, 1978; Weinstein, 1992). To stay focused, however, the current study will limit its investigation to the entrance levels of cognitive and somatic anxiety.

Significance of the Study

There are many types of meditation techniques available. It would not be unreasonable to suppose that the various types of meditation techniques would have different strengths and weaknesses. Moreover, the strengths and weaknesses may be relative to the individual student. In other words, whether one technique is more beneficial than another for a certain meditation learning outcome may depend on the characteristics of the students who learn and practice the technique. However, knowledge of the relative strengths and weaknesses of various meditation techniques has rarely been systematically investigated and still remains in the domain of the tacit knowledge of experienced meditation teachers. If each meditation technique’s relative strengths and weaknesses can be understood in a generalizable way, it will help meditation teachers, especially novice meditation instructors, to adapt their instruction in a way that better facilitates students’ meditation learning. The current study attempts to enhance such an understanding. Specific hypotheses will be stated at the end of the literature review.
CHAPTER 2. LITERATURE REVIEW

The current study project on meditation employs Aptitude-Treatment Interaction as a research framework (Snow, 1991). To establish a theoretical background, this chapter will identify and examine appropriate outcome variables, aptitude variables and a treatment variable for meditation learning. First, change in trait anxiety will be introduced as a potential outcome variable, and entrance level of trait anxiety, a potential aptitude variable. Second, sitting and moving meditation techniques will be introduced as two values of the treatment variable. Considering the characteristics of the meditation techniques, two sub-components of trait anxiety (cognitive anxiety and somatic anxiety) will be investigated as potential outcome variables, and the pretest measures of two modes of anxiety, as aptitude variables. Specific hypotheses on the relationships among the three kinds of variables (outcome variable, condition or aptitude variable, and treatment variable) will be suggested at the end of the review.

Outcome of Meditation Learning

An appropriate outcome of meditation learning can be hinted at by an attempt to define meditation. In the spiritual context, an ultimate sense of meditation refers to non-dualistic observation without distinction between subject and object (Krishnamurti, 1964; Osho, 1996). However, in the psychological health-care context, an acceptable definition of meditation can be “the conscious training of attention aimed at modifying mental processes so as to elicit enhanced states of consciousness and well being” (Walsh, 1984, p.24). The spiritual sense of meditation does not involve any method of training. Meditation in this sense is the ideal state of mind which happens naturally. However, the definition of meditation in the spiritual context has implications for the training of meditative attention. The training of meditative attention needs to be natural, effortless and without constriction (Wallace, 2006).
Meditation involves concentration, but the concentration in meditation is not active striving to accomplish a certain task (Kabat-Zinn, 1990; Tolle, 2003). Rather, this type of concentration is passive and receptive (Smith, 1990). The receptivity and passivity of meditation training entails an important attitudinal foundation of meditation: non-judgment. Through non-judgmental training of the attention, meditation practice can calm one’s mind, and calmness, in turn, leads to clarity of mind (Naamon, 1998). In short, meditation is the cultivation of mental clarity with balance between calmness/relaxation and alertness/wakefulness (Osho, 1996; Wallace, 2006).

Among the two aspects of meditation (calmness/relaxation and alertness/wakefulness), the calmness/relaxation effects of meditation have drawn health care professionals’ attention and evidence has been accumulated showing reduction in negative psychological and physiological symptom arousals. Among the symptom improvements, anxiety was a widely investigated outcome in meditation studies (Baer, 2003; Greeson, 2009; Kabat-Zinn, 1982; Lee et al., 2007). If meditation is just a relaxation technique and brings about only a state or temporary effect, it cannot be said that there was learning or a therapeutic effect. However, there is sufficient evidence that meditation can modify individuals’ trait anxiety, which is a dispositional change (Jorm, 1989). According to Spielberger (1983), trait anxiety manifests as “relatively stable individual differences in the tendency to perceive stressful situations as dangerous or threatening (p. 5).” Considering that learning can be defined as “a process that leads to a change in a learner’s disposition and capabilities that can be reflected in behavior (Gagné et al., 2005, p.3),” it would be reasonable to adopt change in trait anxiety as a learning outcome from meditation instruction for stress reduction.
How Meditation Affects a Reduction in Trait Anxiety

Trait anxiety is a dispositional characteristic of an individual which is assumed to be stable over a relatively short period of time (Spielberger, 1983). Therefore, when it is claimed that meditation is effective in reducing trait anxiety, it is not likely that one trial of meditation could reduce trait anxiety right away. Rather, repeated and regular practice of meditation must precede positive change in trait anxiety. Then, what process of a type of meditation would decrease the participants' trait anxiety? Smith's cognitive-behavioral model of relaxation (1990) sheds light on the answer to this question. Smith identified three processes of relaxation: arousal reduction, cognitive skill development and change in cognitive structure. First, meditation is a kind of resting. By not using one's sense organs, one can rest, not using one's psychological and physical energy. Second, meditation can reduce psychological arousals by turning one's attention from ruminating on negative thoughts to a simple object (Jain et al., 2007). As defined in the previous section, meditation is a conscious training of attention (Walsh, 1984). The meditation exercise starts with putting one's attention on a simple object such as the breath. Whenever intruding thoughts and emotions arise during the meditation, the practitioner recognizes them and redirects the attention to the original object of focus. This process would prevent distress caused by constantly thinking about worries and concerns.

In addition to focusing skill, Smith also identified 'passivity' as a cognitive skill inducing relaxation. Passivity is “the ability to stop unnecessary goal-directed and analytic activity (Smith, 1990, p.11).” Even though the purpose of adopting the focusing skill in meditation is to induce relaxation, paradoxically, the goal of the focusing needs not to be directed toward relaxation. Stopping goal-directed activity is equivalent to non-striving, one of the attitudinal foundations of mindfulness cited by
Kabat-Zinn (1990). Kabat-Zinn explained that this paradox originates from the nature of meditation exercise, which is to simply be present. When a meditation practitioner is goal-directed during meditation, his mind is not directed toward the present moment but toward the future when the goal of relaxation will be achieved. Thus, Kabat-Zinn suggested that a practitioner intentionally cultivate the attitude of non-striving during meditation.

Another cognitive skill in Smith's (1990) model is receptivity, which is defined as “the ability to tolerate and accept experiences that may be uncertain, unfamiliar, or paradoxical" (p.11). Similarly, Kabat-Zinn (1990) identified ‘acceptance’ as another attitudinal foundation of mindfulness. When a new meditation learner begins to practice meditation, he/she may have unexpected, uncertain, or even negative experiences. According to Kabat-Zinn, if a meditation practitioner tries to resist or avoid such experiences instead of seeing things as they are, this may create more tension and prevent positive change from occurring. Anxiety is often contrasted with fear. While fear has objects to be afraid of, anxiety is uneasiness without a clearly identified object to be afraid of (May, 1977). If one can see things as they are, one can be free from a sense of unidentified and exaggerated danger so that he/she may reduce anxiety. This mechanism was supported by Hargus and others (2010). They found that mindfulness training actually makes a difference in the way people relate to their own experience. In their study, people in mindfulness training could retain specificity and meta-awareness of their crisis situations without becoming overwhelmed compared to a control group.

Besides arousal reduction and development of cognitive skills, one can enhance the depth of relaxation by changing one's cognitive structure such as beliefs, values and commitments that underlie thoughts, speech, and actions (Smith, 1990). This
process is cyclical. As one begins to realize that relaxation skills work, the relaxation practice will be reinforced and he/she will be intrinsically motivated to extend the technique outside of the training session into life at large. In other words, positive experience from relaxation practice may change one’s beliefs, values, and commitments. This change, in turn, deepens one’s relaxation by changing his/her environment and life style (Smith, 1990). Sears and Kraus (2009) partially supported the third aspect of Smith's model by showing that changes in irrational beliefs mediate the effect of meditation intervention on anxiety. However, since Sears and Kraus (2009) did not test whether change in anxiety mediates changes in irrational beliefs, it is not conclusive as to whether the relationship is unidirectional or bidirectional.

Among the three processes of relaxation by meditation, the current study pays attention to the process involving cognitive skills: focusing, passivity and receptivity. If a learner can focus well during meditation, passivity or receptivity will be relatively less important in the relaxation process. However, if one’s focusing does not work well during meditation, lack of passivity and receptivity would be additional hindrances to the relaxation process. Since the three skills are intertwined, any condition facilitating one skill will be likely to bring about a positive skill-development loop leading to relaxation or anxiety reduction.

The next section will review learner aptitude, a necessary condition for the positive process of anxiety reduction.

*Aptitude for Meditation Learning*

The role of cognitive skill in Smith's model (1990) and the relationship between trait anxiety and attention suggest that trait anxiety may be a potential aptitude modifying the effect of a meditation program. It was shown that high trait anxiety impaired the inhibitory functions of attention (Wood, Mathews, & Dalgleish,
2001) and thereby anxious individuals were susceptible to distraction (Eysenck & Graydon, 1989). Since attention control skill is one of the important mechanisms through which meditation reduces anxiety (Davidson & Goleman, 1984; Smith, 1990), as discussed in the previous section, it can be surmised that there is a reciprocal relationship between trait anxiety and attention control. Considering this reciprocal process, the learner's entrance level of trait anxiety may determine the effect of meditation in reducing trait anxiety.

A person with high trait anxiety is more likely to have difficulty not only in controlling his or her attention but also in being receptive to seeing no immediate result from meditation practice compared to a person with low trait anxiety. The lack of an immediate experience of relaxation followed by a lack of receptivity and yet an intentional attempt to relax may ironically lead the meditation learner to experience more anxiety, which is called relaxation-induced anxiety (Heide & Borkovec, 1983; Wegner, Broom & Blumber, 1997).

Trait anxiety may also affect the motivation of meditation learners. According to Csikszentmihalyi's Flow Theory (1975), conditions encouraging anxiety discourage the intrinsic motivation of a learner. The type of anxiety directly relevant to motivation is not trait anxiety per se but state anxiety. Nonetheless, trait anxiety is a major condition affecting state anxiety. In other words, a meditation learner with high trait anxiety is likely to have state anxiety, especially when he/she feels that a given meditation practice is difficult. This phenomenon is consistent with the learning principle that students are likely to have debilitating anxiety when they believe they have little chance of success (Ormrad, 2004). The debilitating state anxiety may discourage a meditation learner from practicing meditation.
Two Meditation Treatments: Sitting vs. Moving

One of the most widely applied meditation techniques is putting one's attention on one's breath while maintaining a quiet sitting posture. During this type of meditation, if any thought, emotion or sensation arises, a practitioner simply notices such mental and physical experiences, and keeps bringing his/her attention back to the breath. However, an individual with high trait anxiety may have difficulty in practicing this mental exercise because of a low capacity for autonomous attention control. Studies on Aptitude-Treatment Interaction (ATI) witnessed supporting evidence that a stressful instructional situation impairs the performance and learning of anxious students (Corno et al., 2002). Considering the difficulty of autonomous cognitive skill application, sitting meditation can be a stressful instructional situation to meditation learners with high trait anxiety.

An alternative to alleviate the difficulty of sitting meditation technique can be moving meditation in which a meditation learner is aware of his/her slow bodily movement. A pilot study adopted such a moving meditation and compared the outcome of the moving meditation program with that of a sitting meditation program in terms of reducing college students' trait anxiety measured by Spielberger’s State-Trait Anxiety Inventory – Trait form (Spielberger, 1983) (Appendix A, p.101). The outcomes were compared over four measurement points in terms of rate of change in trait anxiety. The primary result did not show interaction between type of meditation (sitting vs. moving) and pretest trait anxiety in its effect on rate of change in trait anxiety ($N=22$, $t=.10$, $p=.924$) (Cheon, 2010). However, the results in the middle of the program after the first four sessions showed, as expected, that in students with a high level of initial trait anxiety, the moving meditation program more effectively reduced trait anxiety than did the sitting meditation program ($N=22$,
However, no such interaction effect was found by the end of the program ($N=17$, $t=.84$, $p=.420$) and again in a one-month follow-up ($N=18$, $t=.33$, $p=.748$). The study can be interpreted as showing that, at least in the beginning stage of a meditation program, for those with high trait anxiety, moving meditation technique may make a meditation program more effective than sitting meditation in reducing college students' trait anxiety whereas, for those with low trait anxiety, sitting meditation technique may make a meditation program more effective than moving meditation.

**Moving Meditation as a Somatic Technique**

The characteristic of the moving meditation technique to which attention was paid in the above pilot study was that the moving meditation would relieve required cognitive load compared to sitting meditation because the moving meditation practice is more structured and requires less autonomous attention control than sitting meditation practice. However, another characteristic of the moving meditation technique is its somatic aspect. As mentioned previously, moving meditation requires less cognitive skill than sitting meditation. In this aspect, it can be said that moving meditation is a less cognitive technique. On the other hand, moving meditation involves active bodily motion as an object of focus during the meditation practice compared to sitting meditation. Indeed, breath awareness during sitting meditation has a somatic quality. However, since moving meditation involves more physical activity than sitting meditation, it may not be unreasonable to categorize moving meditation as a dominantly somatic technique and sitting meditation as a dominantly cognitive technique, even though this distinction between a cognitive technique and a somatic technique is relative.

In order to understand the differential effects of sitting meditation and moving
meditation, the next section will review studies on cognitive relaxation technique and somatic relaxation technique.

**Matching Hypothesis**

If technique A is more beneficial than technique B for outcome \( Y_1 \), and technique B is more effective than technique A for outcome \( Y_2 \) regardless of pre-existing individual differences of \( X \) (see Figure 2.1), then technique selection is simple. An instructor would always choose technique A for outcome \( Y_1 \) and technique B for outcome \( Y_2 \) regardless of students’ aptitude level of \( X \).

![Figure 2.1: Technique selection regardless of level of aptitude. X indicates level of aptitude. \( Y_1 \) and \( Y_2 \) indicate learning outcomes. The regression lines represent the relationships between aptitude and outcomes within each group adopting technique A or B.](image)

Schwartz, Davidson and Goleman (1978) suggested the approach mentioned above for treating people’s anxiety, distinguishing global anxiety into two sub-components: cognitive anxiety and somatic anxiety. Cognitive anxiety is characterized by symptoms associated with thought process such as worry, intrusive thoughts, and lack of concentration. In contrast, somatic anxiety is characterized by symptoms of excessive autonomic-endocrine stimulation such as sweating, hyperventilation, palpitation, clammy hands, dry mouth/throat and stomach distress as well as skeletal-
motor tension such as jitteriness, trembling, muscle aches and fatigability (DeGood & Tait, 1987; Ree et al., 2008). In the retrospective study by Schwartz et al. (1978), two types of anxiety were measured after one group of participants took an exercise class and the other group a meditation class. Exercise was considered a somatic relaxation technique and meditation was considered a cognitive relaxation technique. The post-treatment measures showed that the exercise group reported less somatic anxiety than the meditation group whereas the meditation group reported less cognitive anxiety than the exercise group. From this result, Schwartz et al. (1978) suggested the matching hypothesis which claimed that greater reduction in somatic anxiety was more associated with somatic relaxation technique and greater reduction in cognitive anxiety was more associated with cognitive technique. Figure 2.2 depicts the matching hypothesis.

Figure 2.2. Relationship between type of relaxation technique and change in cognitive/somatic anxiety (Matching Hypothesis). ΔCANX = Change in Cognitive Anxiety, ΔSANX = Change in Somatic Anxiety, a1 = Differential Effectiveness for Change in Cognitive Anxiety, a2 = Differential Effectiveness for Change in Somatic Anxiety. Coefficient a1 and a2 can be estimated in regression analyses in which ΔCANX and ΔSANX are outcome variables and ‘Type of Technique’ an independent variable.

However, this conclusion met with a serious critique. As Delmonte (1985)
pointed out, the two groups were neither matched nor formed by random assignment. Moreover, only post-treatment scores were measured. The two groups might have differed in their predispositions from the very beginning. In other words, participants with low somatic anxiety, who were more likely to prefer exercise, might volunteer for the exercise group. Conversely, participants with low cognitive anxiety, who were more likely to prefer meditation, might volunteer for the meditation class. This possibility could not be excluded because the questionnaire was administered only one time, at the post-intervention session.

There have been contradicting reports on Schwartz and his colleagues’ matching hypothesis. Some studies supported the matching hypothesis (Lehrer, Schoicket, Carrington, & Woolpolk, 1980; Norton & Jonson, 1983), but others did not (Gill, Kolt, & Keating, 2004; Terry, Coakley, & Karageorghis, 1995; Weinstein & Smith, 1992). Noticing that cognitive and somatic techniques did not differ in their effectiveness in reducing both cognitive and somatic anxiety, Gill et al. (2004) suggested that a possible reason for there being no difference between the two techniques’ effectiveness was the complex and highly interdependent nature of the human body and mind, in which sub-systems reciprocally influence each other. Another possible explanation may be that the participants’ aptitude for the relaxation technique might differ across the studies. The pilot study (Cheon, 2010) mentioned in the previous section suggested that the effects of the two types of technique may differ depending upon the learners’ aptitude level measured by entrance level of trait anxiety. Likewise, the effect of cognitive technique and somatic technique on cognitive anxiety and somatic anxiety may differ depending upon the learners’ aptitude levels.

The following section will review a more developed study identifying potential
aptitudes in treating cognitive and somatic anxiety in detail. Its findings suggested a
direction for the current study and it will be explained how the hypotheses of the
current study were formulated at the end of this Chapter.

*Cognitive Anxiety and Somatic Anxiety as Aptitudes*

Kabat-Zinn, Chapman and Salmon (1997) suggested potential aptitudes for
different kinds of meditation learning. They investigated outcomes of a meditation
applied stress reduction program adopting three meditation techniques: sitting
meditation, Hatha Yoga, and body scan meditation. Sitting meditation was considered
to be the most cognitive technique, Hatha Yoga the most somatic, and body scan
meditation in the middle. The results showed that individuals with high cognitive and
low somatic anxiety preferred the somatic technique (i.e., Hatha Yoga), whereas those
with high somatic and low cognitive anxiety preferred the cognitive technique (i.e.,
sitting meditation). The higher the baseline cognitive anxiety was, the less cognitive
technique was preferred and the more somatic technique was preferred, which means
that the relative preference for the somatic technique over the cognitive technique was
higher (m1 in Figure 2.3). On the other hand, the higher the baseline somatic anxiety
was, the more cognitive technique was preferred and the less somatic technique was
preferred, which means that the relative preference for the somatic technique over the
cognitive technique was lower (m2 in Figure 2.3). This relationship can be depicted as
in Figure 2.3.
Figure 2.3. Relationship between baseline cognitive/somatic anxiety and preference for meditation technique. CANX0 = Baseline cognitive trait anxiety, SANX0 = Baseline somatic trait anxiety, Relative Preference for Somatic Technique over Cognitive Technique = Preference score for somatic technique – Preference score for cognitive technique.

The mechanism of such a relationship may be explained by the perceived difficulty of a given technique. It is likely that, among those with the same level of somatic anxiety, individuals with high cognitive anxiety feel that a cognitive technique is relatively more difficult and seek a somatic technique as an alternative more than those with low cognitive anxiety do. On the other hand, among those with the same level of cognitive anxiety, individuals with high somatic anxiety feel that somatic technique is more difficult and seek cognitive technique as an alternative more than those with low somatic anxiety do. Because both cognitive and somatic techniques were used in one program, outcome difference between techniques could not be tested. However, the above results suggest that baseline cognitive and somatic anxiety may modify the differential effectiveness between techniques, with an
assumption that the technique preference would be positively correlated with the program outcome. It would be a reasonable to conjecture that a high level of perceived difficulty of a given technique caused by high anxiety of the same domain of the utilized technique may hinder individuals from experiencing relaxation, whereas the opposite type of technique may facilitate relaxation. Seyle's (1974) explanation of the relationship between stress and the sub-systems of the human body/mind support the above inference. “Substituting demands upon our musculature for those previously made upon the intellect not only gives our brain a rest but helps us to avoid worrying about the frustrating interruption. In other words, stress on one system helps to relax another” (Selye, 1974, p.77). A person with high cognitive trait anxiety is more likely to have stress on the cognitive system (Ree et al., 2008). In such a condition, when additional cognitive load is imposed upon the cognitive system, despite its purpose of relaxation, the relaxation exercise may not be effective in inducing relaxation. The same explanation can be applied to the somatic system.

_Cognitive Anxiety and Somatic Anxiety as Outcome Predictors_

Additionally, outcome results of Kabat-Zinn, Chapman and Salmon (1997), measured by reduction of cognitive and somatic anxiety, suggested a complex relationship between the two components of anxiety. Table 2.1 summarizes the results.
Table 2.1
Reduction Rate in Each Component of Anxiety.

<table>
<thead>
<tr>
<th>Reduction of CANX</th>
<th>SANX0 Low</th>
<th>SANX0 High</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANX0 Low</td>
<td>N/A</td>
<td>14%</td>
</tr>
<tr>
<td>CANX0 High</td>
<td>60%</td>
<td>43%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reduction of SANX</th>
<th>SANX0 Low</th>
<th>SANX0 High</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANX0 Low</td>
<td>N/A</td>
<td>54%</td>
</tr>
<tr>
<td>CANX0 High</td>
<td>35%</td>
<td>45%</td>
</tr>
</tbody>
</table>

Note. CANX = Cognitive Anxiety, CANX0 = Baseline Cognitive Anxiety, SANX = Somatic Anxiety, SANX0 = Baseline Somatic Anxiety. Those whose anxiety was low in both components were not available (Kabat-Zinn et al., 1997).

