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The Psychological and Physiological Markers of Christian Meditation: A Quasi-Experimental Study of Centering Prayer

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Abstract

Research seeking to understand the various practices of meditation has expanded greatly in frequency and quality in the past century. Many have documented the effects of secular and eastern forms of meditation on psychopathology, well-being, executive functioning, and physiological changes of brainwaves, heart rate variability, and stress reduction (Cahn & Polich, 2006; Kok et al., 2013; Newberg et al., 2010). However, few have attempted to understand meditation in a Christian context. This study seeks to delineate the effects of a Christian form of meditation, known as Centering Prayer, on novice, college undergraduate practitioners as compared to non-practicing peers in areas of subjective reports of mood, well-being, and spirituality, as well as physiological measures of brain waves, heart rate, and skin response (sweat). Results suggest Centering Prayer enacts similar mechanisms as other secular and religious meditative practices that improve phenomenological awareness and attentional concentration. These effects were experienced from more embodied, nonconscious mechanisms found in our nervous system than our subjective awareness. However, due to the limitations of

the study design, small sample, and measurement difficulties, more research is need to more confidently understand just how the subjective psychological perspective perceives the brain, heart, and skin responses to regular practice of Christian contemplation. Future research will also seek to imbed this knowledge about Centering Prayer within the social, spiritual, and religious contexts to help the future practice of Christian meditation.

*Keywords***:** spirituality, psychophysiology, well-being, executive functioning, Centering Prayer

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Chapter 1

Introduction

The concept and practice of spirituality has been an important aspect of human existence for millennia. Every human cultural system of the world has spiritual roots (Zaleski & Zaleski, 2005). Western civilization can trace back to any number of spiritual traditions, as can Native American, African, Near-Eastern, Indian, Far-Eastern, and Pacific Island civilizations. Such can be said of contemporary cultures as well. A recent study of samples from 13 major world countries found a mean 76.8% of respondents identified as spiritually oriented (Zimmer et al., 2019). A review of the world's spiritual practices concludes meditation and prayer is a foundational behavioral and cognitive component of spirituality that positively influences the experiences of practitioners (Zaleski & Zaleski, 2005). From the neurotheological perspective that has arisen in the past two decades in response to the increasing knowledge gained from neuroscience: "both phenomenological and physiological information are required for the full understanding of any religious experience or practice." (Newberg, 2010, p. 147). Unfortunately, the contemporary practice of clinical psychology in the United States appears to have largely overlooked the importance of spiritual matters (Vogel et al., 2013).

Spirituality involves both beliefs and behavioral practices, both of which may be religious in nature (Koenig, 2012). Meditation is one such practice that spans several major world religions as well as those who do not identify as religious or spiritual. Meditation has been defined differently within diverse cultural settings but can be described generally as a practice of

engaging in a specific attentional state that self-regulates the body and mind (Cahn & Polich, 2006; Koenig, 2015). While this definition emphasizes the outcome and benefits of meditation, as will this study, noting that many practitioners engage in meditation without specific outcomes in mind is important. Meditation is an intentional practice that encourages an ethic of being rather than doing. This emphasis on *being* over *doing* becomes evident when examining the conceptual dimensions of meditation.

Some have posited that meditation can be thought of as consisting of three dimensions: phenomenological awareness, attentional concentration, and transcendental observation (Cahn & Polich, 2006; Sedlmeir et al., 2012; Wachholtz & Pargament, 2005). Various types of meditation normally emphasize one of the dimensions. For example, mindfulness meditation, associated with Zen Buddhist and Hindu Vipassana traditions, focuses on the non-attached observation of the practitioner's phenomenological awareness (Cahn & Polich, 2006). Another stream of meditation involves a practitioner's active concentration on a mental or sensory activity, such as imagined images, physical objects, body sensations, or mantras (Wachholtz & Pargament, 2005). This type of meditation trains the practitioner to rest their attention for a prolonged state on a singular stimulus and is associated with Hindu Yoga and Buddhist Samatha (Sedlmeier et al., 2012). Transcendental awareness is an aspect of meditation practitioners describe as an expanded awareness of the self that is not centered on the individual's experience or mental contents (Cahn & Polich, 2006). This last dimension sets apart spiritual meditation from secular versions, such as the psychotherapy intervention of mindfulness developed for Acceptance and Commitment Therapy (Fletcher et al., 2010; Wachholtz & Pargament, 2005). In short, meditation is a complex collection of practices with conceptual elements that incorporates aspects of psychological processes that touch, but also reach beyond, the sphere of psychology.