The left side of Table 2.1 shows that, when baseline somatic anxiety (SANX0) was high, those with high baseline cognitive anxiety (CANX0) could reduce CANX (43%) more than those with low baseline cognitive anxiety (14%) [b1 in Figure 2.4], whereas, when CANX0 was high, those with low SANX0 could attain a greater reduction in CANX (60%) than those with high SANX could (43%) [b2 in Figure 2.4]. The right side of the table illustrates that, when somatic anxiety was high, people with lower cognitive anxiety could reduce somatic anxiety more (54%) than those with high cognitive anxiety (45%) [b3 in Figure 2.4], whereas, when cognitive anxiety was high, more somatically anxious people could reduce anxiety more (45%) than those with low somatic anxiety (35%) [b4 in Figure 2.4]. This pattern is depicted in Figure 2.4.
Figure 2.4. Relationship between baseline cognitive/somatic anxiety and change in cognitive/somatic anxiety. CANX0 = Baseline cognitive trait anxiety, SANX0 = Baseline somatic trait anxiety, ΔCANX = Change in Cognitive Anxiety, ΔSANX0 = Change in Somatic Anxiety.

As shown in Figure 2.4, the higher the baseline cognitive/somatic anxiety was, the more cognitive/somatic anxiety was reduced (b1 and b4 of Figure 2.4). The results look reasonable because a person with a high level of anxiety, whether it is the cognitive type or somatic type, would have more room for improvement, whereas a person with a low level of anxiety would have less room for improvement (ceiling
effect). On the other hand, change in cognitive anxiety is positively related with baseline somatic anxiety (b2). This may be because high somatic anxiety hinders the reduction of cognitive anxiety. Conversely, low somatic anxiety facilitates reduction of cognitive anxiety (b2). The same explanation can be applied in the case of somatic anxiety reduction (b3). It seems that low anxiety in one sub-system facilitates improvement in the other sub-system.

**Interaction Model**

Combining the matching hypothesis (Schwartz et al., 1978) with the results from Kabat-Zinn et al. (1997), a more comprehensive model can be drawn as in Figure 2.5.

**Figure 2.5.** Interaction model. Type of Meditation: 0 = Cognitive Technique (Sitting Meditation), 1 = Somatic Technique (Moving Meditation). ΔCANX = Change in Cognitive Anxiety, ΔSANX = Change in Somatic Anxiety.

In Figure 2.5, Paths a1 and a2 refer to the relative effectiveness of the somatic technique in reducing cognitive anxiety and somatic anxiety, respectively, compared to the effectiveness of the cognitive technique. Paths b1, b2, b3 and b4 show the influences of baseline cognitive and somatic anxiety on reduction of cognitive and somatic anxiety regardless of type of technique. Paths m1, m2, m3 and m4 represent moderating effects of baseline cognitive and somatic anxiety on the relative effectiveness of somatic technique over cognitive technique. Paths m1 and m3 are
expected to be negative because high baseline cognitive anxiety would make a somatic technique preferable and thereby more effective than cognitive technique. On the other hand, Paths m2 and m4 are expected to be positive because high baseline somatic anxiety would make a cognitive technique preferable and thereby more effective than somatic technique.

**Hypotheses**

From the above review, the following hypotheses were formulated for the current study.

Hypothesis 1. On average, the participants in the meditation treatment groups will reduce both cognitive trait-anxiety and somatic trait-anxiety more than the participants in the comparison group.

Hypothesis 2. When the main effect and the moderating effect of grand-mean centered baseline cognitive trait anxiety and somatic trait anxiety are controlled, a somatic technique (moving meditation) will be shown to be less effective than a cognitive technique (sitting meditation) for cognitive trait anxiety reduction. (Matching Hypothesis: Path a1 in Figure 2.5)

Hypothesis 3. When the main effect and the moderating effect of cognitive trait anxiety and somatic trait anxiety are controlled, a somatic technique (moving meditation) will be shown to be more effective than a cognitive technique (sitting meditation) for somatic trait anxiety reduction. (Matching Hypothesis: Path a2 in Figure 2.5)

Hypothesis 4. The higher the baseline trait anxiety of one domain (either cognitive or somatic) is, the more the same-domain trait anxiety will be reduced. (Ceiling Effect: Paths b1 and b4 in Figure 2.5)

Hypothesis 5. The higher the baseline trait anxiety of one domain (either
cognitive or somatic) is, the less the trait anxiety of the opposite domain will be reduced. (Facilitation Effect: Paths b2 and b3 in Figure 2.5)

Hypothesis 6. Higher baseline cognitive trait anxiety will make the somatic technique (moving meditation) more effective and the cognitive technique (sitting meditation) less effective in reducing both cognitive and somatic anxiety. (Interaction Effect: Paths m1 and m3 in Figure 2.5)

Hypothesis 7. Higher baseline somatic trait anxiety will make the somatic technique (moving meditation) less effective and the cognitive technique (sitting meditation) more effective in reducing both cognitive and somatic anxiety. (Interaction Effect: Paths m2 and m4 in Figure 2.5)

Among the series of hypotheses above, Hypotheses 6 and 7 are the primary foci of the current study testing the interaction between aptitudes and treatments. Hypotheses 1 and 2 are to test the matching hypothesis of Schwartz et al. (1978), which claims reduction of cognitive anxiety is more associated with the cognitive type of relaxation technique and reduction of somatic anxiety with the somatic technique. Hypotheses 4 and 5 reflect the ceiling effect on the same domain anxiety and the facilitating effect on the other domain anxiety. The series of hypotheses from 2 to 7 implies that the relationship between treatment technique and outcome would not be as simple as Schwartz et al. (1978) suggested. Rather, it is expected that more complex dynamics underlie the relationship between type of technique and anxiety reduction outcome because of the moderating influence of individual differences in the two components of anxiety.

Methods used to test the hypotheses described above are explained in the next chapter.
CHAPTER 3. METHODS

Participants

The target population of the current study was Syracuse University college students. A total of 84 students registered for either of two meditation programs. Among the 84 students in the treatment sample, 77 completed at least one of the four surveys distributed and 58 subjects participated in pretest. Participants without pretest scores were excluded from the main analyses because a baseline score is an important explanatory variable in the current study. Four students who registered but did not attend the programs were additionally excluded from the final sample. Also, those who attended only one meditation session and never showed up again were considered as drop-outs (n=12). The size of the final treatment sample was 42 (sitting 21 and moving 21). Among the total of 70 comparison group participants, 39 with pretest scores were included as the final comparison group sample.

To ensure an appropriate sample size, the students in a large college class were provided extra credit points for the class as an incentive, if they participated in an intervention program and/or surveys. Among the final treatment sample (n=42), 25 participants (60%) received the incentive. In addition, only a portion of the treatment group participants (n=16, 38%) were randomly assigned to either of the two meditation conditions. A detailed sample description with demographic information is displayed in Table 3.1.
Table 3.1
Demographic Information on Participants

<table>
<thead>
<tr>
<th></th>
<th>Sitting Meditation</th>
<th>Moving Meditation</th>
<th>Treatment Total</th>
<th>Comparison</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Registration</td>
<td>42</td>
<td>42</td>
<td>84</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Survey Participation</td>
<td>38</td>
<td>39</td>
<td>77</td>
<td>70</td>
<td>147</td>
</tr>
<tr>
<td>Survey Pretest</td>
<td>29</td>
<td>29</td>
<td>58</td>
<td>39</td>
<td>97</td>
</tr>
<tr>
<td>Program Participation</td>
<td>27</td>
<td>27</td>
<td>54</td>
<td>39</td>
<td>93</td>
</tr>
<tr>
<td>Drop-outs</td>
<td>6</td>
<td>6</td>
<td>12</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Final Sample</td>
<td>21</td>
<td>21</td>
<td>42</td>
<td>39</td>
<td>81</td>
</tr>
<tr>
<td>Incentive</td>
<td>12 (57%)</td>
<td>13 (62%)</td>
<td>25 (60%)</td>
<td>39 (100%)</td>
<td>64 (79%)</td>
</tr>
<tr>
<td>Random Assignment</td>
<td>7 (33%)</td>
<td>9 (43%)</td>
<td>16 (38%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Female</td>
<td>15 (71%)</td>
<td>14 (67%)</td>
<td>38 (69%)</td>
<td>29 (74%)</td>
<td>58 (72%)</td>
</tr>
<tr>
<td>White</td>
<td>14 (67%)</td>
<td>12 (57%)</td>
<td>26 (62%)</td>
<td>26 (67%)</td>
<td>52 (64%)</td>
</tr>
<tr>
<td>Asian</td>
<td>2 (10%)</td>
<td>4 (19%)</td>
<td>6 (14%)</td>
<td>5 (13%)</td>
<td>11 (14%)</td>
</tr>
<tr>
<td>Meditation Experience</td>
<td>13 (62%)</td>
<td>10 (48%)</td>
<td>23 (55%)</td>
<td>19 (49%)</td>
<td>42 (52%)</td>
</tr>
<tr>
<td>Average Age</td>
<td>23.24(6.99)</td>
<td>23.19(9.55)</td>
<td>23.21(8.27)</td>
<td>21.49(5.88)</td>
<td>22.38(7.22)</td>
</tr>
</tbody>
</table>

Note. ‘Survey Participation’ refers to the number of participants who responded to any of the four surveys. ‘Program Participation’ refers to the number of participants who attended meditation session at least one time. Drop-outs are those who attended only one session. 'Incentive' refers to the portion of the participants who were recruited from a college class and provided extra credit points for the class. ‘Random Assignment’ refers to the portion of participants who were randomly assigned to either of the two treatments. 'Meditation Experience' refers to the portion of the participants who had any type of meditation experience. Numbers in parentheses in the Average Age row indicate standard deviations.

Procedures

This study adopted a quasi-experimental design in two aspects. First, a group of college class students were recruited as a comparison group to assess the effectiveness of meditation treatment programs in terms of the rates of change in cognitive and somatic trait-anxiety over time. Even though the conditions of strict internal validity could not be met because of the potential selection bias, adoption of a comparison group similar with the treatment group was expected to enable more valid assessment of the treatment effect than a single group pre-post design. Second, a strict random assignment of treatment group participants to either the sitting meditation program or the moving meditation program could not be implemented because not all participants were available for both types of meditation classes. Among 42 final treatment sample participants, 16 participants were randomly assigned and 26
participants were assigned to the classes which their schedules allowed. The proportions of randomly assigned participants in each group were not significantly different from each other, $\chi^2(1) = .404$, $p = .525$. To minimize the selection bias, the participants were not informed of the type of meditation treatment they would take.

Advertisement for participant recruitment was made through flyers (Appendix E, p.114) and a group e-mail (Appendix F, p.115). The flyers were posted around the campus buildings and the group e-mail was sent to students in a large college class. The students in the large class were invited to participate in either a meditation program followed by repeated surveys or mere surveys. In either case, extra credit points for the class were provided as a study incentive. It was announced that two free meditation programs would be provided for the purpose of stress reduction, and student participants would be asked to answer four surveys which were distributed to them at one-month intervals. Procedures for the research were explained to interested people and they were asked to read and sign an IRB-approved informed consent (Appendix G. IRB Approval Form, Appendix H. Informed Consent). Students interested in the meditation programs registered through e-mails and the registered participants were placed in one of two meditation programs. A description of the types of meditation was not given in order to neutralize participants’ program preference.

The schedule of each class was as follows: 1) Wednesday 5:30 – 6:30 pm (Sitting), 2) Wednesday 7:00 – 8:00 pm (Moving), 3) Thursday 5:30 – 6:30 pm (Moving), 4) Thursday 7:00 – 8:00 pm (Sitting). The schedule was determined randomly with predetermination that the first and fourth classes would be the same whereas the second and the third would be the same.

An independent observer was employed to check treatment integrity and ensure that the meditation programs were implemented as intended. The observer randomly
attended two sessions of each class, eight sessions in total, and observed the classes participating in the class activities. No major variation from the normal process of the programs was reported.

Four surveys to measure participants’ cognitive/somatic trait-anxiety level were conducted on-line using the State-Trait Inventory for Cognitive Somatic Anxiety (STICSA) trait scale with about a four-week interval. Table 3.2 displays meditation treatments and data collection schedule.

Table 3.2
Treatments and Data Collection Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Academic Event</th>
<th>Class</th>
<th>MED1</th>
<th>Send Survey</th>
<th>MED2</th>
<th>Send Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>08/30</td>
<td>First Day of Classes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Recruit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Recruit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Recruit</td>
<td></td>
<td></td>
<td>09/24</td>
<td></td>
<td>09/25</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>09/29</td>
<td></td>
<td>09/30</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>10/06</td>
<td></td>
<td>10/07</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>10/13</td>
<td></td>
<td>10/14</td>
</tr>
<tr>
<td>8</td>
<td>10/19</td>
<td>Mid-term Exam</td>
<td>4</td>
<td></td>
<td>10/20</td>
<td>10/22</td>
<td>10/21</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td>10/27</td>
<td></td>
<td>10/28</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td>11/03</td>
<td></td>
<td>11/04</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>7</td>
<td></td>
<td></td>
<td>11/10</td>
<td></td>
<td>11/11</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td>11/17</td>
<td>11/19</td>
<td>11/18</td>
</tr>
</tbody>
</table>

Thanks-giving

13  11/24  Break
14
15
16  12/17  End of Final Exam  12/17  12/18

Note. The year of data collection was 2010. MED1 and MED2 refer to meditation sessions on Wednesdays and Thursdays, respectively.

Treatments

It should be noted that the treatment in the current study is not meditation per se
but meditation program. Both the sitting meditation program and the moving meditation program aimed at helping the college students to reduce their stress through formal meditation practice and meditation-applied coping strategies for stress reduction. Both programs commonly consisted of the following activities: instruction on meditation posture, formal meditation practice, lecture/Q&A. Moreover, the same classroom was used for both programs. However, different meditation techniques were practiced during the formal meditation practice time.

*Sitting meditation program.* One meditation program adopted sitting meditation with breath focusing technique for formal meditation practice. Both meditation cushions and chairs were prepared and arranged to facilitate students’ sitting posture. A brief walking meditation was utilized as a refresher to alleviate possible physical pain from maintaining the sitting posture. For formal sitting meditation practice, instruction on sitting posture, breathing method and how to deal with wandering thoughts was given and was repeated at each session. In a lecture, mindfulness practice as a coping strategy for stress management was explained and discussed. The sitting meditation participants were encouraged to practice formal sitting meditation for 10 to 20 minutes every day and asked to record their practice logs in standard checklists.

*Moving meditation program.* The other meditation program adopted the routine of *Shipsang* moving meditation (Song, 2005) for formal meditation practice. *Shipsang* moving meditation consists of one warm-up exercise and ten routine movements. The moving meditation program consists of a simplified form of various *Taichi* movements adapted to enable students to follow the motions easily. The purpose of the smooth and coordinated bodily movements in harmony with diaphragmatic breathing was to help the energy circulation of the body and to facilitate an attentive
mind. The program began with four basic movements at the first session and one more movement was added at each of the following sessions. The moving meditation participants were also encouraged to practice movement routines for 10 to 20 minutes every day and asked to keep their practice logs in the same checklists as those of the sitting meditation group. Table 3.3 displays the approximate timeline for each program session.

Table 3.3

<table>
<thead>
<tr>
<th>Sitting Meditation Program</th>
<th>Moving Meditation Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening instruction</td>
<td>Opening instruction</td>
</tr>
<tr>
<td>Sitting Meditation</td>
<td>5 min.</td>
</tr>
<tr>
<td>Walking Meditation</td>
<td>Movement Meditation</td>
</tr>
<tr>
<td>Sitting Meditation</td>
<td>15 min.</td>
</tr>
<tr>
<td>Lecture &amp; Discussion</td>
<td>5 min.</td>
</tr>
<tr>
<td>Sitting Meditation</td>
<td>15 min.</td>
</tr>
<tr>
<td>Lecture &amp; Discussion</td>
<td>20 min.</td>
</tr>
</tbody>
</table>

As shown in Table 3.3, opening instruction and lecture and discussion are common elements of the two programs. The only difference between the two programs was in the 35 minutes of meditation practice.

*Treatment fidelity.* Strategies ensuring treatment fidelity were employed to monitor and enhance the reliability and validity of the treatments, thereby increasing scientific confidence that changes in dependent variable are attributable to the independent variable (Borrelli et al., 2005). The variability of the treatment-provider training, one of the treatment-fidelity components, was expected to be minimal because the meditation instructor was the same across the meditation classes. The instructor was an ordained Won Buddhist minister with a master’s degree from a Buddhist graduate school centered on meditation studies in the U.S. The instructor had received five years of intensive meditation learning and practice, and had five years of meditation teaching experience for both sitting meditation and moving
meditation.

The treatment programs of the current study consist of two basic parts: meditation practice, and lecture and discussion on mindfulness. The two meditation programs were designed to be equal as to lecture and discussion on mindfulness, but different as to meditation practice. One program adopted a sitting meditation practice and the other, moving meditation practice. To ensure treatment fidelity, methods to ensure that treatments were delivered as intended were employed. The instructor prepared ordered lists of treatment activities and lecture hand-outs (Appendix B, pp.103-110) to structure the program plan and used a digital clock to follow the intended session time frame. An independent observer—a graduate student in a doctoral program at the Syracuse University School of Education—was employed to check whether the treatments were implemented as intended. There were a total of four classes: two for the sitting meditation program and two for the moving meditation program. Each class consisted of eight weekly sessions. The observer randomly chose two weeks for each of the four classes and attended a total of eight sessions. Observation checklist forms were given to the observer (Appendix C, p.111). The observer’s checklist report showed that components of the programs were implemented as intended, the instructor treated participants equally and the participants’ compliance with the guidance was positive in all sessions. However, confusion was detected in the observer reports for four Thursday sessions. The observer had apparently used a sitting meditation class checklist for the moving meditation class and moving meditation class checklists for the sitting meditation class for four Thursday sessions. To clarify the confusion and verify the meditation practice implementation, recorded audio tapes for the four sessions involving the observer’s checklist confusion were reviewed. According to the audio tape review, all
meditation components in the checklist were implemented as intended and meditation practice time variations and lecture time variations were negligible. Both maximum meditation practice time difference and maximum lecture time difference were around one minute.

*Measurement*

Trait scales of State-Trait Inventory for Cognitive and Somatic anxiety (STICSA) were used to measure cognitive and somatic trait anxiety. Among 21 items of STICSA-trait scales, 10 items measure cognitive trait anxiety and 11 items measure somatic trait-anxiety (Appendix D, p.113). STICSA was reported as a reliable and valid instrument to measure cognitive and somatic anxiety. Internal consistencies were .75 for cognitive trait items and .80 for somatic trait items, respectively, in a sample of 129 undergraduate students (Ree et al., 2008). Moreover, compared to State-Trait Anxiety Inventory (Spielberger, 1983), STICSA was more strongly correlated with another measure of anxiety and was less strongly correlated with a measure of depression (Grös, Antony, Simms, & McCabe, 2007). Thus, convergent and discriminant validity were also ensured.

Although most intervention studies using STICSA adopted state scale for outcome measure because the state scales would be more sensitive than the trait scales, there has been sufficient evidence that trait anxiety measured by State-Trait Anxiety Inventory (STAI) is modifiable through systematic intervention programs (Jorm, 1989). It was reported that there were significant correlations of $r = .66$ ($p<.01$) between STICSA trait scale and STAI trait scale, $r = .70$ ($p<.01$) between STICSA cognitive trait scale and STAI trait scale, and $r = .49$ ($p<.01$) between STICSA somatic trait scale and STAI trait scale (Grös et al., 2007). Thus, it would not be unreasonable to expect that STICSA cognitive and somatic trait scale would be also
able to capture the change in the trait anxiety constructs followed by intervention programs.

The cognitive and somatic trait scales of STICSA were also used to measure aptitude constructs as well as intervention outcomes. Aptitude constructs are learner characteristics and they are assumed to be stable by their natures during a relatively short period of time. Thus, the scales need to be shown as stable enough to measure aptitude constructs. Test-retest reliabilities would show the degree of stability of the measures and adequate levels of test-retest reliabilities of the scales were reported: $r = .66$ for cognitive trait scale and $r = .60$ for somatic trait scale (Ree et al., 2008).

**Data Analysis**

The statistical method of Multilevel Modeling (MLM) was used to analyze four-wave repeated measures. MLM is a better approach to longitudinal data analysis over repeated ANOVA or MANOVA in that it can deal with missing data in a less biased way by considering all reported data and estimating missing data so that the statistical power can be increased (O'Connell & McCoach, 2004). Moreover, MLM can accommodate analysis of data with irregularly spaced measurement time points. SAS PROC MIXED (version 9.2) was used for the MLM data analysis.

*Multilevel Modeling (MLM).* MLM is a useful and flexible statistical analysis method when the data are structured in a nested way. When a hierarchically structured data set is represented by a single level regression line, it may misrepresent the data by confounding within-group (or within-person) variation with between-group (or between-person) variation (Singer & Willett, 2003; Bryk & Raudenbush, 1992). A linear regression model can be represented by two parameters: intercept and slope. In a single-level regression, the intercept and slope are not allowed to vary. They are not variables but parameters to be estimated. This means that they are fixed by an
estimation process. However, in a two-level linear model, the first-level regression coefficients (intercept and slope) are considered as random variables, not parameters. In the second-level linear model, the first-level random coefficients can be further represented by the second-level parameters including means (fixed effects) and variances (random effects). The current study involves a nested data structure. Four repeated measures of cognitive anxiety or somatic anxiety are nested within individuals. In this situation, an individual $i$’s anxiety level at $j^{th}$ measurement point ($j = 1, 2, 3, 4$) can be represented by the following level-1 equation:

$$\text{ANXIETY}_{ij} = \beta_{0i} + \beta_{1i} \text{TIME}_{ij} + \epsilon_{ij} \quad (3.1a)$$

where it is assumed that:

$$\epsilon_{ij} \sim N(0, \sigma^2_\epsilon). \quad (3.1b)$$

Notation 3.1b signifies that level-1 residuals were assumed to follow normal distribution with the mean of zero. If the data involves only one individual, the data can be represented by a fixed intercept ($\beta_0$) and a fixed slope ($\beta_1$). However, there are many individuals and it would be reasonable to assume that the intercept (i.e., baseline anxiety) and slope (i.e., rate of change in anxiety) would vary across individuals. If one attempts to represent this nested data with single-level regression, he/she should assume that intercepts and slopes are the same across all individuals and deviations of observed values from predicted values are just random errors. This is a strongly unreasonable assumption. On the other hand, MLM can allow level-1 intercept and slope to vary depending on individuals so that it is possible to explain individual differences in baseline and rate of change of outcome measures in a more systematic way. This flexibility can be depicted by the following level-2 equations:
\[ \beta_{0i} = \gamma_{00} + u_{0i} , \]
\[ \beta_{1i} = \gamma_{10} + u_{1i} , \]

(3.2a)

where it is assumed that:

\[
\begin{pmatrix}
  u_{0i} \\
  u_{1i}
\end{pmatrix}
\sim \mathcal{N}
\left[
\begin{pmatrix}
  0 \\
  0
\end{pmatrix},
\begin{pmatrix}
  \sigma_{00}^2 & \sigma_{01} \\
  \sigma_{10} & \sigma_{11}^2
\end{pmatrix}
\right]
\]

(3.2b)

The right sides of equation 3.2a have two components: fixed \((\gamma_{00}, \gamma_{10})\) and random \((u_{0i}, u_{1i})\). The equation 3.2a shows that individual \(i\)’s baseline anxiety score can be explained by the overall mean baseline score \(\gamma_{00}\) and individual \(i\)’s deviation \(u_{0i}\) from the overall mean. Likewise, individual \(i\)’s rate of change in anxiety can be explained by estimated rate of change of the group \(\gamma_{10}\) and individual \(i\)’s deviation \(u_{1i}\) from the overall average slope estimate. In a statistical test, it will be assumed that \(u_{0i}\) and \(u_{1i}\) follow normal distribution with a mean of zero and a variance-covariance matrix as shown in notation 3.2b. The multilevel model represented by equation 3.1 and 3.2 can be graphically illustrated as in Figure 3.1.
In the current study, two outcome variables, cognitive trait-anxiety (CANX) and somatic trait-anxiety (SANX), are initially modeled by combining equation 3.1 (level-1 within-person) and 3.2 (level-2 between-person). Equations 3.3a and 3.3b show the unconditional growth model for each outcome variable:

\[
\text{CANX}_{ij} = \beta_{c0i} + \beta_{c1i} \text{TIME}_{ij} + \epsilon_{cij}, \\
\beta_{c0i} = \gamma_{c00} + u_{c0i}, \\
\beta_{c1i} = \gamma_{c10} + u_{c1i}
\] (3.3a)

\[
\text{SANX}_{ij} = \beta_{s0i} + \beta_{s1i} \text{TIME}_{ij} + \epsilon_{sij}, \\
\beta_{s0i} = \gamma_{s00} + u_{s0i}, \\
\beta_{s1i} = \gamma_{s10} + u_{s1i}
\] (3.3b)
The primary interest of the current study is the random coefficient $\beta_{1i}$ in equation (3.3a) and $\beta_{2i}$ in equation (3.3b), which represent the random rates of change in two anxiety outcome variables. The random rates of change consist of two parts: the fixed effect of the overall mean and the random effect of residuals. Statistical significance of the fixed effects and explained portion of variation in the random effect were tested. A meaningful level-2 predictor should have a parameter estimate which significantly differs from 0 and it should be able to explain a considerable portion of variation in the level-2 slope residuals. The explained proportion of outcome variation can be quantified by pseudo-$R^2$ as suggested by Singer and Willet (2003). The unconditional growth models represented by equations 3.3a and 3.3b would serve as yardsticks for comparison with subsequent growth models with additional level-2 predictors (Singer & Willet, 2003). The following procedures were applied for model development and specification for hypotheses tests.

*Fit Indices.* In the model comparison, two indices were considered: deviance statistics ($-2\text{LL}$) and Akaike’s Information Criterion (AIC). Deviance statistics were used if two models were nested: i.e., both contain the same term and one has at least one additional term. Difference between two deviance statistics follows chi-square distribution and if the full model had significantly lower chi-square value than the reduced model considering the difference of degree of freedom of the two models, it was determined that the full model was better than the reduced model in the sense that the deviation of actual data from the full model is significantly smaller than the reduced model. In the opposite case, the reduced model would be determined to be a better model in the sense that the reduced model is more parsimonious than the full model. AIC was used if two models were not nested: the smaller the AIC, the better the model (Singer and Willett, 2003).
**Specification of covariance structure.** The covariance structure among random effects was specified as ‘unstructured (‘TYPE = UN’ in ‘RANDOM’ command of SAS PROC MIXED)’ in the beginning as suggested by Fitzmaurice and others (2011) because it could allow correlations among random effects. It should be noted that the covariance structure of level-2 random effects are distinguished from the covariance structure of level-1 repeated measures. In a standard multilevel-modeling, after total residuals are explained by random effects of level-2 residuals, the left-over level-1 residuals are assumed to be independent of one another and their variances to be homoscedastic so that the level-1 covariance structure does not need to be specified in a standard multilevel modeling. For example, an autoregressive structure of repeated measures would show that the correlations decline over time as the separation between pairs of repeated measures increases while the variance of each measure remains the same across time (Fitzmaurice et al., 2011). However, this does not imply an autoregressive structure of a random intercept and random slope. Because the scale of baseline measure and the scale of the rate of change of the repeated measure would not be the same in general, it would be unusual to assume that the variance of random intercept and the variance of random slope would be the same unless the scales of the repeated measures are standardized. When a model includes only two random effects, covariance structures such as ‘unstructured,’ ‘heterogeneous compound symmetry’ and ‘heterogeneous autoregressive,’ which require estimation of three parameters, are equivalent. However, covariance structures such as ‘compound symmetry,’ ‘autoregressive’ assume the same variance across time so that they require estimation of only two parameters: one for the variance component and the other for the covariance component. The latter type of covariance structure is too strong a restriction (Singer and Willett, 2003) so that it may result in
model misspecification (Fitzmaurice et al., 2011). The empirical tests with the current data also evidenced that ‘unstructured’ or ‘variance component’ models had better model fit indices than ‘autoregressive’ or ‘compound symmetry’ models. In sum, it is justifiable to specify the covariance structure of the random effects as ‘unstructured’ in the current study at least in the beginning step of the model development. When the correlation between the random effects is not significant, the covariance structure of level-2 residuals was reduced to ‘variance component (‘TYPE = VC’ in ‘RANDOM’ command of SAS PROC MIXED)’ which specified the correlation of random intercept as 0 and then model fits of the two models were compared.

Methods of Estimation. As for parameter estimation method, Full Maximum Likelihood (FML) method was used for the main hypotheses tests because the main hypotheses of the current study are to test the fixed effects of interaction variables and goodness-of-fit statistics from FML can be used to test hypotheses about both fixed and random effects whereas Restricted Maximum Likelihood (RML) method can be used only to test hypotheses about random effects (Singer and Willet, 2003). However, RML was also used during the model development process to compare models involving only variance components.

Centering. Two aptitude variables (level-2), baseline CANX (CANX0) and baseline SANX (SANX0), were centered at grand mean of the whole sample. When research questions of a study involve interaction such as the current study, centering of a continuous variable is essential because it can allow practical interpretation of estimated parameters. In an ATI research, a main concern is not to see statistical interaction per se, but to test whether the decision for optimal treatment selection would change along the meaningful range of students’ aptitude or trait (Cronbach & Snow, 1977). In a graphical form of a two-dimensional space of aptitude and
outcome, this question can be answered by examining whether regression lines of two treatment groups are crossing each other within the range of students’ aptitude. As tested in the assumption checks, the two aptitude variables were normally distributed around the grand mean of the whole sample. Also, the sample mean of each group (Meditation vs Comparison) did not significantly differ, $t = -.63$, $p = .532$ for CANX and $t = .24$, $p = .814$ for SANX. Thus, the two aptitude variables were centered at the grand mean so that interpretation of parameters can be made at the average levels of students’ aptitudes. The two centered aptitude variables are denoted as ‘CANX0c’ and SANX0c.’

**Basic MLM Analysis Model for Hypotheses Tests.** The following MLM can be used to test the study hypotheses under certain assumptions.

$$
\text{CANX}_{ij} = \beta_{c0i} + \beta_{c1i} \text{TIME}_{ij} + \varepsilon_{cij},
$$

$$
\beta_{c0i} = \gamma_{c00} + \gamma_{c010} \text{CANX0c}_i \\
\beta_{c1i} = \gamma_{c100} + \gamma_{c102} \text{MOV}_i \\
+ \gamma_{c110} \text{CANX0c}_i + \gamma_{c112} \text{MOV}_i \text{CANX0c}_i \\
+ \gamma_{c120} \text{SANX0c}_i + \gamma_{c122} \text{MOV}_i \text{SANX0c}_i + u_{c1i} \quad (3.4a)
$$

$$
\text{SANX}_{ij} = \beta_{s0i} + \beta_{s1i} \text{TIME}_{ij} + \varepsilon_{cij},
$$

$$
\beta_{s0i} = \gamma_{s000} + \gamma_{s010} \text{SANX0c}_i \\
\beta_{s1i} = \gamma_{s100} + \gamma_{s102} \text{MOV}_i \\
+ \gamma_{s110} \text{CANX0c}_i + \gamma_{s112} \text{MOV}_i \text{CANX0c}_i \\
+ \gamma_{s120} \text{SANX0c}_i + \gamma_{s122} \text{MOV}_i \text{SANX0c}_i + u_{s1i} \quad (3.4b)
$$

The above equation models can be graphically illustrated as in Figure 3.2.
Figure 3.2. Multilevel interaction model for the hypotheses tests of the current study. Arrows without circles represent fixed effects; arrows with circles represent random effects. CANX = Cognitive trait anxiety; CANX0c = Baseline cognitive trait anxiety centered at the grand mean; SANX = Somatic trait anxiety; SANX0c = Baseline somatic trait anxiety centered at the grand mean; MOV = Type of meditation technique (1 = moving, -1 = sitting).

**Hypotheses and relevant coefficients.** The study hypotheses stated in Chapter 2 can be tested by the direction and statistical significance (p = .05) of parameter estimates in the parentheses as follows:

Hypothesis 1. On average, the participants in the meditation treatment groups will reduce both cognitive trait-anxiety and somatic trait-anxiety more than the
participants in the comparison group. \((\gamma_{c100}, \gamma_{s100})\)

Hypothesis 2. When the main effect and the moderating effect of grand-mean centered baseline cognitive trait anxiety and somatic trait anxiety are controlled, a somatic technique (moving meditation) will be shown to be less effective than a cognitive technique (sitting meditation) for cognitive trait anxiety reduction. \(\text{(Matching Hypothesis: } \gamma_{c102})\)

Hypothesis 3. When the main effect and the moderating effect of cognitive trait anxiety and somatic trait anxiety are controlled, a somatic technique (moving meditation) will be shown to be more effective than a cognitive technique (sitting meditation) for somatic trait anxiety reduction. \(\text{(Matching Hypothesis: } \gamma_{s102})\)

Hypothesis 4. The higher the baseline trait anxiety of one domain (either cognitive or somatic) is, the more the same-domain trait anxiety will be reduced. \(\text{(Ceiling Effect: } \gamma_{c110}, \gamma_{s120})\)

Hypothesis 5. The higher the baseline trait anxiety of one domain (either cognitive or somatic) is, the less the trait anxiety of the opposite domain will be reduced. \(\text{(Facilitation Effect: } \gamma_{c120}, \gamma_{s110})\)

Hypothesis 6. Higher baseline cognitive trait anxiety will make the somatic technique (moving meditation) more effective and the cognitive technique (sitting meditation) less effective in reducing both cognitive and somatic anxiety. \(\text{(Interaction Effect: } \gamma_{c112}, \gamma_{s112})\)

Hypothesis 7. Higher baseline somatic trait anxiety will make the somatic technique (moving meditation) less effective and the cognitive technique (sitting meditation) more effective in reducing both cognitive and somatic anxiety. \(\text{(Interaction Effect: } \gamma_{c122}, \gamma_{s122})\)

The expected directions of the coefficients according to the hypotheses are
presented in Table 3.4.

Table 3.4

*Expected Direction of Coefficients Relevant to the Hypotheses*

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Effect</th>
<th>CANX Coefficient</th>
<th>Expected direction</th>
<th>SANX Coefficient</th>
<th>Expected direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Treatment Effect</td>
<td>$\gamma_{c100}$</td>
<td>(-)</td>
<td>$\gamma_{s100}$</td>
<td>(-)</td>
</tr>
<tr>
<td>H2</td>
<td>Differential Effect</td>
<td>$\gamma_{c102}$</td>
<td>(+)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>H3</td>
<td>Differential Effect</td>
<td>-</td>
<td>-</td>
<td>$\gamma_{s102}$</td>
<td>(-)</td>
</tr>
<tr>
<td>H4</td>
<td>Ceiling Effect</td>
<td>$\gamma_{c110}$</td>
<td>(-)</td>
<td>$\gamma_{s120}$</td>
<td>(-)</td>
</tr>
<tr>
<td>H5</td>
<td>Facilitation Effect</td>
<td>$\gamma_{c120}$</td>
<td>(+)</td>
<td>$\gamma_{s110}$</td>
<td>(+)</td>
</tr>
<tr>
<td>H6</td>
<td>Interaction Effect</td>
<td>$\gamma_{c112}$</td>
<td>(-)</td>
<td>$\gamma_{s112}$</td>
<td>(-)</td>
</tr>
<tr>
<td>H7</td>
<td>Interaction Effect</td>
<td>$\gamma_{c122}$</td>
<td>(+)</td>
<td>$\gamma_{s122}$</td>
<td>(+)</td>
</tr>
</tbody>
</table>
CHAPTER 4. RESULTS

This chapter consists of five sub-sections: 1) Data screening, 2) Preliminary analyses, 3) Hypotheses tests, 4) Post Hoc analyses. Data screening is to check whether any statistical assumption for MLM was violated. Preliminary analyses consist of tests of demographic influences, descriptive statistics and intra-class correlation. Assessment of treatment effect shows overall effectiveness of the meditation program regardless of the type of meditation. Assessment of moderation effect tests whether two meditation programs were differentially effective depending on the participants’ initial level of CANX and SANX. Post hoc analyses are to find out the optimal model explaining the data. Potentially important factors were explored and identified in the post hoc analyses to aid the interpretation of findings.

Data Screening

Before conducting inferential analyses for the study hypotheses, the data were explored to check for any violation in statistical assumptions involved in multilevel modeling (MLM). The MLM statistical analysis involves several assumptions in order to interpret results in a valid way. First, missing data were examined to check whether the pattern of missing data is missing at random (MAR). Second, statistical assumptions regarding a regression analysis were checked. Most assumptions required for a regression analysis also apply to MLM. Assessment of such assumptions can be done through residual analysis (Singer & Willet, 2003). The assumptions examined through the residual analysis were normality, linearity, homoscedasticity and multicollinearity.

Missing data. Missing data is not an uncommon phenomenon in longitudinal studies (Hedeker & Gibbons, 1997). The data set prepared for the current study also involved a portion of missing data. The proportion of missing data at each wave is
presented in Table 4.1.

Table 4.1

<table>
<thead>
<tr>
<th>Proportion of Missing Data</th>
<th>Wave 1</th>
<th>Wave 2</th>
<th>Wave 3</th>
<th>Wave 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting Meditation (N=21)</td>
<td>0</td>
<td>2 (10%)</td>
<td>4 (19%)</td>
<td>10 (48%)</td>
</tr>
<tr>
<td>Moving Meditation (N=21)</td>
<td>0</td>
<td>5 (24%)</td>
<td>7 (33%)</td>
<td>11 (52%)</td>
</tr>
<tr>
<td>Comparison Group (N=39)</td>
<td>0</td>
<td>14 (36%)</td>
<td>8 (21%)</td>
<td>23 (59%)</td>
</tr>
<tr>
<td>Final Total Sample (N=81)</td>
<td>0</td>
<td>21 (26%)</td>
<td>19 (23%)</td>
<td>44 (54%)</td>
</tr>
</tbody>
</table>

Note. The numbers of missing data at Wave 1 are all zero because samples without pretest scores were excluded from the analyses.

Even though an advantage of multilevel analysis of longitudinal data is its flexibility in handling missing data (Hox, 2002; Singer & Willett, 2003), valid interpretation of multilevel analysis still requires the condition that the data missingness should be missing completely at random (MCAR) or missing at random (MAR) (Singer & Willett, 2003). In MCAR, the data missingness does not depend on either observed or unobserved variables. In MAR, on the other hand, the missingness may depend on observed variables, but it is assumed that the missingness is independent of unobserved outcome variables (Hedeker & Gibbons, 1997; Hox, 2002). However, because the very data needed are missing, the independence between the data missingness and the unobserved variable cannot be empirically tested. Instead, a test for MCAR was conducted whether the data missingness is independent from the observed variables using logistic regression (Hedeker, 2012). The test was to determine whether dropping out from the survey could be predicted by measurement point, average score of the previous outcome measurement, treatment group membership and other demographic variables. The results showed that survey drop-out could be significantly predicted by the measurement timing (Wave 4), treatment group membership, and study participation incentive. Participants were more likely to drop out at Wave 4 compared to Wave 2, $\chi^2(1) = 22.43$, $p < .001$. The comparison
group was more likely to drop out than the treatment group, $\chi^2(1) = 7.15$, $p = .008$. Individuals without study participation incentive were more likely to drop-out than those with incentive, $\chi^2(1) = 13.51$, $p < .001$, after controlling for previous average somatic trait anxiety. The results after controlling for previous average cognitive trait anxiety were similar and both outcome measures were not significant predictors for drop-out. In sum, even though the data missing pattern was not missing completely at random (MCAR), no evidence was detected against missing at random (MAR). Thus, it was judged that the data missingness was MAR. Under this assumption of MAR, it was decided to conduct main multilevel modeling analyses using all available data with the full maximum likelihood estimation method without data imputation or listwise deletion. Also, it was planned to control for significant drop-out predictors (e.g., study participation incentive) in the main analyses (Singer & Willett, 2003).

Normality and Outliers. A basic normality test was conducted by examining the residuals from the unconditional growth model in a graphical way (Singer & Willet, 2003). Figure 4.1 illustrates the normal probability plots of the level 1 residuals from the unconditional growth model of cognitive trait anxiety (CANX) outcome.
As shown in Figure 4.1, the high congruence with normal distribution was evident by the display of the data points close to the diagonal line which represents a normal distribution of the data. One extreme outlier was detected in level 1 residuals, shown in the upper right corner of Figure 4.1. The potential outlier was from a participant’s Wave 2 score, which was the maximum score one could get from the survey. The participant’s cognitive and somatic trait anxiety score at Wave 2 were also exceptionally high compared to the participant’s scores at other waves. Thus, the participant’s Wave 2 data point was judged as an outlier and excluded from the additional assumption checks and main data analysis. After eliminating them, no other extreme outliers were detected from level 1 and level 2 residuals.

A more developed model was also examined to test the normality of the random

Figure 4.1. Normal probability plots of the unconditional growth model (Level 1 residuals for CANX)
coefficient of the level 1 predictors: TIME and a time-varying covariate TREAT\(^1\). The normality test results of skewness and kurtosis are summarized in Table 4.2.

**Table 4.2**

*Skewness and Kurtosis of Residuals of Each Outcome Variable*

<table>
<thead>
<tr>
<th>Residual</th>
<th>CANX</th>
<th>SANX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level 1</td>
<td>Level 2</td>
</tr>
<tr>
<td></td>
<td>(\varepsilon_{cij})</td>
<td>(u_{c1i})</td>
</tr>
<tr>
<td><strong>Skewness</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>.705</td>
<td>.225</td>
</tr>
<tr>
<td>N</td>
<td>239</td>
<td>81</td>
</tr>
<tr>
<td>SE</td>
<td>.158</td>
<td>.272</td>
</tr>
<tr>
<td>z</td>
<td>2.109</td>
<td>.909</td>
</tr>
<tr>
<td>p</td>
<td>.035</td>
<td>.363</td>
</tr>
<tr>
<td><strong>Kurtosis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>2.302</td>
<td>1.211</td>
</tr>
<tr>
<td>N</td>
<td>239</td>
<td>81</td>
</tr>
<tr>
<td>SE</td>
<td>.317</td>
<td>.544</td>
</tr>
<tr>
<td>z</td>
<td>2.695</td>
<td>1.492</td>
</tr>
<tr>
<td>p</td>
<td>.007</td>
<td>.136</td>
</tr>
</tbody>
</table>

*Note.* See equation 4.5a for the residual terms. For calculation of standard errors and z scores of skewness and kurtosis, refer to Tabachnick (2007). CANX = Cognitive Trait Anxiety, SANX = Somatic Trait Anxiety.

Skewness is a measure of the symmetry of a distribution and kurtosis is a measure of the peakness of a distribution. A perfect normal distribution has zero values for both measures. Applying the conservative alpha level (.001 for level 1 and .01 for level 2) (Tabachnick, 2007), the skewness and kurtosis of all level 1 and level 2 residuals were not significantly different from zero. Thus, it was judged that violation of the normality assumption was not evident.

**Linearity.** Linearity is an assumption that there is a straight-line relationship between two variables in a linear regression (Tabachnick, 2007). Residual analyses were conducted to check linearity using the unconditional growth model with ‘TIME’ as the growth factor. The assessments of the outcomes took place at \(M = -.02\) months.