One Christian version of meditation, known as Centering Prayer, combines all three dimensions (Fox et al., 2015). Centering Prayer involves non-judgmental awareness of the presence of God, engages practitioners' prolonged attention by focusing on a sacred representation of God (often a simple a word or phrase), and calls on the Christian perspective of transcendental awareness as surrender to the ongoing action of God's love and healing. Centering Prayer has many similarities to Eastern forms of meditation in structure and explicit engagement with a divine or spiritual component as well as some nuanced differences. Christians believe Centering Prayer is a meditation that actively seeks the presence of God, and any benefit or change that occurs during prayer is a result of God's action. The question remains, however, how exactly does God's action affect the practitioner on the physiological and psychological level?

Benefits of Meditation

Research suggests meditation is beneficial for medical health. Several systematic reviews have outlined promising medical benefits of meditation. Kok et al. (2013) described 31 studies of meditation practices in medical health settings that found meditation is associated with an increased immune system response, improved cardiovascular functioning, and decreased perception of pain severity.

Furthermore, Black et al. (2009) reviewed 16 studies of adolescent practitioners of meditation and similarly concluded a positive effect on participants' cardiovascular functioning (e.g., decreased heart rate and blood pressure). Arias et al. (2006) concluded from 82 studies that meditative practices are broadly effective in treating medical conditions, especially diagnoses of epilepsy, premenstrual syndromes, and menopausal symptoms. The major mechanisms of change for meditation throughout these studies appears to be twofold: (a) a general reduction of stress,

and (b) an improvement in biophysiological functioning (i.e., immune/cardiovascular functioning). Kok et al. (2013) note the order of these two mechanisms of change is unclear; does stress reduction allow for improved physical functioning, or vice versa? Regardless, Eastern and secular meditative practices appear to be clearly beneficial for health purposes.

Studies of meditation and psychological health do not resolve the question of whether stress reduction or physiological functioning occurs first, but they do verify that meditation improves psychological functioning as well as physical. Orme-Johnson and Barnes (2014) reviewed 14 studies and reported that the practice of meditation decreases participants' trait-anxiety. The decrease is most effective with high-anxiety populations (such as individuals with PTSD) and is more effective than treatment as usual (TAU). Rubia's systematic review (2009) concluded similarly that the use of meditation as an intervention for the psychiatric disorders of anxiety and depression produced a decrease in symptoms for both. Hendriks et al. (2017) surmised from their meta-analysis of 17 randomized clinical trials of yoga practitioners that meditation improves psychological well-being. Whether the meditative practice be mindful or yogic in nature, the evidence above suggests such practices improve psychological functioning. This research about meditative practices suggests that the psychological aspects of human existence is affected by spiritual factors. In other words, spirituality and psychology are (a) both real, definitive, and unique aspects of human functioning that can be researched, and (b) are at least unidirectionally linked. However, in each of the studies reviewed here, the direct link between meditation and psychological outcomes is opaque due to the heterogeneity of meditative practices included as well as the variable spiritual context of practice. In fact, studies investigating the link between meditation and psychological health are more nebulous than those

seeking to understand the physical health of meditators. One reason may involve the lack of cohesive theory behind the cognitive effect of meditation.