\(^1\) See equation 4.5a for the residual terms used for the normality test (p.58).
(SD = .09, n = 81) for the baseline, at M = .86 (SD = .12, n = 60) for Wave 2, at M = 1.88 (SD = .14, n = 62) for Wave 3, and at M = 2.81 (SD = .15, n = 37) for Wave 4, respectively. Thus, mean time intervals between the assessments were .87 months, 1.02 months, and .94 months, respectively. It was judged that the time intervals were similar enough to treat them as equal in the analysis. Thus, the variable ‘TIME’ was set up to have the value of 0, 1, 2, and 3 in terms of months at waves 1, 2, 3, and 4, respectively. First, the correlation between level 1 residuals and TIME did not show significant correlation. Moreover, graphical observation of scatter plots of residuals and lowess line (Keith, 2005) suggested that there might be a non-linear relationship between level 1 residuals and TIME for CANX outcome of the comparison group:
Figure 4.2a. Level 1 Residuals and Lowess Line of CANX over Time: Comparison Group

Figure 4.2b. Level 1 Residuals and Lowess Line of CANX over Time: Treatment Group
As shown in Figures 4.2a and 4.2b, the slope between TIME 2 and 3 had different trends showing that the comparison group’s level of CANX dropped noticeably whereas the treatment group’s CANX level might went up slightly. The linearity vs. non-linearity of the outcome measures were examined in more detail and are presented in the main analyses section (pp.58-61).

*Homoscedasticity.* Homoscedasticity is another assumption for regression analysis, requiring that the variabilities of residuals around predicted outcome scores are the same at each level of predictor variables (Tabachnick, 2007). MLM also requires the assumption of *homoscedasticity* (Singer & Willet, 2003). As shown in Figures 4.2a and 4.2b, level 1, residual variances remained similar at each measurement point. Scatter plots plotted between level 2 residuals and predictor variables (baseline scores) also showed fairly homogenous variability trends. Thus, it was judged that the condition of homoscedasticity was not violated.

*Multicollinearity.* Multicollinearity refers to high correlation among predictors (Tabachnick, 2007). Multicollinearity should be avoided to acquire stable regression coefficients. When predictors are redundant in explaining an outcome variable, variances of coefficients can be inflated so that the coefficient estimates may become unstable (Tabachnick, 2007). In the current study, potential multicollinearity among predictors for level 2 random slope was examined through the ‘VIF’ option of SAS PROC REG. ‘VIF’ refers to variance inflation factor. As a rule of thumb, a variable with VIF over 10 may indicate the problem of collinearity (Regression with SAS, 2011). Even when level 2 predictors, such as two baseline scores, gender, race, age, incentive, treatment group membership, were added together in the calculation of regression of level 2 slopes, no predictors exceeded 10 on the VIF index. It was concluded that multicollinearity was not evident.
Preliminary Analyses

Demographic influences. To determine whether outcome variables differ depending on demographic variables, basic conditional multilevel analyses were conducted with each demographic variable as a moderating condition of the growth rates of CANX and SANX over time. First, there were no differences between the included sample (N = 81) and the excluded sample (N = 66) in terms of their rates of change over time in both outcomes: CANX (b = .259, p = .633), SANX (b = .121, p = .822). It was not evident that any selection bias was introduced in the inclusion criteria. For the inclusion criteria, refer to the Participants section of Chapter 3. The result also revealed that, within the included final sample (N = 81), there were no significant differences with regard to demographic variables except gender. The female students showed significantly lower rates of change than the male students for both CANX (b = -1.702, p=.005) and SANX (b = -1.853, p = .002). To reflect this result, it was planned to control for the influence of gender on the rate of change over time in the main analyses.

Descriptive Statistics. Mean, standard deviation, internal consistencies, and zero-order correlations for the outcome variables used in the main analyses were examined and are displayed in Table 4.3.
Table 4.3  
*Means, Standard Deviations, Internal Consistencies, and Correlations among Outcome Variables*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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</thead>
<tbody>
<tr>
<td>1. CANX1</td>
<td>81</td>
<td>21.05</td>
<td>6.33</td>
<td>(.86)</td>
<td>.60***</td>
<td>.58***</td>
<td>.64***</td>
<td>.67***</td>
<td>.27*</td>
<td>.27*</td>
<td>.40†</td>
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<tr>
<td>2. CANX2</td>
<td>60</td>
<td>21.85</td>
<td>6.88</td>
<td>(.89)</td>
<td>.65***</td>
<td>.43*</td>
<td>.39**</td>
<td>.67***</td>
<td>.39**</td>
<td>.31†</td>
<td></td>
</tr>
<tr>
<td>3. CANX3</td>
<td>62</td>
<td>20.94</td>
<td>6.79</td>
<td>(.90)</td>
<td>.70***</td>
<td>.49***</td>
<td>.41**</td>
<td>.70***</td>
<td>.60***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. CANX4</td>
<td>37</td>
<td>20.49</td>
<td>7.41</td>
<td>(.92)</td>
<td>.45**</td>
<td>.35*</td>
<td>.42**</td>
<td>.66***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. SANX1</td>
<td>81</td>
<td>18.04</td>
<td>5.20</td>
<td>(.83)</td>
<td>.43***</td>
<td>.50***</td>
<td>.53***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. SANX2</td>
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<td>18.17</td>
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<td>(.90)</td>
<td>.45***</td>
<td>.53**</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>7. SANX3</td>
<td>62</td>
<td>18.56</td>
<td>6.71</td>
<td>(.91)</td>
<td>.76***</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
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<td>8. SANX4</td>
<td>37</td>
<td>17.78</td>
<td>6.12</td>
<td>(.92)</td>
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<td></td>
<td></td>
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</tbody>
</table>

*Note.* Cronbach’s alphas are presented in parentheses on the diagonal. CANXj = Cognitive Trait Anxiety at Wave j; SANXj = Somatic Trait Anxiety at Wave j. †p<.10, *p<.05, **p<.01, ***p<.001.

The internal consistency estimates presented along the diagonal in Table 4.3 indicate that the CANX and SANX have acceptable levels of internal consistency in the current college student sample. Similarly, split-half reliability coefficient was .87 for the cognitive factor, and .84 for the somatic factor in Ree’s (2008) scale development study. All correlations were significant with one exception (CANX2 and SANX4) of marginal significance. No unusual values were detected among descriptive statistics.

*Intra-class Correlation.* In a two-level regression analysis for longitudinal data, repeated measures (level 1) are nested within a person (level 2). Adoption of two-level regression analysis can be justified when two conditions are met. First, variance in each level should significantly differ from 0. If it does not differ from 0, then the variance at that level would be attributable only to error terms so that it cannot be explained by predictors. Second, a considerable amount of variance should be attributable to both level 1 and level 2. If either of level 1 or level 2 takes most of the total variance, then multilevel approach would not explain the data much better than a single level regression analysis. The unconditional means
model depicted by equation 4.1 was examined to verify if the first condition was met:

\[
\begin{align*}
\text{Level 1:} & \quad Y_{ij} = \beta_{0i} + \varepsilon_{ij} \\
\text{Level 2:} & \quad \beta_{0i} = \gamma_{00} + u_{0i}
\end{align*}
\] (4.1)

\(Y_{ij}\): Outcome score of person \(i\)'s \(j\)th measurement point,
\(\beta_{0i}\): Level 1 intercept
\(\gamma_{00}\): Level 2 intercept
\(\varepsilon_{ij}\): Level 1 residuals
\(u_{0i}\): Level 2 residuals

The results showed that level 1 and level 2 variances of residuals were all significantly different from zero for both CANX (\(\sigma^2_\varepsilon = 14.464, p < .001\) and \(\sigma^2_0 = 29.695, p < .001\)) and SANX (\(\sigma^2_\varepsilon = 13.826, p < .001\) and \(\sigma^2_0 = 19.730, p < .001\)).

Next, an intra-class correlation (ICC) was calculated for each outcome variable with the formula as in equation 4.2 (Singer & Willet, 2003):

\[
\text{ICC} = \frac{\sigma^2_0}{\sigma^2_0 + \sigma^2_\varepsilon}
\] (4.2)

\(\sigma^2_\varepsilon\): Level 1 intercept residual variance
\(\sigma^2_0\): Level 2 intercept residual variance

Intra-class correlations (ICC) of each variable were .60 for CANX and .50 for SANX. These results mean that the variations in outcome variables are attributable to individual differences by 60% for CANX and 50% for SANX and to intra-individual differences over time by 40% for CANX and 50% for SANX, respectively. The results suggest that the variations in outcomes cannot be explained solely by either intra-individual difference (level 1) or individual difference (level 2). Thus, it was justified to use the two-level analysis approach rather than single level regression analyses to explain the data of the current study.
Hypotheses Tests

Model developments for the treatment effects assessment (H1). Means and standard deviations for the comparison (No Meditation) and treatment (Meditation) group at each Wave are displayed in Table 4.4.

Table 4.4

<table>
<thead>
<tr>
<th></th>
<th>No Treatment</th>
<th>Treatment (Meditation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>1. CANX1</td>
<td>39</td>
<td>20.59</td>
</tr>
<tr>
<td>2. CANX2</td>
<td>25</td>
<td>22.20</td>
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<tr>
<td>3. CANX3</td>
<td>31</td>
<td>22.16</td>
</tr>
<tr>
<td>4. CANX4</td>
<td>16</td>
<td>19.44</td>
</tr>
<tr>
<td>5. SANX1</td>
<td>39</td>
<td>18.18</td>
</tr>
<tr>
<td>6. SANX2</td>
<td>25</td>
<td>18.68</td>
</tr>
<tr>
<td>7. SANX3</td>
<td>31</td>
<td>19.84</td>
</tr>
<tr>
<td>8. SANX4</td>
<td>16</td>
<td>17.38</td>
</tr>
</tbody>
</table>

Note. CANXj = Cognitive Trait Anxiety at Wave j, SANXj = Somatic Trait Anxiety at Wave j.

The trends of the overall anxiety (CANX + SANX) are depicted in Figure 4.3.

Figure 4.3. Trends of overall anxiety over time. ANX = CANX + SANX.
Two approaches were considered to assess treatment effects. One is to use a level 2 predictor and the other is to use level 1 time-varying covariate. In the first approach, the level 2 predictor is a dummy variable indicating the treatment group membership: 1 = the treatment group versus 0 = the comparison group. Then, the coefficient of the dummy variable represents the difference between the treatment group and the comparison group. Equation 4.3 represents the first approach for the outcome of CANX:

\[
\text{CANX}_{ij} = \beta_{c0i} + \beta_{c1i} \text{TIME}_{ij} + \epsilon_{cij}
\]

\[
\beta_{c0i} = \gamma_{c000} + \gamma_{c001} \text{TX}_i + u_{c0i}
\]

\[
\beta_{c1i} = \gamma_{c100} + \gamma_{c101} \text{TX}_i + u_{c1i}
\]

In equation 4.3, TIME was coded 0, 1, 2, and 3 for Waves 1, 2, 3, and 4, respectively. TX_i refers to group membership of individual i (1 = treatment group, 0 = comparison group). Then, coefficient \( \gamma_{c001} \) represents the difference in the baselines of the treatment and comparison groups and coefficient \( \gamma_{c101} \) represents the difference in the rates of change. This approach assumes that each participant of the treatment group received the treatment homogeneously throughout the program period. On the other hand, the second approach does not assume homogenous treatment across individuals. By considering a treatment variable as a time-varying covariate, it allows different treatment dose levels over time for individuals. The following equation represents the second approach:

\[
\text{CANX}_{ij} = \beta_{c0i} + \beta_{c1i} \text{TIME}_{ij} + \beta_{c2i} \text{TREAT}_{ij} + \epsilon_{cij}
\]

\[
\beta_{c0i} = \gamma_{c000} + \gamma_{c001} \text{TX}_i + u_{c0i}
\]

\[
\beta_{c1i} = \gamma_{c100} + u_{c1i}
\]

\[
\beta_{c2i} = \gamma_{c200} + u_{c2i}
\]
In equation 4.4, \( TREAT_{ij} \) refers to treatment dose measured by individual \( i \)'s number of meditation program attendance by \( j^{th} \) measurement point. Coefficient \( \gamma_{c100} \) involving the level 1 predictor \( \text{TIME} \) can be interpreted as the average rate of change in \( \text{CANX} \) over time when the meditation program is not treated at all. Coefficient \( \gamma_{c200} \) explaining the level 1 predictor \( \text{TREAT} \) indicates the effect of a unit meditation session on \( \text{CANX} \). The advantage of the time-varying covariate model is that it would more accurately reflect the shape of the growth trajectory than the first approach when there is variability in the degree of the treatment received (McCoach & Kaniskan, 2010). This approach assumes that the treatment effect is proportionate to the number of occasions of program attendance. It was judged that the time-varying treatment model would be more appropriate for hypotheses tests of the current study because the treatment group participants of the current study (\( N = 42 \)) had considerable variability in the degree of treatment they received: \( M = 5.81, \ SD = 1.65, \ Range = 6 \). Model comparison will be made between the first and second approaches in a later section (Model 4.3 vs Model 4.4 in Table 4.5).

In addition to using a time-varying covariate model, another aspect was considered in assessing treatment effects to reflect a potential statistical artifact, so called, regression to the mean. Regression to the mean is a tendency in repeated measures for values higher than the mean to be followed by lower values and for values lower than the mean to be followed by higher values (Aickin, 2009). The phenomenon of regression to the mean can be controlled for by including baseline measure as a predictor of the intercept and the slope of \( \text{TIME} \) as follows (George, June, & David, 1990; Glymour et al., 2005):
\[ \text{CANX}_{ij} = \beta_{c0i} + \beta_{c1i} \text{TIME}_{ij} + \beta_{c2i} \text{TREAT}_{ij} + \varepsilon_{cij} \]
\[ \beta_{c0i} = \gamma_{c00} + \gamma_{c010} \text{CANX0}_{ci} \]
\[ \beta_{c1i} = \gamma_{c10} + \gamma_{c110} \text{CANX0}_{ci} + u_{c1i} \]
\[ \beta_{c2i} = \gamma_{c20} + u_{c2i} \] (4.5a)

Note that the sub-equation explaining the level 1 intercept in equation 4.5a does not have a residual term. This is because the level 1 intercept would be perfectly predicted by the baseline score of each individual. Thus, equation 4.5a is equivalent to equation 4.5b which adopts the change score as outcome variable and drops the level 1 intercept:

\[ \Delta \text{CANX}_{ij} = \beta_{c1i} \text{TIME}_{ij} + \beta_{c2i} \text{TREAT}_{ij} + \varepsilon_{cij} \]
\[ \beta_{c1i} = \gamma_{c10} + \gamma_{c110} \text{CANX0}_{ci} + u_{c1i} \]
\[ \beta_{c2i} = \gamma_{c20} + u_{c2i} \] (4.5b)

‘\( \Delta \text{CANX}_{ij} \)’ denotes the change of individual i’s cognitive trait anxiety from the baseline to wave j. The model represented by equation 4.5a or 4.5b is conceptually consistent with the current study design in the sense that the initial status is not estimated but is used as a predictor.

Consideration was also given to the potential non-linear trends of the outcomes in the treatment assessment. As described in the section on the linearity checks, it was suspected that there was a considerable shift of the trend between Wave 3 and Wave 4. Among the four waves, the first three waves of data were collected during the semester or the meditation program period whereas the fourth wave of data was collected after the semester or the meditation programs ended. It is conceivable that trends of college students’ trait anxiety would differ between a college semester and a break. To reflect the data observation and the possible substantial reason underlying
the trends of the data, a piecewise linear model was additionally tested. A piecewise linear model is a combination of linear models with different slopes (Singer & Willet, 2003). In data which can be advantageously explained by a piecewise linear model, the rate of change in outcome becomes different at a certain point. Equation 4.6 shows a piecewise linear model:

\[
CANX_{ij} = \beta_{c0i} + \beta_{c1i} \text{TIME}_{ij} + \beta_{c2i} \text{TREAT}_{ij} + \beta_{c3i} \text{POST}_{ij} + \epsilon_{cij}
\]

\[
\beta_{c0i} = \gamma_{c00} + \gamma_{c010} \text{CANX0c}_i
\]

\[
\beta_{c1i} = \gamma_{c10} + \gamma_{c110} \text{CANX0c}_i + \epsilon_{c1i}
\]

\[
\beta_{c2i} = \gamma_{c20} + \epsilon_{c2i}
\]

\[
\beta_{c3i} = \gamma_{c30} + \gamma_{c301} \text{TX}_i
\]

In equation 4.6, the level 1 predictor POST\(_{ij}\) refers to time passage since Wave 3, thus coded as: \(\text{POST}_{ij} = (\text{TIME}_{ij} - 2)\) if \(j > 3\) and \(\text{POST}_{ij} = 0\) if \(j \leq 3\).\(^2\) With this coding scheme, the coefficient \(\beta_{c3i}\) means additional growth factor over time after the meditation programs ended. Depending on the treatment group membership, the additional growth factor is determined as either \(\gamma_{c300}\) for the comparison group or \(\gamma_{c300} + \gamma_{c301}\) for the treatment group. According to the plot observations (Figure 4.2 and 4.3), the additional growth factor of the comparison group (\(\gamma_{c300}\)) is expected to be negative and the additional growth factor difference between the treatment group and the comparison group (\(\gamma_{c301}\)) is expected to be positive.

**Results of model comparisons for the treatment effects assessment.** Additional preliminary analyses were conducted to determine whether the demographic variables have influence on the unit treatment session effect. Assessment of the program effects on each outcome was conducted with the four models described by equations (4.3), (4.4), (4.5) and (4.6). The model fitting results are compared in Table 4.5.

\(^2\) For more detailed information on a piecewise linear model and its coding scheme, refer to Fitzmaurice et al. (2011, p.149 – 152).
### Table 4.5

<table>
<thead>
<tr>
<th>Model</th>
<th>Model 4.1</th>
<th>Model 4.3</th>
<th>Model 4.4</th>
<th>Model 4.5</th>
<th>Model 4.6</th>
</tr>
</thead>
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<td>Outcome = CANX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model Fit Indices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2LL</td>
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<td>1452.9</td>
<td>1450.6</td>
<td>1247.7</td>
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<tr>
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<td>17.0 (5)</td>
<td>-</td>
<td>-</td>
<td>32.0 (2)</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>.004</td>
<td>-</td>
<td>-</td>
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<tr>
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<td>-2.3</td>
<td>-204.3</td>
<td>-28.0</td>
<td></td>
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<td>M1 vs M3</td>
<td>M3 vs M4</td>
<td>M4 vs M5</td>
<td>M5 vs M6</td>
<td></td>
</tr>
<tr>
<td>Variance Components</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1 $\sigma_{cc}^2$</td>
<td>14.46***</td>
<td>11.08***</td>
<td>10.72***</td>
<td>5.97***</td>
<td>4.75***</td>
</tr>
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<td>30.61***</td>
<td>30.99***</td>
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<td></td>
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<tr>
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<td>1.90*</td>
<td>6.47***</td>
<td>7.51***</td>
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<tr>
<td>TREAT $\sigma_{c2}^2$</td>
<td>-</td>
<td>.73*</td>
<td>.91*</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td>.259</td>
<td>.587</td>
<td>.672</td>
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<td>-</td>
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<td>.095</td>
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<td>Model Comparison</td>
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<td>M3 vs M4</td>
<td>M4 vs M5</td>
<td>M5 vs M6</td>
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<td>Variance Components</td>
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<td></td>
</tr>
<tr>
<td>Level 1 $\sigma_{cc}^2$</td>
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<td>10.98***</td>
<td>11.24***</td>
<td>5.98***</td>
<td>5.84***</td>
</tr>
<tr>
<td>Intercept $\sigma_{c0}^2$</td>
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<td>16.46***</td>
<td>15.74***</td>
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<td></td>
</tr>
<tr>
<td>TIME $\sigma_{c1}^2$</td>
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<td>3.13*</td>
<td>6.09***</td>
<td>5.87***</td>
<td></td>
</tr>
<tr>
<td>TREAT $\sigma_{c2}^2$</td>
<td>.62†</td>
<td>.98**</td>
<td>.95**</td>
<td></td>
<td></td>
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<tr>
<td>Pseudo R² Statistics</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Level 1 $R_{cc}^2$</td>
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<td>.187</td>
<td>.568</td>
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<td>Intercept $R_{c0}^2$</td>
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<td>.202</td>
<td>-</td>
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</tr>
<tr>
<td>TIME $R_{c1}^2$</td>
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<td>-</td>
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<td></td>
<td></td>
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<tr>
<td>TREAT $R_{c2}^2$</td>
<td>-</td>
<td>-</td>
<td>.031</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Models with better model fit indices were made bold and underlined. All results are presented after controlling for gender and study incentive except model 4.1. To conserve space, level 2 covariances are not presented. † p<.10. * p<.05. ** p<.01. *** p<.001.
In comparing Model 4.3, 4.4 and 4.5, Akaike Information Criterion (AIC) was used because the models are not nested in each other. For both CANX and SANX, AIC of Model 4.4 is slightly smaller than that of Model 4.3 and AIC of Model 4.5 is much smaller than that of Model 4.4. Results of Model 4.4 and 4.5 contrast the change of variance component of the unit treatment session effect. The variance of the unit treatment dose effect on CANX converged to zero when the intercept was allowed to vary (Model 4.4) whereas the variance of the unit treatment dose effect on CANX was significantly different from zero (estimate = .73, p = .025) when the intercept was fixed by letting it be predicted by the baseline score (Model 4.5). This trend was not detected in the results for SANX. The variance of the unit treatment dose effect was marginally significant even when the intercept was allowed to vary (estimate = .62, p = .078).

Model 4.5 was nested in Model 4.6, thus deviance statistic (-2LL) was used to compare them. The deviance statistic (-2LL) of Model 4.6 was significantly smaller than that of Model 4.5 considering the degree of freedom, $\chi^2(2) = 32.0, p < .001$ for CANX, but not for SANX, $\chi^2(2) = 4.7, p = .095$. It appears that the level 1 predictor POST additionally explains a considerable amount of variance in CANX (.587 to .672, 8.5%), but not in SANX (.587 to .609, 2.2%) as can be seen from the results of variance components and Pseudo $R^2$ in Table 4.4. Pseudo $R^2$ Statistics measures the proportion of change in variance from the basic model to the model of interest (Singer & Willet, 2003). Even though the model fit of Model 4.5 was slightly better than Model 4.6 for SANX, Model 4.6 was determined as the final model for both CANX and SANX so that the assessment for each outcome could be consistent and comparable by controlling for the effect of POST for both outcomes.
Results of the treatment effects assessment. Based on the model fitting results, the treatment effects on each outcome were assessed by using Model 4.6. Overall meditation treatment effects per session were shown to be significant both for CANX, \( b = -.62, p = .004 \), and for SANX, \( b = -.42, p = .028 \) after controlling for the effect of TIME and POST. The effect size of the treatment effect was calculated following the guideline of Feingold (2009). A formula to calculate effect size in a growth modeling analysis was suggested as follows:

\[
    d = \frac{\text{Average growth rate difference between groups} \times \text{Time}}{\text{Pooled standard deviation at baseline}} \quad (4.7a)
\]

In the time-varying treatment model of the current study, formula 4.7a can be modified as follows:

\[
    d = \frac{\text{Effect of unit treatment session} \times \text{Average number of attendance}}{\text{Pooled standard deviation at baseline}} \quad (4.7b)
\]

The treatment sample’s average number of meditation session attendance was \( M = 5.81 \) (SD = 1.65). The pooled standard deviation of the baseline of each outcome variable was 6.33 for CANX and 5.20 for SANX. The effect size of each outcome was .52 for CANX and .45 for SANX. Applying a common rule of thumb (small = .20, medium = .50, large = .80; Cohen, 1988), the overall meditation program was assessed to have medium effect size for both outcomes. The results of treatment effect assessments for each outcome are summarized in Table 4.6.
Table 4.6

*Fixed Effects of Model 4.6 and Effect Sizes*

<table>
<thead>
<tr>
<th></th>
<th>CANX</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\gamma_{000}$</td>
<td>$\gamma_{000}$</td>
<td>$\gamma_{000}$</td>
</tr>
<tr>
<td>Intercept</td>
<td>21.22***</td>
<td>17.91***</td>
<td>39.13***</td>
</tr>
<tr>
<td>TIME</td>
<td>$\gamma_{c100}$</td>
<td>$\gamma_{s100}$</td>
<td>$\gamma_{c110}$</td>
</tr>
<tr>
<td></td>
<td>1.17*</td>
<td>.88†</td>
<td>-.15**</td>
</tr>
<tr>
<td>POST</td>
<td>$\gamma_{c300}$</td>
<td>$\gamma_{s301}$</td>
<td>$\gamma_{c301}$</td>
</tr>
<tr>
<td></td>
<td>5.72***</td>
<td>-2.21***</td>
<td>7.83***</td>
</tr>
</tbody>
</table>

(1) Unit Dose Effect | $\gamma_{c200}$ | $\gamma_{s200}$ |
|                    | -.57*   | -.40*    |

(2) Average Dose | 5.81 | 5.81 | 5.81 |
(3) Program Effect [(1)x(2)] | -3.31 | -2.32 | -5.52 |
(4) Baseline SD | 6.33 | 5.20 | 10.56 |
(5) Effect Size [(3)/(4)] | .52 | .45 | .52 |

Note: ANX = CANX + SANX. Models with better model fit indices are bolded and underlined. All results are presented after controlling for gender and study participation incentive. †p<.10. *p<.05. **p<.01. ***p<.001.

It should be noted that the parameter estimates of TIME and POST in Table 4.6 portray qualifications of the treatment assessment. The negative direction of the treatment effect does not mean that the treatment group’s CANX and SANX were reduced during the program period because the average rate of change in CANX and SANX over time within the treatment group does not significantly differ from zero, $b = -.493$, p = 0.229 for CANX and $b = -.270$, p = 0.960 for SANX. Instead, the results suggest that the treatment effects of the meditation programs prevented the students’ CANX and SANX from increasing during the college semester. In addition, even though anxiety levels in the treatment group during the post-semester time period appear to increase according to Figure 4.3 (p.55), the trends did not significantly differ from zero ($b = 1.440$, p = 0.107 for CANX and $b = .787$, p = 0.375 for SANX), which suggest that the increase of anxieties in the treatment group during the post-semester is
due to random sampling error. Because the practice history of the comparison group was not available, it could not be tested how much portion of the treatment effects were attributable to the participants’ individual meditation practice.

**Modeling Differential Effect.** Means and standard deviations for sitting and moving meditation condition are displayed in Table 4.7.

<table>
<thead>
<tr>
<th></th>
<th>Sitting</th>
<th></th>
<th></th>
<th>Moving</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CANX1</td>
<td>21</td>
<td>21.76</td>
<td>4.71</td>
<td>21</td>
<td>21.19</td>
<td>7.21</td>
</tr>
<tr>
<td>2. CANX2</td>
<td>19</td>
<td>22.42</td>
<td>5.54</td>
<td>16</td>
<td>20.63</td>
<td>8.15</td>
</tr>
<tr>
<td>3. CANX3</td>
<td>17</td>
<td>20.65</td>
<td>6.72</td>
<td>14</td>
<td>18.57</td>
<td>5.85</td>
</tr>
<tr>
<td>4. CANX4</td>
<td>11</td>
<td>22.55</td>
<td>7.16</td>
<td>10</td>
<td>19.90</td>
<td>9.61</td>
</tr>
<tr>
<td>5. SANX1</td>
<td>21</td>
<td>17.33</td>
<td>4.23</td>
<td>21</td>
<td>18.48</td>
<td>4.93</td>
</tr>
<tr>
<td>6. SANX2</td>
<td>19</td>
<td>17.63</td>
<td>5.44</td>
<td>16</td>
<td>18.00</td>
<td>8.53</td>
</tr>
<tr>
<td>7. SANX3</td>
<td>17</td>
<td>16.71</td>
<td>5.50</td>
<td>14</td>
<td>18.00</td>
<td>5.32</td>
</tr>
<tr>
<td>8. SANX4</td>
<td>11</td>
<td>18.18</td>
<td>5.13</td>
<td>10</td>
<td>18.00</td>
<td>7.62</td>
</tr>
</tbody>
</table>

*Note.* CANXj = Cognitive Trait Anxiety at Wave j, SANXj = Somatic Trait Anxiety at Wave j.

Before testing interaction effects, the overall differential effects between sitting meditation and moving meditation was assessed by adding a level 2 predictor denoting the type of meditation to Model 4.6:

\[
\text{CANX}_{ij} = \beta_{c0i} + \beta_{c1i} \text{TIME}_{ij} + \beta_{c3i} \text{POST}_{ij} + \beta_{c2i} \text{TREAT}_{ij} + \varepsilon_{cij}
\]

\[
\beta_{c0i} = \gamma_{c00} + \gamma_{c01} \text{CANX0c}_i
\]

\[
\beta_{c1i} = \gamma_{c10} + \gamma_{c11} \text{CANX0c}_i + u_{c1i}
\]

\[
\beta_{c3i} = \gamma_{c30} + \gamma_{c31} \text{TX}_i
\]

\[
\beta_{c2i} = \gamma_{c20} + \gamma_{c201} \text{MOV}_i + u_{c2i}
\]

Variable MOV\(_i\) represents whether an individual \(i\) belongs to the moving meditation group or not (e.g., MOV = 1 for moving meditation condition, and MOV = 0 otherwise). It should be noted that the group represented by MOV = 0 includes not only individuals in the sitting meditation group but also in the comparison group.
However, when the model of equation 4.8 tests the treatment effect, three groups (comparison, sitting and moving) are distinguished in two steps. The first distinction is made at level 1 by contrasting the comparison group and the treatment group as a whole. The second distinction is made at level 2 by contrasting the moving meditation group versus the sitting meditation group, both of which belong to the treatment group. Thus, the dummy variable MOV in the last sub-equation of equation 4.8 signifies the type of meditation because the sub-equation involves only the treatment group as the result of the distinction at level 1 so that the variable MOV in the equation 4.8 can take the role of contrasting the sitting versus moving meditation condition. The matching hypotheses of the multi-process theory would expect that the moving meditation would be less effective than the sitting meditation in reducing cognitive anxiety, but more effective than the sitting meditation in reducing somatic anxiety. However, these hypotheses were not supported. The results of the test of the average differential effects per session between the two techniques were not all significant, \( b = -.355, p = .137 \) for CANX and \( b = -.256, p = .224 \) for SANX.

**Modeling Interaction Effect and Hypotheses Tests.** To test the main hypotheses, an interaction model was developed by adding the aptitude variables and interaction variables to Model 4.8:

\[
\begin{align*}
\text{CANX}_{ij} &= \beta_{c0i} + \beta_{c1i} \text{TIME}_{ij} + \beta_{c3i} \text{POST}_{ij} + \beta_{c2i} \text{TREAT}_{ij} + \varepsilon_{cij} \\
\beta_{c0i} &= \gamma_{c000} + \gamma_{c010} \text{CANX}_{0c_i} \\
\beta_{c1i} &= \gamma_{c100} + \gamma_{c110} \text{CANX}_{0c_i} + u_{c1i} \\
\beta_{c3i} &= \gamma_{c300} + \gamma_{c301} \text{TX}_{i} \\
\beta_{c2i} &= \gamma_{c200} + \gamma_{c201} \text{MOV}_{i} + \gamma_{c210} \text{CANX}_{0c_i} + \gamma_{c211} \text{MOV}_{i} \text{CANX}_{0c_i} + \gamma_{c220} \text{SANX}_{0c_i} + \gamma_{c221} \text{MOV}_{i} \text{SANX}_{0c_i} + u_{c2i} 
\end{align*}
\]

There are three kinds of predictor variables in the level 2 equation involving the random coefficient \( \beta_{c2i} \) of equation 4.9. The first is the type of meditation (MOV). The
second is aptitude: baseline cognitive trait-anxiety (CANX0c) and baseline somatic trait-anxiety (SANX0c). The third type is the product of variables between treatment and the two aptitudes: MOV x CANX0c and MOV x SANX0c. The baseline measure predictors are centered at the grand mean by subtracting the whole sample’s mean score from individual scores to facilitate interpretation of the coefficients of the intercepts (Dedrick et al., 2009). Also, an effect coding was used to represent the values of the treatment variable “MOV” (1 = moving meditation condition, -1 = sitting meditation condition) instead of a dummy coding. Because the main effects of baseline measures on rate of change (H4 ceiling effect and H5 facilitation effect) were parts of the study interests, the effect coding would facilitate the interpretation of the relevant coefficient estimates in the data analysis results. The analysis framework denoted by equation 4.9 can be graphically illustrated as in Figure 4.4.
Figure 4.4. Multilevel interaction model for the hypotheses tests of the current study. Level 1 predictor POST was omitted for parsimony of the figure. Arrows without circles represent fixed effects; arrows with circles represent random effects. CANX = Cognitive trait anxiety; CANX0c = Baseline cognitive trait anxiety centered at the overall mean; SANX = Somatic trait anxiety; SANX0c = Baseline somatic trait anxiety centered at the overall mean; TREAT = number of treatment sessions attended; MOV = Type of meditation technique (1 = moving, -1 = sitting).

The directions of the five coefficients $\gamma_{c202}$, $\gamma_{c210}$, $\gamma_{c220}$, $\gamma_{c212}$ and $\gamma_{c222}$ for CANX show the test results of Hypotheses 2, 4, 5, 6 and 7 stated in Chapter 2, respectively. In the same way, the directions of the five coefficients $\gamma_{s202}$, $\gamma_{s220}$, $\gamma_{s210}$, $\gamma_{s212}$ and $\gamma_{s222}$ for SANX show the test results of Hypotheses 3, 4, 5, 6 and 7 stated in Chapter 2, respectively. It must be noted that Hypothesis 4 also involves path coefficient $\gamma_{c110}$ for
CANX and $\gamma_{s120}$ for SANX. The hypotheses test results are summarized in Table 4.8.

Table 4.8  
Results of the Hypotheses Tests

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Effect</th>
<th>Coefficient</th>
<th>Expected direction</th>
<th>Estimate</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>Treatment Effect $\gamma_{c200}$</td>
<td>(-)</td>
<td>-.617</td>
<td>-3.01</td>
<td>.006</td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>Differential Effect $\gamma_{c202}$</td>
<td>(+)</td>
<td>-1.60</td>
<td>-1.28</td>
<td>.202</td>
<td></td>
</tr>
<tr>
<td>H4</td>
<td>Ceiling Effect $\gamma_{c110}$</td>
<td>(-)</td>
<td>-.164</td>
<td>-2.32</td>
<td>.022</td>
<td></td>
</tr>
<tr>
<td>H4</td>
<td>Ceiling Effect $\gamma_{c210}$</td>
<td>(-)</td>
<td>.012</td>
<td>.34</td>
<td>.736</td>
<td></td>
</tr>
<tr>
<td>H5</td>
<td>Facilitation Effect $\gamma_{c220}$</td>
<td>(+)</td>
<td>-.023</td>
<td>-.59</td>
<td>.557</td>
<td></td>
</tr>
<tr>
<td>H6</td>
<td>Interaction Effect $\gamma_{c212}$</td>
<td>(-)</td>
<td>.002</td>
<td>.08</td>
<td>.937</td>
<td></td>
</tr>
<tr>
<td>H7</td>
<td>Interaction Effect $\gamma_{c222}$</td>
<td>(+)</td>
<td>.008</td>
<td>.24</td>
<td>.815</td>
<td></td>
</tr>
<tr>
<td>SANX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>Treatment Effect $\gamma_{s200}$</td>
<td>(-)</td>
<td>-.445</td>
<td>-2.45</td>
<td>.022</td>
<td></td>
</tr>
<tr>
<td>H3</td>
<td>Differential Effect $\gamma_{s202}$</td>
<td>(-)</td>
<td>-.070</td>
<td>-.63</td>
<td>.530</td>
<td></td>
</tr>
<tr>
<td>H4</td>
<td>Ceiling Effect $\gamma_{s120}$</td>
<td>(-)</td>
<td>-.152</td>
<td>-2.04</td>
<td>.044</td>
<td></td>
</tr>
<tr>
<td>H4</td>
<td>Ceiling Effect $\gamma_{s220}$</td>
<td>(-)</td>
<td>-.037</td>
<td>-.89</td>
<td>.376</td>
<td></td>
</tr>
<tr>
<td>H5</td>
<td>Facilitation Effect $\gamma_{s210}$</td>
<td>(+)</td>
<td>.033</td>
<td>1.39</td>
<td>.166</td>
<td></td>
</tr>
<tr>
<td>H6</td>
<td>Interaction Effect $\gamma_{s212}$</td>
<td>(-)</td>
<td>-.029</td>
<td>-1.21</td>
<td>.227</td>
<td></td>
</tr>
<tr>
<td>H7</td>
<td>Interaction Effect $\gamma_{s222}$</td>
<td>(+)</td>
<td>.017</td>
<td>.53</td>
<td>.598</td>
<td></td>
</tr>
</tbody>
</table>

Note. Significant results are bold and underlined. The coefficient estimates are the results from the effect coding.

As can be seen from Table 4.8, the treatment effects (H1) were also confirmed by the interaction model. The magnitudes of the effects were similar to the results from the treatment assessment model (Model 4.6): estimate = -.57 (Model 4.6) vs -.62 (Model 4.9) for CANX and estimate = -.40 (Model 4.6) vs -.45 (Model 4.9) for SANX.

After controlling for baseline measures’ main effect and moderation effect, it was expected that the moving meditation would be less effective than sitting meditation in reducing CANX (H2), but more effective in reducing SANX (H3) (Matching Hypotheses). These hypotheses can be represented by the positive
direction of the coefficient $\gamma_{c202}$ for H2 and the negative direction of the coefficient $\gamma_{s202}$ for H3. Neither of them was significant, which means that the two meditation techniques were similarly effective for those with an average level of baseline anxieties.

Hypothesis 4 expected that the higher the baseline trait anxiety of one domain (either cognitive or somatic) is, the more the same-domain trait anxiety will be reduced (Ceiling effect). This hypothesis can be represented by the negative direction of coefficients $\gamma_{c210}$ and $\gamma_{s220}$ regarding level 1 predictor TREAT and coefficient $\gamma_{c110}$ and $\gamma_{s120}$ regarding level 1 predictor TIME. As can be seen in Table 4.8, the coefficients regarding TREAT ($\gamma_{c210}$ and $\gamma_{s220}$) were not significant for both CANX and SANX, but the coefficients regarding TIME ($\gamma_{c110}$ and $\gamma_{s120}$) were significant for both CANX and SANX.

Hypothesis 5 expected that the lower the baseline trait anxiety of one domain (either cognitive or somatic) is, the more the trait anxiety of the opposite domain will be reduced (Facilitation Effect). This hypothesis can be represented by the positive direction of both coefficients $\gamma_{c220}$ and $\gamma_{s210}$. As can be seen in Table 4.8, neither of them was significant, which means that Hypothesis 5 was not supported.

Hypothesis 6 expected that higher baseline cognitive trait anxiety will make the somatic technique (moving meditation) more effective and the cognitive technique (sitting meditation) less effective in reducing both cognitive and somatic anxiety. This hypothesis can be represented by the negative direction of both coefficient $\gamma_{c213}$ and $\gamma_{s213}$. Neither of them was significant, which means that Hypothesis 6 was not supported.

Hypothesis 7 expected that higher baseline somatic trait anxiety will make the somatic technique (moving meditation) less effective and the cognitive technique
(sitting meditation) more effective in reducing both cognitive and somatic anxiety. This hypothesis can be represented by the positive direction of both coefficient $\gamma_{c223}$ and $\gamma_{s223}$. Neither of them was significant, which means that Hypothesis 7 was not supported.

In summary, according to the main hypotheses tests, the existence of the interaction between the aptitudes and the type of the treatment was not evident.

Post Hoc Analyses

Four post hoc analyses were conducted. First, it was tested whether previous meditation experience played a role as a higher-order moderator (equation 4.10). The second test was to examine whether the model could be simplified by combining the separate aptitude variables into their ratio variable (equation 4.11). The third post hoc test was to verify the presence of simplified interaction disregarding the aptitude variables (equation 4.12). The fourth test examined the mediating effects of individual meditation practice (equation 4.13).

Higher-order interaction. Unlike Kabat-Zinn et al. (1997), the participants of the current study were not all new to meditation. In the survey questionnaire, various types of meditation were listed to check the participants’ meditation practice history (Appendix D, p.112). Displayed in Table 4.9 is the distribution of the practice duration of the meditation which each treatment participant practiced for the largest amount of time among the listed meditations in the survey questionnaire. For a meaningful analysis, the columns indicating previous meditation experience (Less than 2 months, 2 to 24 months, More than 24 months) were collapsed into presence of meditation experience (n=23, 55%). Displayed in Table 4.10 are means and standard deviations for each meditation condition under different previous meditation practice history.
Table 4.9
Distribution of the duration of previously practiced meditation for the Treatment group

<table>
<thead>
<tr>
<th>Meditation Program</th>
<th>No Experience</th>
<th>Experience</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
<td>Less than 2 months</td>
<td>2-24 months</td>
</tr>
<tr>
<td>Sitting</td>
<td>8</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Moving</td>
<td>11</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>19 (45%)</td>
<td>13</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 4.10
Means and Standard Deviations at Each Meditation Program Depending on Previous Meditation Experience

<table>
<thead>
<tr>
<th>Meditation Program</th>
<th>No Experience</th>
<th>Experience</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sitting</td>
<td>Moving</td>
<td>Sitting</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>1. CANX1</td>
<td>8</td>
<td>21.05</td>
<td>6.33</td>
</tr>
<tr>
<td>2. CANX2</td>
<td>8</td>
<td>21.85</td>
<td>6.88</td>
</tr>
<tr>
<td>3. CANX3</td>
<td>8</td>
<td>20.94</td>
<td>6.79</td>
</tr>
<tr>
<td>4. CANX4</td>
<td>7</td>
<td>20.49</td>
<td>7.41</td>
</tr>
<tr>
<td>5. SANX1</td>
<td>8</td>
<td>18.04</td>
<td>5.20</td>
</tr>
<tr>
<td>6. SANX2</td>
<td>8</td>
<td>18.17</td>
<td>6.34</td>
</tr>
<tr>
<td>7. SANX3</td>
<td>8</td>
<td>18.56</td>
<td>6.71</td>
</tr>
<tr>
<td>8. SANX4</td>
<td>7</td>
<td>17.78</td>
<td>6.12</td>
</tr>
</tbody>
</table>

*Note. CANXj = Cognitive Trait Anxiety at Wave j, SANXj = Somatic Trait Anxiety at Wave j,*
Furthermore, by including a dummy variable EXP (1 = experience, 0 = no experience) as a higher-order moderator in the model, it was tested whether the interaction effects between the type of meditation and baseline anxiety measures (MOV x CANX0c and MOV x SANX0c) differed depending on the existence of the previous meditation experience (EXP). The equation model for this test is as follows:

\[
\text{CANX}_{ij} = \beta_{c0i} + \beta_{c1i} \text{TIME}_{ij} + \beta_{c3i} \text{POST}_{ij} + \beta_{c2i} \text{TREAT}_{ij} + e_{cij}
\]

\[
\begin{align*}
\beta_{c0i} &= \gamma_{c00} + \gamma_{c010} \text{CANX0c}_i \\
\beta_{c1i} &= \gamma_{c100} + \gamma_{c110} \text{CANX0c}_i + u_{c1i} \\
\beta_{c3i} &= \gamma_{c300} + \gamma_{c301} \text{TX}_i \\
\beta_{c2i} &= \gamma_{c200} + \gamma_{c202} \text{MOV}_i + \gamma_{c200} \text{EXP}_i + \gamma_{c204} \text{MOV}_i \times \text{EXP}_i \\
&+ \gamma_{c210} \text{CANX0c}_i + \gamma_{c212} \text{MOV}_i \times \text{CANX0c}_i + \gamma_{c213} \text{EXP}_i \times \text{CANX0c}_i + \gamma_{c214} \text{MOV}_i \times \text{EXP}_i \times \text{CANX0c}_i \\
&+ \gamma_{c220} \text{SANX0c}_i + \gamma_{c222} \text{MOV}_i \times \text{SANX0c}_i + \gamma_{c223} \text{EXP}_i \times \text{SANX0c}_i + \gamma_{c224} \text{MOV}_i \times \text{EXP}_i \times \text{SANX0c}_i + u_{c2i}
\end{align*}
\]

(4.10)

The interaction results are summarized in Table 4.11.