Meditation, Attentional Concentration, and Neuroscience

As mentioned, a primary component of meditation is attentional concentration, and several studies reviewed below have studied the connection between meditators and their neurocognitive abilities. Cahn and Polich's (2006) review of neurophysiological and neuropsychological studies of meditation indicates that meditation broadly influences practitioner's long-term capacities to attend to specific stimuli, absorb themselves in such stimulation, and increase their perceptual sensitivity. The authors concluded meditation improves these capacities simply due to enhancements inherent to sustained practice. They speculated further that meditation improves psycho-physiological functioning in the natural mitigation of anxiety due to decreased automatization and reactivity to stressful stimulation. In Rubia's (2009) review, the cognitive effects of long-term and short-term practice of meditation enhanced reaction time, decreased error rate, and improved inhibitory processing. A more recent example of the cognitive benefits of meditation showed improvements in fluency, sequencing, and logical memory in memory loss patients (Newberg et al., 2010). The cognitive underpinnings of meditation, and resultant attentional benefits, appear to be focused on executive functioning—a set of higher order processes indicated in the ability to control attention and regulate emotions (i.e., the reduction of psychiatric symptoms and heart rate variability).

If so, the neuroanatomical regions of the brain, and the correspondent neuroelectric event-related potential (ERP), associated with executive functioning would correlate to regions of the brain activated during meditation. The research shows variability in that regard, however, especially among differing types of meditation. On one level, brain imaging studies of Eastern

and Christian meditators during meditation show expected activation in the prefrontal cortex and inferior frontal lobes (areas associated with executive functioning and emotional regulation; Newberg et al., 2001; Newberg et al., 2003). More specifically, the cingulate gyrus, the inferior and orbital region of the frontal cortex, and the dorsolateral prefrontal cortex (DLPFC) show increased blood flow during the practice of Eastern meditation. The thalamus is also more activated, an area not associated directly with executive functioning, but with sensation and perception. Christian meditation also activates the inferior parietal lobes, areas associated with the processing of emotions in facial stimuli, language, body images, and mathematical operations. Taken together, these studies suggest the expected brain regions associated with executive functioning are, in fact, activated during the practice of meditation but are not the only areas activated. Furthermore, the variability in brain activation in response to various meditative practices is, unsurprisingly, equally variable (Fletcher et al., 2010).

ERP studies indicate an equal amount of variability across types of meditation. More interestingly, several systematic reviews of brainwaves during meditation found ERPs activate oppositely from ERPs of typical executive functioning tasks. Lee et al. (2018) concluded meditation, regardless of type, is "associated with global increases in oscillatory activity" (p. 178). However, the authors also noted that different mediations have been found to affect the brain differently when observing brainwave frequencies (e.g., delta, theta, and gamma waves) and regions (e.g., parietal, temporal, and prefrontal regions). Cahn and Polich's review (2006) found that in the majority of EEG studies meditation creates theta wave activity in the prefrontal cortex, inferior parietal lobules, and the posterior portion of the superior temporal gyrus. Theta waves occur most frequently during dream stages of sleep. Conversely, long-term Buddhist meditation practitioners were found to produce gamma wave activity during their practice (Lutz

et al., 2004). Gamma waves are associated with intense executive functioning tasks. Brainwave type, much like regional neural activity, depends on the type of meditation.

Christian Meditation

There is a tension in the Christian community concerning empirical outcome research around prayer and meditation. On one hand, empirical research misses the point, at least somewhat. The relationship built with God through prayer is centrally about connection to the divine, not about the results such a connection provides practitioners. On the other hand, Christian faith hinges on the belief that a relationship with God is beneficial. The benefits of Christian meditation appear to influence physical and mental health, but to highlight those benefits above the deontological premise that a relationship with God is good for its own sake requires a complex navigation of cultural worldviews. Perhaps relatedly, Christian meditation is almost absent from the neuropsychological and neurophysiological literature, unlike more Eastern meditation counterparts. This is problematic because it would be helpful to understand the implications of Christian meditation in light of the variability in neural activity related to various styles of meditation. Whatever the relationship between Christian meditation and psychophysiology, it is likely to be nuanced and complex. Any assumption that the benefits of meditation can be captured in a generalized way to Christian populations is ignoring cultural variability (Ferguson et al., 2010). Similarly, not all forms of meditation are likely to have similar effects. One study found mindfulness-based meditation in a Christian context is less effective in decreasing psychiatric symptoms than mindfulness-based meditation adapted to Christian beliefs (Huennekens, 2018).