### Table 4.11

<table>
<thead>
<tr>
<th>Variable</th>
<th>Higher-order Interaction</th>
<th>Non-meditators</th>
<th>Meditators</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOV</td>
<td>$\gamma_{c204}$</td>
<td>1.057**</td>
<td>$\gamma_{c202}$</td>
</tr>
<tr>
<td>MOV x CANX0c</td>
<td>$\gamma_{c214}$</td>
<td>.316***</td>
<td>$\gamma_{c212}$</td>
</tr>
<tr>
<td>MOV x SANX0c</td>
<td>$\gamma_{c224}$</td>
<td>-.170†</td>
<td>$\gamma_{c222}$</td>
</tr>
</tbody>
</table>

**Outcome : CANX**

| MOV      | $\gamma_{c204}$ | .263 | $\gamma_{c202}$ | -.378 | $\gamma_{c202} + \gamma_{c204}$ | -.115 |
| MOV x CANX0c | $\gamma_{c214}$ | .289* | $\gamma_{c212}$ | -.249** | $\gamma_{c212} + \gamma_{c214}$ | .040 |
| MOV x SANX0c | $\gamma_{c224}$ | -.238 | $\gamma_{c222}$ | .228† | $\gamma_{c222} + \gamma_{c224}$ | .009 |

**Outcome : SANX**

*Note.* †p<.10. *p<.05. **p<.01. ***p<.001.

The results in the first row of each outcome in Table 4.11 show the differential effect between the sitting meditation and the moving meditation for those with average levels of baseline CANX and baseline SANX. The matching hypotheses
would expect that the moving meditation would be less effective than the sitting meditation in reducing CANX (Hypothesis 2) but more effective in reducing SANX (Hypothesis 3). The matching hypotheses were not supported. Opposite to the expectation, the moving meditation was significantly more effective than the sitting meditation for those without previous meditation in reducing CANX ($\gamma_{c202}$). In other cases, the two meditations were similarly effective ($\gamma_{c204} + \gamma_{c202}$, $\gamma_{s202} + \gamma_{s204}$). The second row of each outcome shows the change of the differential effect by unit change in baseline CANX. Hypothesis 6 expected that the higher baseline cognitive trait anxiety would make the moving meditation relatively more effective and the sitting relatively less effective. This hypothesis was supported among non-meditators ($\gamma_{c212}$, $\gamma_{s212}$), but not among meditators ($\gamma_{c214} + \gamma_{c212}$, $\gamma_{s212} + \gamma_{s214}$). The third row shows the change of the differential effect by unit change in baseline SANX. Hypothesis 7 expected that the higher baseline somatic trait anxiety would make the moving meditation relatively less effective and the sitting relatively more effective. This hypothesis was supported among non-meditators ($\gamma_{c222}$, $\gamma_{s222}$), but not among meditators ($\gamma_{c224} + \gamma_{c222}$, $\gamma_{s222} + \gamma_{s224}$). The column of higher-order interaction shows if and how much the differential effects differ between non-meditators and meditators.

In sum, the results suggest that Aptitude-Treatment Interactions were present among non-meditators, but not among meditators. Within the non-meditator group, there was a significant tendency for individuals with high baseline CANX to get more benefit from moving meditation than sitting meditation in reducing both CANX and SANX. Another trend, which requires cautious interpretation, was that moving meditation appeared to be less effective for individuals with high baseline SANX in reducing CANX and SANX, but it was not statistically significant. It seemed that beginning meditators are influenced by the type of meditation technique in
conjunction with their level of baseline anxiety measures. These results were largely consistent with the expectations of the main hypotheses of the current study. The results in Table 4.11 can be graphically illustrated as in Figure 4.5a and Figure 4.5b.
Figure 4.5a. Plot of regression lines illustrating interactions for non-meditators. Numbers on the horizontal lines are ±SD around the mean. MOV = Type of meditation (moving vs. sitting). \( \Delta \text{CANX} \) and \( \Delta \text{SANX} \) are changes in CANX and SANX per unit meditation session, respectively.
Figure 4.5b. Plot of regression lines illustrating interactions for meditators.
Interaction with a combined aptitude measure. Even though coefficients for interaction terms in the model of equation 4.10 were significant and model fit also improved, it seemed to be necessary to modify the model. First, introducing a higher-order moderator in the model made the analysis model complex. Moreover, the separate measures of CANX0 and SANX0 per se are of little practical value as aptitude constructs. When it comes to the purpose of informing meditation instructors' decision between cognitive vs. somatic meditation technique, the results on CANX0 and SANX0 from the model of equation 4.10 implied the opposite directions of suggestions within the non-mediator subgroup. For example, within the subgroup without previous meditation experience, the results of Model 4.10 would suggest matching high CANX0 with somatic technique and high SANX0 with cognitive technique. However, as a previous study and the current study show, CANX and SANX are positively correlated: $r = .53$, $p<.01$ in Grös et al. (2007) and $r = .68$, $p<.001$ in the current study. In other words, those with high CANX also tend to have high SANX. Therefore, the suggestions considering CANX0 and SANX0 may cancel each other so that the direction for the technique selection would be indeterminable.

The issue mentioned above raised the necessity to integrate the two potential aptitude variables and assess their influences simultaneously. For this purpose, as Davidson and Schwartz (1976) mentioned, the ratio of cognitive and somatic trait anxiety (CANX0/SANX0) was introduced in Model 4.12 to distinguish the relative dominance between two anxiety traits. The ration measure was also centered at the grand mean of the whole sample. In sum, the centered ratio measure (RATIOc) in Model 4.12 would have advantages of making the analysis model more parsimonious and information from the results more practically useful:
CANX\(_{ij} = \beta_{c0i} + \beta_{c1i} \text{TIME}\(_{ij} + \beta_{c2i} \text{TREAT}\(_{ij} + \beta_{c3i} \text{POST}\(_{ij} + \varepsilon_{cij}

(4.11)

\begin{align*}
\beta_{c0i} &= \gamma_{c00} + \gamma_{c010} \text{CANX}_{0i} + \gamma_{c020} \text{MOV}_{i} + \gamma_{c030} \text{RATIO}_{i} \text{c} + \gamma_{c040} \text{EXP}_{i} \\
\beta_{c1i} &= \gamma_{c10} + \gamma_{c110} \text{CANX}_{0i} + u_{c1i} \\
\beta_{c2i} &= \gamma_{c200} + \gamma_{c202} \text{MOV}_{i} + \gamma_{c203} \text{EXP}_{i} \\
\beta_{c3i} &= \gamma_{c300} + \gamma_{c301} \text{TX}_{i} + \gamma_{c302} \text{MOV}_{i} + \gamma_{c303} \text{RATIO}_{i} \text{c} + \gamma_{c304} \text{EXP}_{i}
\end{align*}

The model fit of Model 4.11 was similar or better than Model 4.10: AIC = 1237.3 (Model 4.10) vs 1238 (Model 4.11) for CANX and AIC = 1262.8 (Model 4.10) vs 1256.5 (Model 4.11) for SANX. Even though Model 4.10 was slightly better (by .7) than Model 4.11 in terms of AIC, BIC of Model 4.12 (1285.9) was better than Model 4.10 (1294.8). A model with smaller AIC or BIC is a better model. The results also revealed the significant interactions. The results on interaction are summarized in Table 4.12.

Table 4.12

<table>
<thead>
<tr>
<th>Variable</th>
<th>Higher-order Interaction</th>
<th>Non-meditators</th>
<th>Meditators</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOV</td>
<td>(\gamma_{c204}) .471*</td>
<td>(\gamma_{c202}) - .533***</td>
<td>(\gamma_{c202} + \gamma_{c204}) -.062</td>
</tr>
<tr>
<td>MOV x RATIOc</td>
<td>(\gamma_{c234}) 1.821**</td>
<td>(\gamma_{c232}) - 1.209**</td>
<td>(\gamma_{c232} + \gamma_{c234}) .611</td>
</tr>
<tr>
<td>Outcome : SANX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOV</td>
<td>(\gamma_{c204}) .192</td>
<td>(\gamma_{c202}) - .229</td>
<td>(\gamma_{c202} + \gamma_{c204}) -.037</td>
</tr>
<tr>
<td>MOV x RATIOc</td>
<td>(\gamma_{c234}) 1.833*</td>
<td>(\gamma_{c232}) - 1.797**</td>
<td>(\gamma_{c232} + \gamma_{c234}) .036</td>
</tr>
</tbody>
</table>

* p<.05. ** p<.01. *** p<.001.

The first row of each outcome in Table 4.12 shows the differential effect between the sitting meditation and the moving meditation for those with average levels of ratio between two baseline anxiety measures. The second row of each outcome shows how differential effects change depending on the ratio of two baseline anxiety measures. The results in Table 4.12 can be graphically illustrated as in Figure 4.6.
Figure 4.6. Plot of regression lines illustrating interactions with a combined aptitude measure. RATIOc is the combined aptitude (degree of dominance of CANX0 over SANX0, centered at grand mean (M=1.19, SD = .30). MOV = Type of meditation (moving vs. sitting). ΔCANX and ΔSANX are changes in CANX and SANX per unit meditation session, respectively.
Figure 4.6 displays the interaction results within the range of plus/minus standard deviation around the average level of the aptitude. Overall, Figure 4.6 suggests that there was significant interaction between the aptitude and treatment for those without previous meditation experience (non-meditators), whereas there was no interaction for those with previous meditation experience (meditators). As for the effect on CANX within the non-meditators, moving meditation was better than sitting meditation for those with dominance of cognitive anxiety or average level of relative dominance, and the two meditation methods had similar effects for those with dominance of somatic anxiety. A similar pattern was shown for the effect on SANX within the non-meditators, as moving meditation was better than sitting meditation for those with dominance of cognitive anxiety and the two meditation methods had similar effects for those with dominance of somatic anxiety or average level of relative dominance.

The above post hoc analyses results qualify the conclusions of the main analyses. Indeed, there was no evidence for the existence of aptitude-treatment interaction within the meditator sub-group. And yet, it was evident that the aptitude-treatment interaction existed within the non-meditator sub-group.

*Interactions disregarding aptitude measures.* Simplified higher-order interactions disregarding two aptitude variables were tested to see whether the differential average effects per session between the sitting and the moving differ depending on the previous meditation experience regardless of the aptitude variables.

\[
\text{CANX}_{ij} = \beta_{c0i} + \beta_{c1i} \text{TIME}_{ij} + \beta_{c3i} \text{POST}_{ij} + \beta_{c2i} \text{TREAT}_{ij} + \epsilon_{ij} \\
\beta_{c0i} = \gamma_{c00} + \gamma_{c010} \text{CANX0c}_i \\
\beta_{c1i} = \gamma_{c100} + \gamma_{c110} \text{CANX0c}_i + \nu_{c1i} \\
\beta_{c3i} = \gamma_{c300} + \gamma_{c301} \text{TX}_i \\
\beta_{c2i} = \gamma_{c200} + \gamma_{c202} \text{MOV}_i + \gamma_{c203} \exp_i + \gamma_{c204} \text{MOV}_i \exp_i + \nu_{c2i}
\] (4.12)
The average differential effects per session regardless of the two aptitude variables are presented in Table 4.13.

### Table 4.13

*Overall Differential Effects Depending on Meditation Experience*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Higher-order Interaction</th>
<th>Non-meditators</th>
<th>Meditators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Estimate</td>
<td>Coefficient</td>
</tr>
<tr>
<td>CANX</td>
<td>$\gamma_{c204}$</td>
<td>.792†</td>
<td>$\gamma_{c202}$</td>
</tr>
<tr>
<td>SANX</td>
<td>$\gamma_{s204}$</td>
<td>.397</td>
<td>$\gamma_{s202}$</td>
</tr>
<tr>
<td>ANX</td>
<td>$\gamma_{204}$</td>
<td>1.021</td>
<td>$\gamma_{202}$</td>
</tr>
</tbody>
</table>

*Note.* ANX = CANX + SANX. †p<.10. *p<.05.

The results show that the average differential effects between the sitting meditation and the moving meditation did not differ significantly depending on the previous meditation experience. However, within the non-meditator group, the moving meditation appeared to be more effective than the sitting meditation in reducing cognitive trait anxiety and overall trait anxiety. Figure 4.7 illustrate the results.
Figure 4.7. Plot of regression lines illustrating interaction between the type of meditation technique and previous meditation experience. ΔCANX, ΔSANX are changes in CANX and SANX per unit meditation session, respectively.

Mediation of Individual Practice. Additional tests were conducted to investigate whether the treatment effects and the interaction effects of program attendance were mediated by the participants’ individual practice. Conventionally, there are three necessary conditions for mediation (Baron & Kenny, 1986). The relationship between the independent variable and outcome variable should be statistically significant. The relationship between the independent variable and the mediator variable should be
The relationship between the mediator variable and the outcome variable should be statistically significant. Additionally, the relationship between the independent variable and the outcome variable should become insignificant after controlling for the relationship between the mediator variable and the outcome variable. The mediation tests for the treatment effect satisfied all conditions for mediation. However, the interaction effect was not shown to be mediated by the individual practice. The mediation of the interaction effect requires that the moderator variable moderates the relationship between the independent variable and the mediator variable or the relationship between the mediator variable and the outcome variable. The test results showed that there was no interaction among the type of meditation, ratio of baseline anxiety measures and previous meditation experience in the effect of program attendance on the amount of individual practice ($b = 5.376, p = .443$). There was no interaction among the type of meditation, ratio of baseline anxiety measures and previous meditation experience in the effect of individual practice on both CANX ($b = -.154, p = .599$) and SANX ($b = -.296, p = .384$). Thus, it was concluded that the interaction effects between type of meditation, ratio of baseline anxiety measures and previous meditation experience were not mediated by individual practice.
CHAPTER 5. DISCUSSION

This chapter discusses the implications and application of the results presented in Chapter 4. First, the findings of the main and post hoc analyses are briefly discussed with reference to possible explanations. Topics discussed are treatment effects (H1), matching hypothesis (H2, H3), ceiling effects (H4), facilitation effects (H5) and interaction effects (H6, H7). Second, the current study’s theoretical implications and their relevance to questions addressed in previous studies on meditation are discussed. Third, the implications for practice are suggested. Next, limitations of the study are reviewed and suggestions for future research are presented. The chapter closes with a summary conclusion for the whole dissertation.

Discussion of Findings

Treatment effects. Hypothesis 1 is a criterion for a summative evaluation of two meditation programs’ effectiveness in reducing participants’ trait anxiety levels. Hypothesis 1, stated that the participants in two meditation treatment groups would reduce both cognitive trait-anxiety and somatic trait-anxiety more than the participants in the comparison group comparing the longitudinal data from pretest through post treatment. This hypothesis was not supported by the results. The initial results failed to meet the criterion of significant effectiveness. However, a closer examination of the repeated measures enabled me to make refined inference about the effects of the meditation programs. Refined analysis of the findings revealed non-linear trends for the comparison control group. In the comparison control group, both cognitive anxiety and somatic anxiety tended to increase during the semester, and then decrease to about the same baseline pretest levels of the beginning of the semester. This finding seems to indicate that cognitive and somatic trait anxiety as measured by the current instrument are stable constructs even though college students may
experience anxiety-provoking experiences during the college semester. On the other hand, the treatment groups showed linear trends of maintaining the same level of trait-anxieties throughout the semester, and did not experience the mid-semester increases reported by the control cohort. From this result, it can be inferred that the meditation programs may have alleviated the participants’ stress of the semester during the meditation treatment period, thus preventing an increase in their levels of anxiety. However, the fact that the treatment groups and the comparison control group did not differ in their final measures of cognitive and somatic trait anxiety suggests that the benefits of the meditation programs did not continue to improve following the termination of the program, and the programs’ duration of eight weeks was not sufficient to change participants’ anxiety traits.

Matching hypothesis. Hypotheses 2 and 3 state that a somatic meditation technique would be less effective than a cognitive meditation technique in reducing cognitive trait anxiety (Hypothesis 2), yet more effective in reducing somatic trait anxiety (Hypothesis 3) after controlling for the main effect and the moderating effect of the grand-mean centered baseline cognitive and somatic trait anxiety. These hypotheses address the matching hypothesis that an instructional method directed at the participants’ dominant anxiety type would be more efficacious. Differently from Schwartz, Davidson and Goleman (1978), the current hypotheses address the differential effectiveness after controlling for the baseline anxieties’ main effects and moderating effect. In the analyses of the current study, the baseline measures were centered at the grand-means of the total sample. Thus, Hypotheses 2 and 3 were intended to test the matching hypothesis (Schwartz, Davidson and Goleman, 1978) at the average levels of the two baseline measures. These hypotheses were not supported by the results. There were no significant differential effects between sitting meditation
and moving meditation in reducing cognitive trait anxiety and somatic anxiety at the average levels of baseline cognitive and somatic trait anxiety. In conclusion, one technique was not more effective than another for either cognitive or somatic anxiety.

_**Ceiling effect.**_ Hypothesis 4 stated that the higher the baseline trait anxiety of one domain (either cognitive or somatic), the more significantly the trait anxiety of the same domain would be reduced. This hypothesis was supported. The baseline cognitive trait anxiety negatively predicted the rate of change over time in the cognitive trait anxiety. Moreover, the baseline somatic trait anxiety negatively predicted the rate of change over time in somatic trait anxiety. This result is consistent with Kabat-Zinn et al. (1997). However, the reasons for these results are not straightforward. Three probable theories are discussed. First, the regression toward the mean over time may have been caused by a statistical artifact (Barnett et al., 2005). Regression toward the mean refers to “a tendency for subjects who score below average on a test to do better next time, and for those who score above average to do worse (Hopkins, 2002).” The regression toward the mean for the STICSA measure may be a statistical artifact due to measurement error of the instrument, but it may also reflect natural change over time (Aikin, 2009). These two possibilities could not be distinguished within the current analytical framework because the current study did not correct for measurement error. Thus, it is not clear whether the negative relationship between the baseline score and the rate of change over time was caused by statistical artifact or true natural change. The third potential explanation is the differential treatment effect depending on the baseline scores. Within a treatment group, the treatment may be more effective for those with more severe symptoms and less effective for those with less severe symptoms. This possibility was not supported. After controlling for the negative relationship between a baseline anxiety and rate of
change over time, the relationship between a baseline anxiety and change of the same domain of anxiety by a single treatment session was not significant.

**Facilitation effect.** Hypothesis 5 stated that the higher the baseline trait anxiety of one domain (either cognitive or somatic) was, the less the trait anxiety of the opposite domain would be reduced. This hypothesis supposed that the traits of two systems of the human body and mind have a reciprocal relationship in such a way that earlier stability of one system has a positive influence on the other system’s later stability, whereas earlier instability of one system has a negative influence on the other system’s later stability. This perspective was not supported by the results of the current study.

When the current results for the ceiling effect and facilitation effect are taken together, the implication may be that there are no general relationships between type and level of baseline trait anxieties and their changes by a meditation treatment. However, considering the different design and analysis frameworks, the current results are not directly contrary to findings reported by Kabat-Zinn et al. (1997). The first difference is that the participants in the Kabat-Zinn study received various meditation treatments in one program. The meditation treatments had different degrees of cognitive and somatic components: sitting meditation, body scan and Hatha Yoga. On the other hand, the participants in the current study received only either cognitive (sitting meditation) or somatic meditation (moving meditation). It is possible that different treatments may change the way aptitudes or attributes of learners influence the outcome.

Second, the outcome Kabat-Zinn investigated was simply overall change from pretest to the conclusion of the meditation program, whereas the outcome in the current study was change per meditation session after controlling for the time effect.
The goal of the analytic approach in the current study was to account for the considerable variation in dosage of treatment. In other words, participation in meditation sessions varied among the participants in the current study. The different analysis approach might also result in the different results.

Third, the relevant results of Kabat-Zinn were more suggestive than conclusive. The study simply showed the percentages of anxiety reduction among subgroups with different levels of cognitive or somatic trait anxiety and did not conduct significance tests for the difference between groups. Thus, Kabat-Zinn (1997) did not show hard evidences for ceiling effect and facilitation effect as these pertain to meditation practice. Moreover, the suggested relationships in Kabat-Zinn’s study were drawn from the results when the level of the other mode of anxiety (e.g., cognitive or somatic) was high. When the level of the opposite mode of anxiety is average or below average, the relationships may change. In other words, there could be an interaction between the two modes of baseline trait anxieties for the outcomes of anxiety reductions.

*Interaction effect.* Hypothesis 6 stated that higher baseline cognitive trait anxiety would make the somatic technique (moving meditation) more effective and the cognitive technique (sitting meditation) less effective in reducing both cognitive and somatic anxiety. Hypothesis 7 stated that higher baseline somatic trait anxiety will make the somatic technique (moving meditation) less effective and the cognitive technique (sitting meditation) more effective in reducing both cognitive and somatic anxiety. Hypotheses 6 and 7 were formulated based on the Kabat-Zinn (1997) study to examine the relationships between the participants’ dominant mode of anxiety expression and their meditation technique preference. A significant finding of the Kabat-Zinn study (1997) suggested that participants with dominantly higher CANX0
than SANX0 tended to prefer somatic technique (Hatha Yoga) whereas those with dominantly higher SANX0 than CANX0 tended to prefer cognitive technique (sitting meditation). Based on the finding, Kabat-Zinn and his colleagues suggested the potential benefit of matching a meditation technique to the opposite mode of dominant anxiety expression (somatic technique to CANX dominance vs. cognitive technique to SANX dominance). Under the assumption that preference of meditation technique and the reduction of the anxiety outcomes would be positively correlated, the present study predicted that the somatic technique would be relatively more beneficial than the cognitive technique for participants whose CANX is dominant anxiety expression.

The initial main analyses results did not support the interaction hypotheses in general, but the post hoc analyses found that the expected interaction was present within the subgroup sample of non-meditators. The sample of the current study was not homogeneous in terms of their previous meditation experience. Among the 42-person treatment sample, 23 subjects (55%) had various types of meditation practice experience before participation in the meditation programs of the present study.

In the case of the meditators, the differential effects between the two meditation techniques (sitting vs. moving) on the two outcome measures (CANX and SANX) were not significant regardless of the dominance of one anxiety mode over the other. However, within the subgroup of non-meditators, the somatic technique (moving meditation) was shown to be more effective than the cognitive technique (sitting meditation) in reducing both CANX and SANX for those whose CANX0 was dominant over SANX0 in reducing both types of anxieties (see Figure 4.4 on p.67). In other words, there was a significant interaction between the type of meditation technique and the relative dominance of baseline cognitive vs. somatic trait anxiety.
within the non-meditator group. This finding was not observed within the other subgroup (meditators). It appears that the potential hindrance of high cognitive anxiety in non-meditators was facilitated by the somatic technique, but meditators with cognitive anxiety dominance did not seem to need such facilitation by the somatic technique.

**Theoretical Implications**

The current study does not support the multi-process theory (Davidson & Schwartz, 1976; Schwartz et al., 1978), which claimed that a relaxation technique for a given mode would be more effective in reducing the same mode of anxiety than the technique for the other mode of anxiety. The multi-process theory and the current study’s claim differ in two aspects. First, the present study could not reach the conclusion that a certain meditation technique is more effective in reducing a specific mode of anxiety than it is in reducing the other mode of anxiety. When a technique did not have an effect on cognitive anxiety, the technique did not have an effect on somatic anxiety either, and vice versa. On the other hand, when a technique had an effect on cognitive anxiety, it also had an effect on somatic anxiety, and vice versa. This finding is consistent with the study of Gill et al. (2003), whose data showed that a cognitive relaxation technique and a somatic relaxation technique were similarly effective in reducing both cognitive and somatic state anxiety. As claimed by Gill et al. (2003), it appears that change in one mode of anxiety leads to change in the other mode of anxiety due to the interconnected nature of the human body and mind.

Second, the current study suggests that the type of meditation technique (cognitive vs. somatic) can be sensitive to the participants’ type of anxiety trait in producing a relaxation effect. Ree and colleagues (2008) showed that the scale of cognitive and trait anxieties are not only the summed measure of one’s cognitive and
somatic anxiety experience but also the type of stressor and degree of vulnerability to the stressors. The implication of her study for this dissertation is that if a certain anxiety trait is high, it is likely that the meditation learner will experience the same-mode meditation technique as a stressor. For example, if one’s cognitive trait anxiety is high, a cognitive meditation technique may be stressful to learn. This line of thought is consistent with Smith (1990), who claimed that different relaxation techniques require different levels of relaxation skill. An important difference of the current study from Smith (1990) is that the current study paid attention to not only cognitive aptitude but also somatic aptitude. Smith’s (1990) primary interest in relaxation skill concerned cognitive ones such as focusing, whereas the current study demonstrated the relevance of both cognitive and somatic aptitude.

The second line of thought necessitates reexamination of the concept of cognitive technique vs. somatic technique. The current study claims that another dimension, such as the level of difficulty of a given technique, must be considered in investigating the differential effectiveness of multiple meditation techniques. In Davidson’s multi-process theory, the distinction between cognitive technique and somatic technique was made according to the ‘locus of attentional focus’ (Davidson et al., 1976). For example, hypnotic suggestion is a cognitive technique because an individual generates cognitive activity such as imagining certain situations as guided by a facilitator of the hypnosis. On the other hand, Hatha Yoga is a somatic technique because one actively generates physical yogic behavior. Davidson et al. (1976) also mentioned the active/passive dimension which is similar to the dimension of level of difficulty. For example, Davidson et al. (1976) categorized the breathing of Zen meditation as passive somatic activity and the physical motions of Hatha Yoga as active somatic activities. However, they did not consider how the active/passive
dimension might have influenced the relaxation effects. The current study claims that this issue is a missing chain of reasoning which the multi-process theory failed to consider. When a meditation learner perceives a given meditation technique as difficult, his/her attention will not be facilitated or even distracted by the meditation practice. For example, participants with high somatic trait anxiety are likely to feel that the movements of the Shipsang meditation, investigated as a moving meditation in the current study, are hard to follow. In this case, their attentions are likely to be distracted by the perceived difficulty and discomfort of the movements.

The essential difference of the two meditation techniques used in the current study lies in the object of awareness and attention. The object of attention in the sitting meditation was the breath whereas the object of attention in the moving meditation was slow motions adapted from Taichi and Qigong. As far as the object of attention is concerned, both techniques involve the somatic aspect, as Davidson et al. (1976) theorized, because both breath and physical motions are related with one’s body. However, moving meditation can be said to be more somatic than sitting meditation in that the bodily movement, the object of attention in moving meditation, is more actively generated physical behavior whereas the breath in sitting meditation is more passively generated. It is probable that individuals with high somatic anxiety would experience more difficulty in generating active movements than passive/natural movements.

In the domain of awareness/attention, the sitting meditation can be said to be more cognitive than moving meditation in that the former requires a higher level of attention control ability than the latter. It is because the breath, the object of attention in sitting meditation, is a weak stimulus which would require high cognitive skill to maintain one’s attention to it. On the other hand, the slow motions in moving
meditation, adapted from Taichi and Qigong, are relatively stronger stimuli to focus on because they are more physically strong and visually vivid than the breath. It is likely that stronger stimuli attract one’s attention more easily and so would enable an individual to pay constant attention to the intended object. Moreover, the instructor in the moving meditation program used continuous guidance to let the students follow his moving meditation motions whereas minimal guidance was provided during the sitting meditation program. This aspect would make the moving meditation less cognitively challenging. In sum, the moving meditation required less attention control ability than the sitting meditation. Thus, individuals with high cognitive anxiety, whereby one’s attention would be hindered (Eysenck & Graydon, 1989), would be better facilitated by the moving meditation than the sitting meditation.

Combined with the above discussions, the nature of cognitive/somatic trait anxieties, the aptitudes of the current study, are aligned with the claims of the current study. Ree and colleagues (2008) discovered that the type of trait anxiety, either cognitive or somatic, represents “the type of stressor under which an individual will display elevated state anxiety (p.328).” Applying this finding to the current study, it can be said that individuals with dominant cognitive trait anxiety over somatic trait anxiety would be more vulnerable to cognitive stressors than somatic stressors whereas those with dominant somatic trait anxiety over cognitive trait anxiety would be more vulnerable to somatic stressors than cognitive stressors. Considering the dimension of difficulty in the two meditation techniques, the sitting meditation can be regarded as a cognitive stressor and moving meditation as a somatic stressor. It should be noted that this classification is not an absolute one because the perception of the individual is an important factor in the discussion of stress (Lazarus & Folkman, 1984). Because learners’ characteristics and general tendencies would be strong
factors determining the instructional effectiveness and attractiveness at least in the beginning stage, it can be claimed that less stressful instructional technique would be more effective than more stressful technique. Following this line of thought, compared to the sitting meditation, a cognitively stressful or challenging technique, the moving meditation, a somatically stressful or challenging technique, would be relatively effective for those with dominant cognitive trait anxiety over somatic trait anxiety and relatively ineffective for those with dominant somatic trait anxiety over cognitive trait anxiety.

Attention also needs to be paid to the difference between individuals with and without previous meditation experience. The results in Chapter 4 suggest that the moving meditation and the sitting meditation did not differ in their effects of reducing cognitive and somatic anxieties for individuals with previous meditation experience. This implies that individuals with previous meditation experience tend to be insensitive to types of meditation technique prescribed regardless of their dominant type of anxiety expression. This can be interpreted to mean that even though a technique may be challenging, meditators could be receptive of such challenging aspects of a meditation technique.

The important process of learning meditation involves not just self-regulation of one's attention to the desirable object such as the breath. An equally or more important part of the meditation learning process takes place when one cannot follow the intended guidance for attention and is distracted by intrusions of other thoughts and feelings from one's body and mind. Davidson's multi-process theory may be applied to the situation when the meditation learners are able to follow the instruction and the training session continues for a short period of time. Without guidance or even with guidance, it is not an easy task, especially for beginning meditators, to sustain one's
attention on one object for an extended period of time. The different results between Davidson and Kabat-Zinn might originate from these different contexts of the meditation or relaxation practices. Davidson's review (1976) was of mostly research-oriented experimental conditions whereas Kabat-Zinn's study context was the actual professional field of treating patients. Researchers in experiments can make more efforts to ensure the participants follow the intended procedures. However, it is not desirable or even possible for a meditation teacher in a field meditation program to control the participants to make them follow the intended internal procedures of attention. On this matter, Kabat-Zinn emphasizes the importance of the manner of a meditation instructor's guidance for meditation. He or she may invite the participants but not force them. This aspect of meditation instruction needs to be entailed in the attitude of a meditation instructor. Furthermore, the current study implies that the invitational meditation instruction can be designed through the application of proper techniques in their proper order considering the participants’ cognitive and somatic characteristics.

Practical Implications and Suggestions

The findings of this study have significant implications for the design and delivery of a meditation program. First, this study demonstrated that meditation technique selection may have influence on the effectiveness of a meditation program for beginning meditation learners. Also, this study showed that cognitive and somatic characteristics of participants measured by a trait anxiety scale for each domain are information worthwhile to consider in designing a meditation program. A suggestion from this study for the design of a meditation program is that a cognitively challenging technique needs to be prescribed for less cognitively vulnerable students and a somatically challenging technique for less somatically vulnerable students,
especially for beginning meditation learners. However, this suggestion should not be accepted as generalizable information for meditation technique selection depending on the learner’s cognitive and somatic trait anxieties. Learner characteristics and situational conditions, which need to be considered for the design of an effective meditation program, would not be limited to such anxiety traits of the learners. A meditation instructor needs to be flexible enough to adapt and adjust the instruction while delivering the instructional program.

Second, the difference between beginning meditators and experienced ones demonstrated in this study is consistent with the desirable direction of meditation learning in terms of attitudes to be fostered. The fact that meditation technique selection does not matter for experienced meditators implies that the process of learning meditation includes mastering how to deal with challenges and difficulties due to the meditation learners’ cognitive and somatic characteristics. Depending on the learners’ physical/physiological and psychological characteristics, the same instructional method may be experienced differently by the learners. For example, a mature meditation learner would be able to tolerate whatever experience he/she has during meditation practice whereas an immature learner may experience restlessness due to lack of immediate benefit from the instruction. This suggests that a meditation instruction needs to address this issue of fostering attitudinal foundations (Kabat-Zinn, 1990): Non-judging, Patience, Beginner’s mind, Trust, Non-striving, Acceptance, Letting go. The cognitive skills such as receptivity and passivity presented by Smith (1990) are also aligned with the Kabat-Zinn’s attitudinal foundations. Similarly, Gunaratana (2002) suggested attitudes for meditation practice: Don’t expect anything; Don’t strain; Don’t rush; Don’t cling to anything and don’t reject anything; Let go; Accept everything that arises; Be gentle with yourself. The
descriptions of the attitudes for meditation are diverse, but they are all inter-related qualities of meditation practice.

Limitations and Suggestions for Future Research

This dissertation is an important contribution to the field because it is one of only a handful of studies to specifically explore instructional specificity for meditation instructional design based on participant anxiety profiles. However, there are still several important limitations of this research that need to be addressed.

First, because random sampling was not conducted, the sample cannot be described as representative of college students. Because of the limitations of time, money and qualified available instructors, only one college campus (Syracuse University) was selected. Also, it cannot be claimed that the current results can be applied to other populations such as adolescents, clinical patients, etc. because their cognitive and somatic characteristics would not be the same as those of college students. Thus, future research for other populations would be necessary to verify that cognitive and somatic trait anxiety would function as aptitudes moderating the differential effects between the cognitively challenging and somatically challenging meditation techniques.

An insufficient number of participants limits the current study from reaching a strong conclusion. Especially, the post hoc analysis to test higher-order interaction doubled the number of subgroups so that the number of subjects in each group decreased. Thus, the possibility cannot be strongly excluded that the significant results of the current study were found by chance. Studies investigating beginners and meditators separately need to be replicated to verify whether the post hoc analyses on higher-order interaction were valid.

Another limitation is that a strict experimental research procedure for random
assignment could not be applied because of the participants’ schedule preferences. However, because the participants were blinded about the type of meditation program before they were assigned and it is unlikely that the schedule preference and the group assignment process were related, it is expected that the limitation to the inferences from the study results would be mitigated. Future research with a more substantial screening process would uplift the quality of the study.

Potential research biases caused by the fact that the researcher and the meditation instructor were the same person could not be excluded. However, in order to minimize this possibility, each meditation session was standardized as much as possible with a consistent time schedule for each activity. Also, the researcher did not have access to the survey data until the end of the meditation program and the follow-up data collection. Future research would be benefited by employing meditation instructors blinded about the purpose of the study so that any relevant bias may be avoided.

The fact that only the self-report measurement tool was used to measure the outcomes is also a limitation of the current study. Demand characteristic and/or social desirability might be involved in the evaluation process. Follow-up studies with physiological measures would secure more objective claims on the topic of the present study.

The effects of meditation practice are not limited to the reduction of trait anxieties. For example, the other pillar indicating the meditative state besides relaxation or calmness is ‘wakefulness.’ Currently, various mindfulness scales would be able to measure this meditative state and trait. Other aptitude variables may moderate the effects of meditation on ‘wakefulness’ or ‘mindfulness.’ It would enrich the understanding and practice of adaptive meditation instruction to investigate the
influence of the aptitude variables of the current study or other aptitude variables on meditation outcome other than anxiety reduction.

Summary and Conclusions

An able meditation instructor designs, develops and delivers a meditation session or program that is as effective and appealing as possible. The current study systematically demonstrated that trait anxiety profiles (cognitive trait anxiety and somatic trait anxiety) and the presence of meditation experience can be important learner characteristics to be considered in designing an effective meditation program. Teaching and learning meditation is a dialectical process. The way in which a certain learner characteristic influences instructional outcomes of a meditation program is not fixed. Individuals’ anxiety traits are potential obstacles to the meditation learning process as in other learning processes. Thus, in the beginning stage of meditation instruction, certain design aspects need to be considered to properly mitigate such obstacles caused by learners’ anxiety traits and facilitate their acquiring necessary skills and attitudinal foundations for meditation practice. However, stressors can be not only stumbling blocks but also stepping stones. It depends on how the meditation learner accepts the potential stressors. An important aspect of a meditation instruction would be to help the learners to transform the stumbling blocks into stepping stones and stressful situations into life learning opportunities.
APPENDICES

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Appendix A. State-Trait Anxiety Inventory – Trait form (STAI)

**SELF-EVALUATION QUESTIONNAIRE STAI Form Y-2 (One Page)**

1. Please provide the following information:

   **1. E-mail address**

   **2. Age**

   **3. Gender**
   - Male
   - Female

2. **1. Directions**

   A number of statements which people have used to describe themselves are given below. Read each statement and then check the appropriate response to the right of the statement to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seem to describe how you generally feel.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>01. I feel pleasant.</td>
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<tr>
<td>02. I feel nervous and restless.</td>
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<td>03. I feel satisfied with myself.</td>
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<td>04. I wish I could be as happy as others seem to be.</td>
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<td>05. I feel like a failure.</td>
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<tr>
<td>06. I feel rested.</td>
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<tr>
<td>07. I am &quot;calm, cool, and collected.&quot;</td>
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<td>08. I feel that difficulties are piling up so that I cannot overcome them.</td>
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<tr>
<td>09. I worry too much over something that really doesn't matter.</td>
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<tr>
<td>10. I am happy.</td>
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<tr>
<td>11. I have disturbed thoughts.</td>
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<tr>
<td>12. I lack self-confidence.</td>
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<tr>
<td>13. I feel secure.</td>
<td></td>
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</tbody>
</table>
SELF-EVALUATION QUESTIONNAIRE STAI Form Y-2 (One Page)

15. I feel inadequate.
16. I am content.
17. Some unimportant thoughts run through my mind and bothers me.
18. I take disappointments so keenly that I can't put them out of my mind.
19. I am a steady person.
20. I get in a state of tension or turmoil as I think over my recent concerns and interests.

3. Meditation Practice History

* 1. Directions: Below is a list of categories representing a variety of meditation practices that you may or may not have experience within your life. Using the 1-5 scale below, please check the response that best represents the amount of time you have ever spent with these practices.

<table>
<thead>
<tr>
<th></th>
<th>Never practiced before</th>
<th>Less than 2 months</th>
<th>2-24 months</th>
<th>More than 24 months</th>
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<tbody>
<tr>
<td>Tai Chi/Qi Gong</td>
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<tr>
<td>Hatha Yoga</td>
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<tr>
<td>Mindfulness</td>
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<tr>
<td>Meditation/Ajapaneke</td>
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<tr>
<td>Zen Meditation</td>
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<tr>
<td>Transcendental Meditation</td>
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</tr>
<tr>
<td>Meditation</td>
<td></td>
<td></td>
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<tr>
<td>Other forms of meditation</td>
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</tbody>
</table>
Appendix B. Lecture Handout

Stress, Conditions and Mindfulness

WEEK 1

Source of Stress
- What kinds of stress do you have?

Stress
- Stressor (Cause) + Conditioned Body & Mind (Condition)
  \rightarrow Be stressed (Result)
  
  \textit{Examples:}
  - Bacteria/Virus + Vulnerable immune system \rightarrow Disease
  - Lack of preparation for presentation
  - Perfectionist Personality \rightarrow Be anxious
  - Lack of preparation for presentation
  - Optimistic Personality \rightarrow Remain Calm (but...)
  - Middle way

Source of Conditioned Body & Mind
- Unwholesome health behaviors/habits
- Childhood experience (e.g. Trauma)
- Education
- Culture
- Ethical standpoint/Value system

Awareness and Mindfulness
- What is awareness?
- Great inner resource for pacification
- Let things just be with observation (Training in retreat) \rightarrow Sensible to change \rightarrow Calming down \rightarrow Recognition of our own resources for healing \rightarrow Cultivation of the inner resources
- Mindful choice in action (Training in daily lives)
  \rightarrow Recognition of stressware \rightarrow Stopping the mind
  \rightarrow Restoration of our own resource \rightarrow Think (Conscious choice) \rightarrow Courageous/straight forward action

Topics
- Class 1: Stress, Conditions & Mindfulness
- Class 2: Acceptance - Attitudinal Foundation
- Class 3: Breathing
- Class 4: Pleasant & Unpleasant Events
- Class 5: Freedom
- Class 6: Procrastination & Mindfulness
- Class 7: Relationship & Mindfulness
- Class 8: Mindfulness in Daily Lives
Unworthiness

- Internalized standard and expectation
- Feeling of deficiency
- Self-criticism: “Something is wrong with me.”
- Feeling of deficiency → feeling of separation
- Expression of alienation → Addiction
- Competition — Social atmosphere requiring proof of one’s worthiness
- Self-improvement project from the feeling of ‘not good enough’
- However, we already possess our essential goodness. We just need to recognize it.

Unconditional Friendliness

- Story of a meditation teacher with Alzheimer
- Pausing and meeting whatever is happening inside us
- With genuine attitude of unconditional friendliness
- Nothing is wrong — whatever is happening, is just “real life.”
- Inquiry: What wants my attention right now?
- Focus on immediate feelings and sensations
- Noting instead of being entangled with or ignoring it

Accept Everything that Arises

- Accept your feelings, even the ones you wish you did not have. Accept your experiences, even the ones you hate. Don’t condemn yourself for having human flaws and failings. Learn to see all the phenomena in the mind as being perfectly natural and understandable. Try to exercise a disinterested acceptance at all times and with respect to everything you experience.

Be Gentle with Yourself

- Be kind to yourself. You may not be perfect, but you are all you’ve got to work with. The process of becoming who you will be begins first with the total acceptance who you are.

Don’t Cling and Don’t Reject

- Let come what comes and accommodate yourself to that, whatever it is. If good mental images arise, that is fine. If bad mental images arise, that is fine, too. Look on all of it as equal and make yourself comfortable with whatever happens. Don’t fight with what you experience, just observe it all mindfully.
### Breathing

**Week 3**

#### Story of Fire Fighter
- Overcome by smoke → Hyperventilation: Trouble in breathing when get anxious
- Watching breath → Relaxing a little → Feeling about breathing changed → Less caught up in thoughts and fears
- Transferred to practice being aware of other experiences

---

#### Advantage
- Easy to be aware of
- Connection with emotional states
- It is always with us as long as we are alive.

#### Technique
- Nourish, Chest, Belly
- Be aware of the sensations that accompany your breathing at that particular place and hold them in the forefront of your awareness from moment to moment.
- We feel the air as it flows in and out past the nostrils; we feel the movement of the muscles associated with breathing; we feel the belly as it moves in and out.
- No need to try to control
- Be aware of the feeling of each in-breath and each out-breath.

---

#### Belly Breathing
- Focus on the feelings of the breath at the belly → Relaxing & Calming.
- Breath at the belly is like gentle swelling in the deep ocean
- Belly as the center of gravity of your body
- Baby's belly breathing.
- Lie down on your back or stretch out in a recline, close your eyes, and put one of your hands over your belly
- Bring your attention to your hand and feel it move as the breath flows in and out.
- It will come with time all by itself as you continue to practice watching your breath.