Maddix and Andrews (2018) endeavored to explore neuropsychological and neurophysiological measures of various types of Christian prayer, not just meditative forms.

They taught undergraduate students to engage in various spiritual practices—such as prayer, scripture reading, and meditation—and recorded their brainwaves (EEG), heart rate variability (EKG), and electrodermal activity (EDA) during an executive task of inhibition before and after the students engaged the practices. Of all the types of Christian practices, only Christian meditation correlated with differences in EEG, EKG, and EDA results. Their results were limited, however, due to the number of confounding variables among the various Christian practices. Such a limitation begs the question: if Maddix and Andrews (2018) had focused primarily on one form of Christian meditation rather than a variety of types of Christian spiritual practices would their results have been more robust?

As such, the central aim of this study is to explore the effects of the Christian meditation known as Centering Prayer. Much like with other forms of meditation, Centering Prayer has shown promising results in health outcomes. Trait anxiety, stress reduction, and emotional well-being were affected by Centering Prayer with medium to large effect sizes (Asbill, 2015; Ferguson et al., 2010; Huennekens, 2018). A pilot study of Centering Prayer among women with ovarian cancer found reduced pain as well as improved psychological well-being (Johnson et al., 2009). While these studies are promising, they are not yet to the point of systematic review that Eastern and secular meditations have shown, nor do these results explore holistically the effect of Centering Prayer practices on cognitive functioning, as other attentional concentration mediations have shown to improve.

Current Study

The current study tested if the practice of Christian Centering Prayer influences psychophysiological-spiritual markers among novice participants. The three levels of functioning (i.e., psychological, spiritual, and physiological), as reviewed above, have been suggested as areas

meditative behaviors affect. I hypothesized that compared to non-practitioners, novice practitioners of Centering Prayer will self-report differences in their psychological and spiritual functioning and be observed responding physiologically different to a stressful task. I hypothesized that prayers would report less psychopathology, more well-being, more spiritual experiences, and changes in electroencephalograms (EEG), electrocardiograms (EKG), and electro0dermal activity (EDA) in response to cognitive stress. More specifically, I hypothesize neural power measured by EEG will reveal prayers use less power in areas of the brain associated with emotion and concentration, such as the frontal cortex and superior temporal region, due to needing less energy to produce the same effect after practicing prayer. I also predict more power to be utilized in the parietal lobe after prayer compared to non-prayers due to previously shown associations of increased activity in that region in lifelong meditators. I expect prayer practitioners to show increased heart rate variability through EKG measurements due to the general calming effect seen in other meditators. Lastly, I hypothesize mean power from skin-conductance measured by EDA to show lower power compared to non-practitioners, which would indicate generally decreased stress response.

Chapter 2

Methods

Participants

Participants were 27 undergraduate students at a private, religiously affiliated university. Their ages ranged from 18 to 23 years, and they were predominately white (81.5%). A minority of participants identified racially as Latino/a (7.4%), or other (11.1%). The participants were also Christian (100%), women (70%) who modally identified as middle SES (74.1 %). While most participants were in their first year of college (51.9%), others reported being in their second (33.3%) or third (14.8%) years. Recruitment for the study was through a class assignment in the university's college of Christian studies, approved by the department chair. The course was the fall and spring section of a Christian discipleship course. Students in the Fall semester were assigned to the experimental group of practicing Centering Prayer 5 times a week, 20 minutes a day. Students in the Spring semester were assigned to the comparison group that did not practice Centering Prayer. Information above was reviewed and is in another document emailed.

Materials

Informed Consent

Participants consented to participation before participating in the study, see Appendix A for copy of Informed Consent.

Demographics

A survey was developed to gather demographic data on the participants' age, gender, sexuality, ethnicity, SES, and religious affiliation. See Appendix B for copy of demographic questionnaire.

Generalized Anxiety Disporder-7 (GAD-7)

The GAD-7 (Spitzer et al., 2006) measures the severity of symptoms specific and sensitive to Generalized Anxiety Disorder (GAD) through a 7-item, 4-point rating scale ranging from 0, *not difficult at all*, to 4, *extremely difficult*. The scale was shown to have internally consistency at pre-test (Cronbach's alpha = .92) but not at post-test (Cronbach's alpha = .76). See Appendix C for copy of measures.

Patient Health Questionairre-9 (PHQ-9)

The PHQ-9 (Kroenke et al., 2001) measures the severity of symptoms specific and sensitive to disorders of depression through a 9-item, 4-point rating scale ranging from 0, *not difficult at all*, to 4, *extremely difficult*. The scale was shown to have internal consistency on pre-test (Cronbach's alpha = .92) and post-test (Cronbach's alpha = .76). See Appendix C for copy of measures.

Satisfaction with Life Scale (SWLS)

The SWLS measures subjective experience of well-being, such as purpose in life, through a 5-item, 7-point rating scale (Diener et al., 1985). National norms have suggested a mean score between 24.5 and 28 (Kobau et al., 2010). The scale was shown to have internal consistency at pre-test (Cronbach's alpha = .73) and post-test (Cronbach's alpha = .83). See Appendix C for copy of measures.

Daily Spiritual Experience Scale (DSES)

The DSES (Underwood & Teresi, 2002) is a 16-item, 6-point rating scale with the categories of: *many times a day* = 1, *every day* = 2, *most days* = 3, *some days* = 4, *once in a while* = 5, *and never or almost never* = 6. The scale measures the occurrence of common spiritual experiences such as feelings of connectedness and being loved. The scale was shown to have internal consistency at pre-test (Cronbach's alpha = .97) and post-test (Cronbach's alpha = .97). See Appendix C for copy of measures.

Cognitive Ability

The adapted Stroop measures the cognitive ability of executive functioning by requiring participants to identify the semantic or visual color of words and objects in four series of tasks. Ability is measured by reaction time and error rate. Our participants will be compared within-subjects with a test-retest method for a measure of reliability.

Electroencephalogram (EEG)

The EEG measures the electrical outputs created by neuronal circuitry by placing electrodes on the scalp of the skull. This study will us a 24-diode cap to measure the electrical activity around the areas of the skull associated with the frontal, parietal, and temporal cortices using 10 channels. Mean power outputs from individual EEG channels assumes neural activity is occurring in the spatial region surrounding the immediate area of the diode, including the regions around the frontal poles, bilateral and medial prefrontal cortex, bilateral parietal lobe, and bilateral superior temporal lobe.

Electrocardiogram (ECG)

The ECG is an electrical recording system that is placed on the skin near the right clavicle and second rib on the left to measure electrical outputs of the heart which generate heartbeats. An

ECG allows for the measurement of heart rate variability (HRV) through Kubio Software after recording heart beats per minute. HRV was then analyzed for root square means of the standard deviation (RMSSD) of the R-R interval between beats. RMSSD has been found to be associated with the activation of the vagal nerve associated with heart rate regulation. The innervation of the vagal nerve for heartrate is associated with the autonomic nervous system. Higher RMSSD is associated with parasympathetic vagal tone, while lower RMSSD is associated with sympathetic vagal withdrawal (Laborde et al., 2017).

Electrodermal activity (EDA)

The EDA measures microsiemen of the skin. Electrodes were placed on two fingers of the non-dominant hand. Such electrical activity is associated with the autonomic nervous system's stress response of increasing sweat production in the extremities.

Record Sheet

A record sheet was used to record beginning and end times of each trial while participants performed the cognitive task. See Appendix F for copy of record sheet.