---

#### Formal and Informal
- **Formal Discipline**
  - Making a practice time
  - Stop all activity
  - Assume a special posture
  - Dwell in moment to moment awareness of the in-breath and the out-breath
- **Informal meditation practice**
  - Be mindful of breath from time to time during the day
  - Or even all day long
  - Meditation awareness → Physical relaxation + Emotional Calmness + Insight
  - Takes no time, just remembering
- **Formal & Informal complement and enrich each other**
Mindfulness of Sensation

- Examples
  - Sights, Sounds, Smell, Taste, Touch
- Sensation Feeling
  - Pleasant, Unpleasant, Neutral
- General tendency (reaction) of our minds
  - Pleasant  : Cling to it
  - Unpleasant  : Push it away
  - Neutral  : Get bored

Reaction to Sensation

- Sensation (Hearing noise) ('It is unpleasant.')
- Feeling ('Who is making that noise?')
- Thought ('I will stop him/her:)
- Volition Real action and/or reinforce habitual pattern of our mind

Practice

- Be aware of your mind set without judgment whatever stage it is. (feeling/thought/volition)
- Let go of the mind set.
- Bring your attention to the sensation or object of sensation itself.

Let It Go

- How does it differ from 'push it away?'

Let It Go

- Allow what is supposed to happen to happen.
- Attitude of 'How interesting!'
- You are not your thought or emotion.
- Sky vs. Clouds
- Let it come and let it go!
- Let it be!
Freedom

Week 5

Pleasant/Unpleasant Event

- Sharing of experience
- Pleasant event: Craving vs Stopping
- Unpleasant Event: Pushing it away vs Let it come and let it go
- Meaning of Freedom
  - Free = allowed to do whatever you want, without being controlled or restricted
  - Lack of inner freedom

Stress Reactivity

- Reaction of autonomous nervous system to threatening situation = fight or flight
- Actually threatened vs Feeling threatened
- Examples: Threat to social status, ego, strong belief, desire to have things to be a certain way ("My" way)
- Hyperarousal and fight-or-flight regardless of our will
- Sometimes considered as normal

Maladaptive Coping

- Nice thing about fighting or running → Release the arousal after the situation
- Internalize the stress reaction (Suppress, Denial) → Carry and accumulate the arousal (Stress hormones, Agitated thoughts and feelings)
- Filling up time with busyness
  - Chemicals (Alcohol, nicotine, caffeine, sugar, drugs)
  - These are maladaptive because they compound stress in the long run.

Stress Response

- Awareness as the critical element for freedom
- Be mindful of what is actually happening while it is happening → freedom of not to choose the route of fight-or-flight reaction
- Reaction implies automatic and unconscious
- Awareness already introduce a new dimension into the situation.
- No need to suppress → Allowing yourself to feel them
- Regular training of mindfulness → Reliable assistance

Assignment

- In stressful situation, see if you can be aware of your feelings of anger or fear or hurt.
- Say to yourself "here is a stressful situation." or "Now is a time to tune into my breathing and center myself."
- Choose appropriate response to the situation
- Record this stress response process and the result
Stressful Event

- Sharing of experience

Stressful Event & Mindfulness

Week 6

Stopping the Mind

- Habit of emotional and cognitive reaction
  - Strong one
  - Subtle one
- Dreaming state: When we dream, we do not know the fact that we are dreaming.
- Wake up
- Counteract the thinking habit with mindfulness of breath

Observing the Mind

- Find the principle of functioning of one’s mind
- Observe one’s mind like scientific investigation
- How to observe
  - With calmness, in detail, Continuously
- A Principle
  - Cause (seed mind) + Conditions (stressors)
    → Effect (arisen mind)

Handling the Mind

- Let go of arisen mind and transcend seed mind.
- Everything start from my mind at this moment (new seed).

Intention & Determination

- Help us to wake up from dreaming states
- On-going practice
- Let’s practice mindfulness of stressful event and journal recording one more week.
- Next week — Relationship and Mindfulness
Mindfulness Principles

- Be aware of the situation
- Accept and let go of the arisen mind
- Transcend the seed mind
- Choose appropriate action

Passive Relationship

- Avoid conflict by being passive
- Disconnection with one's own feeling and thought
- Not accepting one's own feeling and thought
- Bound by illusory obligations
- Act out of one's passive/submissive tendency

Aggressive Relationship

- Try to exert control over other person
- Be absorbed in one's own feeling, view and agenda
- Identifying oneself with one's feeling and thought
- Unaware of the one ego-centric view
- Act out of one's active/aggressive tendency

Communication

- Be aware of one's feelings and thoughts
- Acknowledge one's feelings and thoughts
- Understand both one's own view and other's view
- Choose appropriate action for mutual benefit

Assertiveness

- Obstacle to being assertive
  - Good person complex → Helping others with lack of peace and harmony
  - Reactive way of saying → Attack other people
  - Social conditioning → e.g. Gender role
- Assertiveness requires non-judging awareness of your actual feeling
- Feelings are just feelings. They are okay to have and feel.
- Maintain your integrity without threatening others' integrity
- "I" statement rather than "you" statement
### Mindfulness in Daily Lives

**Week 8**

### Meditation in Action and at Rest
- Time: In Action vs. At Rest
- Harmony of action and rest leads to healthy life.
- In Action: One mind and Mindfulness
- At Rest: Preparation/Reflection
- Reciprocal Influence between action and rest

### Mindfulness in Action

- In challenging situation
  - Stop → Restore stillness, spaciousness, centeredness
  - Think → Sound thought
  - Act
- While doing a task
  - Totally become one with the task.
  - Do not let any thought hinder the task whether it is good or bad.
  - Good thought → Meme and let it go
  - Bad thought → Let it go

### Preparation

- Plan for life/year/month/week/day
- Preparation leads to calmness in action.
- 70-80% of success depend on preparation.
- Meditation as preparation
  - Save and recharge vital energy
  - Cultivate the calmness and stillness
  - Transfer the calmness and stillness to daily life

### Reflection

- Teach oneself
- Set up objectives
- Praise yourself when your action is in accordance with the objectives.
- Let go of disturbance and correct your mistakes without being judgmental.
  - Distinguish your intrinsic value from the quality of your action or state of your mind.

### Books

- [Wherever You Go, There You Are] by Jon Kabat-Zinn
- [Radical Acceptance] by Tara Brach
- [Mindfulness in Plain English] by Ven. Henepola Gunaratana
- [Stillness Speaks] by Eckhart Tolle
- [Total Freedom] by Jiddu Krishnamurti
- [Peace Is Every Step] by Thich Nhat Hanh
### Appendix C. Observer Checklist

#### Sitting Meditation Program Checklist

<table>
<thead>
<tr>
<th>Week #</th>
<th>Class #</th>
<th>Date &amp; Time</th>
<th>Plan</th>
<th>Integrity (1=Yes, 0=No)</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Opening</td>
<td>Time (5 minutes)</td>
<td>Time implemented:</td>
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<td>Ringing Bell 10 times</td>
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<td>Addressing the nature of meditation</td>
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<td>Sitting Meditation</td>
<td>Time (35 minutes)</td>
<td>Time implemented:</td>
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<td>Initial guidance for meditation practice</td>
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<td>Beginning Bell</td>
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<td>The second guidance</td>
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<td>Ending Bell</td>
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<td>Walking Meditation</td>
<td>Addressing focusing point (breath or feet, etc)</td>
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<td>One attention guidance</td>
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<td>Questions and Answer</td>
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<td>The initial guidance</td>
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<td>Beginning Bell</td>
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<td>The second guidance</td>
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<td>Ending Bell</td>
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<td>Equal treatment to participants</td>
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<td>Participants’ compliance with the guidance</td>
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<td>Lecture</td>
<td>Time (30 minutes)</td>
<td>Time implemented:</td>
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<td></td>
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<td></td>
<td></td>
<td>Sharing of meditation experience</td>
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<td>Explaining the contents in the hand-out</td>
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<td>Question and Answer</td>
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<td>Equal treatment to participants</td>
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<td></td>
<td></td>
<td></td>
<td>Participants’ attention to the lecture</td>
<td></td>
</tr>
</tbody>
</table>

#### Movement Meditation Program Checklist

<table>
<thead>
<tr>
<th>Week #</th>
<th>Class #</th>
<th>Date &amp; Time</th>
<th>Plan</th>
<th>Integrity (1=Yes, 0=No)</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Opening</td>
<td>Time (5 minutes)</td>
<td>Time implemented:</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Ringing Bell 10 times</td>
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<td>Addressing the nature of meditation</td>
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<td></td>
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<td></td>
<td>Movement Meditation</td>
<td>Time (35 minutes)</td>
<td>Time implemented:</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Shupsang meditation in standing</td>
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<td></td>
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<td></td>
<td>Shupsang meditation in sitting</td>
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<td></td>
<td></td>
<td>Chi energy meditation in sitting</td>
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<td></td>
<td>Equal treatment to participants</td>
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<td></td>
<td>Participants’ compliance with the guidance</td>
<td></td>
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<td></td>
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<td></td>
<td>Lecture</td>
<td>Time (30 minutes)</td>
<td>Time implemented:</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sharing of meditation experience</td>
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<td></td>
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<td></td>
<td></td>
<td>Explaining the contents in the hand-out</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Question and Answer</td>
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<td>Equal treatment to participants</td>
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<td></td>
<td></td>
<td>Participants’ attention to the lecture</td>
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</tbody>
</table>

Observer: Print Name:  

Signature:  


Appendix D. State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA) -Trait Scale

1. **Demographic Information**

   * 1. Please create your ID (the initial of your last name + the last 4 digits of your SUID).
   
   * 2. What is your age?
   
   * 3. What is your gender?
     
     - Male
     - Female
     - Other

   * 4. What is your ethnicity?
     
     - Caucasian
     - African American
     - Hispanic
     - Other

   * 5. Your availability for program participation
     (If you are available on both days, please check "Both")
     
     - Wednesday 7-8 pm
     - Thursday 7-8 pm
     - Both
     - Neither

   * 6. Directions: Below is a list of categories representing a variety of meditation practices that you may or may not have experience within your life. Please check the response that best represents the amount of time you have ever spent with these practices.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Never</th>
<th>Less than 2 months</th>
<th>2-24 months</th>
<th>More than 24 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tai Chi/Gi Gong</td>
<td></td>
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<td></td>
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<tr>
<td>Hatha Yoga</td>
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<tr>
<td>Mindfulness/Meditation/Vipassana</td>
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<tr>
<td>Zen Meditation</td>
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<tr>
<td>Transcendental Meditation</td>
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</tbody>
</table>
1. Below is a list of statements which can be used to describe how people feel. Beside each statement are four responses which indicate how often each statement is true of you. Please read each statement carefully and check the response which best indicates how often, in general, the statement is true of you. Please answer according to what really reflects your experience rather than what you think your experience should be.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not at all</th>
<th>A little</th>
<th>Moderately</th>
<th>Very much so</th>
</tr>
</thead>
<tbody>
<tr>
<td>01. My heart beats fast</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>02. My muscles are tense</td>
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<tr>
<td>03. I feel agonized over my problems</td>
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<td></td>
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<tr>
<td>04. I think that others won't approve of me</td>
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<tr>
<td>05. I feel like I'm missing out on things because I can't make up my mind so easily</td>
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<tr>
<td>06. I feel dizzy</td>
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<tr>
<td>07. My muscles feel weak</td>
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<tr>
<td>08. I feel tired and shaky</td>
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<tr>
<td>09. I picture some future misfortune</td>
<td></td>
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<tr>
<td>10. I can't get something out of my mind</td>
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<tr>
<td>11. I have trouble remembering things</td>
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<tr>
<td>12. My face feels hot</td>
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<td>13. I think that the worst will happen</td>
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<tr>
<td>14. My arms and legs feel stiff</td>
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<tr>
<td>15. My throat feels dry</td>
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<tr>
<td>16. I keep busy to avoid uncomfortable thoughts</td>
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<td></td>
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<tr>
<td>17. I cannot concentrate without irrelevant thoughts invading</td>
<td></td>
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<tr>
<td>18. My breathing is fast and shallow</td>
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<tr>
<td>19. I worry that I cannot control my thoughts as well as I would like to.</td>
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<tr>
<td>20. I have butterflies in the stomach</td>
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<tr>
<td>21. My palms feel clammy</td>
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</tbody>
</table>
ARE YOU UNDER STRESS???
Don't Miss Your Opportunity to Learn
Meditation for Stress Reduction

OPPORTUNITY
TO LEARN & PRACTICE
MEDITATION

A meditation instructor (also a doctoral student at Syracuse University) is recruiting participants for research on the effects of meditation on anxiety and mindfulness in college students.

Eligibility:
Any college student (both graduate and undergraduate) at the age of 18 or over.

Procedure:
Four 8-week meditation classes for stress reduction will be provided during the Fall 2010 semester and participants will be suggested to take one of the four classes or may be asked to take part in the control group. Each weekly meditation session will last for about an hour. Level of anxiety and mindfulness will be surveyed at four times.

When and Where:
The first session of each meditation program will be held at
1. 5:30 - 6:30 pm on September 29 (Wed), Hall of the Languages 500
2. 7:00 - 8:00 pm on September 29 (Wed), Hall of the Languages 500
3. 5:30 - 6:30 pm on September 30 (Thur), Hall of the Languages 500
4. 7:00 - 8:00 pm on September 30 (Thur), Hall of the Languages 500

For more information, please contact:
Sanghyeon Cheon (junm83@gmail.com, 315-481-4197)
Doctoral Student, Instructional Design, Development and Evaluation

Note: This study is being supervised by Dr. Dessa Bergen-Cico, in the Department of Health & Wellness, College of Human Ecology, Syracuse University.
Appendix F. Recruitment Group E-mails

Research Recruitment E-Mail

Dear all,

Greetings!

My name is Sanghyeon Cheon. I am a meditation instructor and also a doctoral student at Syracuse University, Instructional Design, Development and Evaluation. I am inviting you to participate in a research study on meditation. The research is to investigate the effects of meditation on anxiety and mindfulness skill in college students. Any college student (both graduate and undergraduate) at the age of 18 or over is eligible for the research.

During this research, four 8-week meditation classes will be provided and participants will be suggested to take one of the four classes. You may also participate in the research as a part of the comparison group. Each weekly meditation session will last for about an hour and level of anxiety and mindfulness will be surveyed at four times. By participating in the research, you may reduce your stress from various sources and learn meditation-applied coping strategies for stress reduction.

The first session of each meditation class is planned at

1. 5:30 - 6:30 pm on September 29 (Wed), Hall of the Languages 500
2. 7:00 - 8:00 pm on September 29 (Wed), Hall of the Languages 500
3. 5:30 - 6:30 pm on September 30 (Thur), Hall of the Languages 500
4. 7:00 - 8:00 pm on September 30 (Thur), Hall of the Languages 500

This study is being supervised by Dr. Dessu Bergen-Cico, in the Department of Health & Wellness, College of Human Ecology, Syracuse University.

If you are interested or have questions, please call me at 315-481-4197 or write at junsh83@gmail.com.

Sincerely,

Sanghyeon

Cheon

Doctoral student
Instructional Design, Development &
Evaluation 330 Huntington Hall, Syracuse
University, Syracuse, NY 13244
Phone: 315-481-4197
E-mail: junsh83@gmail.com
Appendix G. IRB Approval Form

SYRACUSE UNIVERSITY
Institutional Review Board

MEMORANDUM

TO: Dessa Bergen-Cico
DATE: March 3, 2010
SUBJECT: Renewal Approval-Expedited Review
IRB #: 09-010
TITLE: Adaptive Instruction for Effective Meditation to Address Anxiety Among College Students

The request for renewal of your human subjects protocol has been reviewed by the Institutional Review Board (IRB) and has been evaluated for the following:
1. the rights and welfare of the individual(s) under investigation;
2. appropriate methods to secure informed consent; and
3. risks and potential benefits of the investigation.

Your protocol is approved for implementation and operation for a period of one year, from March 2, 2010 to March 1, 2011. If appropriate, attached is the protocol's approved informed consent document, date-stamped with the expiration date. **This document is to be used in your informed consent process.** If you are using written consent, Federal regulations require that each participant indicate their willingness to participate by signing the informed consent document and be provided with a copy of the signed consent form. Regulations also require that you keep a copy of this document for a minimum of three years.

**CHANGES TO APPROVED PROTOCOL:** By its very nature, research involving human participants often requires changes in plans and procedures. You are reminded of your responsibility to obtain IRB approval of any changes in your protocol prior to implementing them, except when such change is essential to minimize harm to the participants. Changes in approved research initiated without IRB review and approval to eliminate apparent immediate hazards to the participant must be reported to the IRB within five days. Protocol changes are requested on an amendment application available on the IRB web site; please reference your IRB number and attach any documents that are being amended.

**CONTINUATION BEYOND APPROVAL PERIOD:** To continue this research project beyond March 1, 2011, you must submit a renewal application for review and approval. A renewal reminder will be sent to you approximately 60 days prior to the expiration date. **(If the researcher will be traveling out of the country when the protocol is due to be renewed, please renew the protocol before leaving the country.)**

**UNANTICIPATED PROBLEMS INVOLVING RISKS:** You must report any unanticipated problems involving risks to subjects or others within 10 working days of occurrence to the IRB at 315.443.3013 or orip@syr.edu.

**STUDY COMPLETION:** The completion of a study must be reported to the IRB within 14 days.
Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Kathleen King, Ph.D.
IRB Chair

Note to Faculty Advisor: This notice is only mailed to faculty. If a student is conducting this study, please forward this information to the student researcher.

DEPT: Health & Wellness, 426 Ostrom Ave.

STUDENT: Sanghyeon Chen
Appendix H. Informed Consent

INFORMED CONSENT

Project Title: Adaptive Instruction for Effective Meditation to Address Anxiety among College Students

My name is Sanghyeon Chen, and I am a graduate student at Syracuse University. I am Inviting you to participate in a research study titled, "The Effects of Meditation on Anxiety in College Students." The study is voluntary, so you may choose to participate or not. This sheet will explain the study to you and please feel free to ask questions about the research if you have any. I will be happy to explain anything in greater detail if you wish.

I am interested in learning how your anxiety level changes throughout a college semester. You will be asked to answer the questions related to anxiety four times over the semester. Each test will take approximately 10 minutes of your time. All information will be kept confidential. I will use an alphanumeric code for your responses rather than your name, and only I and my faculty advisor will have the key to identify which code belongs to which participant.

The benefit of this research is that you will be helping us to understand the effects of meditation programs in reducing college students' anxiety. By taking part in the research, you may reduce your stress and learn meditation-applied coping strategies for stress reduction.

The risk to you of participating in this study may be discomfort with the content of the questions asking about your level of anxiety. The risks of the study will be minimal. All data will be collected and analyzed by the principal investigator and maintained in the central office of the study. The data will be stored securely and will be maintained in a confidential manner.

If you do not want to take part, you have the right to refuse to take part, without penalty. If you decide to take part and later no longer wish to continue, you have the right to withdraw from the study at any time, without penalty. If you have any questions, concerns, complaints about the research, contact Dr. John Bergman at phone 315-443-2080. Email: jbergman@syr.edu or Sanghyeon Chen at phone 315-443-4197, email jtnkh85@gmail.com. If you have any questions about your rights as a research participant, you have questions, concerns, or complaints that you wish to address to someone other than the investigator, if you cannot reach the investigator, contact the Syracuse University Institutional Review Board at 315-443-3013.

Syracuse University
IRB Approved

Current Status: Active

INSTRUCTIONS: Use only for research purposes.

1/20/11

Syracuse University,
College of Human Ecology
Department of Health and Wellness

Department of Health and Wellness, Syracuse University
120 Governors Avenue, Syracuse, NY 13244-5100
Phone: 315-443-5283, Fax: 315-443-2716, http://humanecology.syr.edu
All of my questions have been answered, I am over the age of 18 and I wish to participate in this research study. I have received a copy of this consent form.

Signature of participant ___________________________ Date __________________

Print name of participant ___________________________

Signature of investigator ___________________________ Date __________________

Print name of investigator __________________________
REFERENCES


Ree, M. J., French, D., MacLeod, C., & Locke, V. (2008). Distinguishing cognitive
and somatic dimensions of state and trait Anxiety: Development and validation of the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA).

*Behavioural and Cognitive Psychotherapy, 36*, 313-332.

Regression with SAS. UCLA: Academic Technology Services, Statistical Consulting Group. from


VITA

NAME OF AUTHOR: Sanghyeon Cheon

PLACE OF BIRTH: Gunsan, South Korea

DATE OF BIRTH: October 20th, 1974

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:


  Won-Buddhist Studies, Youngsan University of Sŏn Studies, Younggwang, South Korea, 2000 – 2002.

  Economics, Seoul National University, Seoul, South Korea, 1993 – 2000.

DEGREES AWARDED:

  M.WBS. (Won-Buddhist Studies), 2004, Won Institute of Graduate Studies, Glenside, PA, USA.

  B.A. (Won-Buddhist Studies), 2002, Youngsan University of Sŏn Studies, Yeonggwang, South Korea

  B.A. (Economics), 2000, Seoul National University, Seoul, South Korea

PUBLICATIONS


AWARDS AND HONORS:
Scholarship  School of Education Scholarship, Syracuse University, Syracuse, NY, 2009 – 2010.

Grant  School of Education Research & Creative Grant Awards ($950), Syracuse University, Syracuse, NY, 2009.


Graduation with Honor  Youngsan University of Sŏn Studies, South Korea, 2002


PROFESSIONAL EXPERIENCE:

Assistant Professor, Won Institute of Graduate Studies, Glenside, PA, 2011 – Present


Local Coordinator for 23rd Kelly Evaluation Conference, Syracuse University, Syracuse, NY, 2009.

Organizer for IDDE Brown Bag Seminar, Syracuse University, Syracuse, NY, 2008

Instructor, Won Institute of Graduate Studies, Glenside, PA, 2004 – 2005