Instruments

The Acknowledge program was used to follow and record the physiological measures. The researcher was seated behind the participant and could view the second computer screen on which the visual stimulus was presented to the participant without disturbing the participant. The data were acquired using the Biopac Data MP150 Acquisition Analysis System (Biopac, n.d.). A 24-channel electrode cap was worn during the recordings. Two gold ear clips were used for reference grounds. Silver GSR electrodes were attached to the second and third finger of the non-dominant hand. Electrodes were attached (adhesive) to the right clavicle area and just beneath

the left rib area. Electrode gel was pre-applied on the adhesive of the GSR and ECGT electrodes. Electrode gel was applied to the scalp with a blunt syringe.

The SuperLab 5.0 program was used to create and run the adapted Stroop task. The program was ran for a 5-minute rest period followed by an initial learning task to semantically identify the texts of "red," "green," "blue," "brown," and "purple." The program was randomly display 10 trials of the stimulus list in all black ink, then repeat. Next, "XXX," XXXX," "XXXXX," and "XXXXXX," was displayed in random ink color of red, green, blue, brown, and purple ink in 30 trials. Afterwards, the texts "red," "green," "blue," "brown," and "purple" was presented in random color of red, green, blue, brown, and purple ink for 60 trials two times. Then the program randomly displayed the text "red," "green," "blue," "brown," "purple," "RED," "GREEN," "BLUE," "BROWN," or "PURPLE," in random color of red, green, blue, brown, and purple ink for 40 trials. The program again randomly displayed 10 trials of the texts of "red," "green," "blue," "brown," and "purple" in all black ink. See Appendix D for copy of stimulus list.

Procedure

After being approved by George Fox University's Human Subjects Research Committee, participants were assigned into the experimental group or the comparison group based off the semester they attended the identified course. Participants were asked to undergo EEG, ECG, and EDA testing for 30 minutes twice (once pre-intervention, and again post-intervention). See Appendix E for the experiment's step-by-step procedures. While being monitored by the EEG, ECG, and EDA, the participants filled out the PHQ9, GAD7, SWLS, DSES, and a demographic questionnaire that consisted of 37 items. They then sat for a 5-minute rest period twice, once pre-test and again post-test. Participants performed an adapted version of the Stroop task between

rest periods. The adapted Stroop is a cognitive task split into four sub-tasks, described above. The researcher recorded the start and end time of each task. A rest period established participants baseline for 5 minutes pre- and post-Stroop task. A mountainous lake scene was depicted through the rest period. Finally, participants were asked to practice a Christian meditative practice for 20 minutes a day for 5 weeks as part of their course assignment if in the Fall Semester of the course. Participants in the Spring semester did not engage in Centering prayer, but the Spring course changed in no other way. Participants filled out a daily questionnaire reporting their amount of time spent praying. Students in the Spring Semester were not assigned nor taught Centering Prayer but were asked to partake in the same pre- and post-intervention tasks of answering survey data and performing a cognitive task while being recorded through EEG, EKG, and EDA software. After participants completed the post-test, a debrief explaining the hypotheses of the results was conducted.

Data Analysis

The research question asks if students have changes in psychopathological symptoms, subjective well-being, daily spiritual experiences, executive functioning, and neurophysiological activity after engaging in the intervention of practicing Centering Prayer. These variables were measured via self-reports (GAD-7, PHQ-9, SWLS, and DSES), accuracy hit rate and reaction times (Adapted Stroop), mean power (EEG), mean microsemiens (EDA), and heart rate variability (EKG). A mixed MANOVA for pre and post measures was used to interpret the data.

Chapter 3

Results

Psychological Measures

Descriptive statistics for the psychological measures of anxiety (GAD7; Spitzer et al., 2006) and depression (PHQ9; Kroenke et al., 2001) are listed in Table 1. Standard deviations for both groups and both measures were found to be large compared to the resulting means. Also, the comparison group at pre-test evidenced significant group differences with large effect sizes at pre-test in anxiety (two-tailed Welches $t(16.44) = -3.73$, $p = .002$, Hedge's G = 3.47) and depression (two-tailed $t(23) = -6.16$, $p < .001$, Cohen's d=2.92).

Table 1

Descriptive Statistics Between Groups for Results on Generalized Anxiety Disorder 7 and Patient Health Questionnaire 9

	Comparison (n = 14)		Experimental (n = 13)				
Variable	*M*	*SD*	*M*	*SD*	*t (26)*	*p*	*d*
Pre GAD7	11.14	5.14	4.46	4.31	-7.69	< .001*	-3.10
Pre PHQ9	24.21	9.99	4.31	3.40	6.82	< .001*	2.63
Post GAD7	3.42	2.11	4.38	2.63	-9.95	< .001*	-3.72
Post PHQ9	3.41	2.39	4.31	3.59	-.328	.37	-.13

Note. Between group *t*-scores were conducted to determine if group differences existed pre-training. * p <.01.

As a result of the group differences found at pre-test, a multivariate analysis of covariance (MANCOVA) was conducted to determine the effect of Centering Prayer on symptoms of anxiety and depression between groups at post-test. Prior to the analysis, outliers were removed from the MANCOVA, eliminating GAD7 scores above 17. All assumptions of these statistical analyses were met. Participants' pre-test scores were used as the covariate. MANCOVA results revealed a main effect of time between pre- and post-test for anxiety. A trending significance was observed for time between pre- and post-test for depression. A main effect for group was found for both anxiety and depression. Refer to Table 2 for detailed results of the MANCOVA analysis for psychological measures.

Table 2

MANCOVA Between Groups for Results on Generalized Anxiety Disorder 7 and Patient Health Questionnaire 9

Variable	MS[a]	F (1,22)	*p*	η_p^2
GAD7				
Time	23.091	7.85	.01*	.26
Group	105.226	9.99	<.01*	.62
Group X Time	4.21	2.11	.24	.06
PHQ9				
Time	16.55	3.35	.08	.13
Group	87.86	17.81	< .01*	.45
Group X Time	1.90	.38	.54	.02

Note. [a] MS = Mean Square. * p <.01

Spiritual Measures

Descriptive statistics for the measure of Daily Spiritual Experiences Scale (DSES; Underwood & Teresi, 2002) is listed in Table 3. Notice the large means for the comparison group at pre-test compared to the experimental group, evidencing significant group differences with large effects at pre-test spiritual experiences.

Table 3

Descriptive Statistics Between Groups for Results on the Daily Spiritual Experiences Scale

	Comparison (n = 13)		Experimental (n = 13)				
Measures	*M*	*SD*	*M*	*SD*	*t*(25)	*p*	*d*
Pre DSES	74.14	8.31	36.15	12.79	9.22	< .001*	3.55
Post DSES	73.85	9.31	35.46	13.04	8.64	< .001*	3.39

Note. Between group *t*-scores were conducted to determine if group differences existed pre-training. * p <.01

As a result of the group differences found at pre-test, a multivariate analysis of covariance (MANCOVA) was conducted to determine the effect of Centering Prayer on subjective perceptions of daily spiritual experiences between groups over time. All assumptions of these tests were met. Participants' pre-test scores were used as the covariate. MANCOVA results revealed no effects of Centering Prayer on subjective perceptions of daily spiritual experiences between groups over time. Refer to Table 4 for detailed results of the MANCOVA analysis for spiritual measures.

Table 4

MANCOVA Between Groups for Results on Daily Spiritual Experiences Scale

Variable	Wilks' λ	MS[a]	F (1,23)	*p*	$\eta_p 2$
DSES					
Time	.96	23.091	.97	.34	.04
Group	.96	20.26	1.05	.32	.04
Group X Time	.96	4.21	1.05	.32	.04

Note. [a] MS = Mean Square

Well-Being Measure

Descriptive statistics for the well-being measure of Satisfaction With Life Scale (SWLS; Diener et al., 1985) is listed in Table 5. Groups were not found to be significantly different at time of pre-test (two-tailed $t(25) = -.27$, $p = .79$, Cohen's $d = -.1$)

Table 5

Descriptive Statistics Between Groups for Results on the Satisfaction with Life Scale

	Comparison (n = 14)		Experimental (n = 13)				
Variable	*M*	*SD*	*M*	*SD*	*t (26)*	*p*	*d*
Pre SWLS	26.21	4.63	25.69	5.42	-.27	.79	-.1
Post SWLS	23.08	3.38	26.46	6.1	-1.76	.09	-.67

Note. Between group *t*-scores were conducted to determine if group differences existed pre-training.

As a result of the group differences found at pre-test, a multivariate analysis of covariance (MANOVA) was conducted to determine the effect of Centering Prayer on subjective

perceptions of SWLS between groups over time. All assumptions of these tests were met. MANOVA results revealed a significant interaction of Centering Prayer on subjective perceptions of satisfaction with life between groups over time. Refer to Table 6 for detailed results of the MANCOVA analysis for SWLS.

Table 6

MANOVA Between Groups for Results on the Satisfaction with Life Scale

Variable	Wilks' λ	MS[a]	F (1,24)	*p*	$\eta_p 2$
SWLS					
Time	.95	13.0	1.40	.25	.05
Group	.92	33.92	.85	.37	.03
Group X Time	.85	40.69	4.37	.05**	.15

Note.[a] MS = Mean Square. ** $p = .05$

Physiological Measures

Descriptive statistics for the physiological measures of brain waves (EEG) are listed in tables by individual channel, refer to the List of Tables for page numbers and titles of channels. Descriptive statistics for physiological measure were analyzed for the separate trials of the stress task, starting with the baseline rest period (rest 1), then the first task of the stroop-like task label WordReading, second task of ColorNaming, third task of Inhibition, fourth task of Switching, a task of word reading that measured Fatigue, and a second rest period (Rest 2). Group differences in the left superior temporal mean power (Channel 7) were found at pre-test on the switching task, (two-tailed $t(22) = -2.44$, $p = .03$, Cohen's $d = .12$). See Tables 1-18 for descriptive statistics of physiological measures.

Table 7

Descriptive Statistics for EEG Fp1 Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	*SD*	*M*	*SD*	*t* (21)	*p*	d
PreEEGFp1							
Rest1	3.52	2.57	3.26	2.90	.24	.82	.10
WordReading	9.55	8.33	6.65	6.12	.96	.35	.39
ColorNaming	10.36	8.83	7.75	8.17	.75	.46	.31
Inhibition	9.72	8.81	6.95	8.43	.78	.44	.32
Switching	10.50	7.59	6.16	5.08	1.39	.18	.57
Fatigue	11.83	9.79	8.76	9.42	.78	.45	.32
Rest2	4.90	4.01	3.22	2.19	1.24	.23	.51
PostEEGFp1							
Rest1	2.34	1.53	2.87	1.80	-.79	.44	-.31
WordReading	12.02	20.13	4.10	3.61	1.39	.19	.51
ColorNaming	12.69	19.87	3.92	3.55	1.56	.14	.57
Inhibition	10.98	15.23	3.89	2.75	1.65	.12	.60
Switching	11.46	14.53	4.65	2.56	1.66	.12	.61
Fatigue	11.21	15.39	7.41	6.73	.81	.43	.30
Rest2	4.34	4.11	3.27	2.09	.82	.43	.31

Table 8

Descriptive Statistics for Eeg Fp2 Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	SD	M	SD	t (22)	p	d
Pre EEG Fp2							
Rest1	3.26	2.31	3.21	2.99	.05	.96	.02
WordReading	10.14	9.32	7.26	7.27	.83	.41	.34
ColorNaming	11.11	9.85	8.47	9.52	.67	.51	.27
Inhibition	10.03	9.66	7.38	9.90	.66	.52	.27
Switching	10.83	8.37	7.16	6.18	1.20	.24	.49
Fatigue	12.22	10.37	9.50	10.72	.63	.54	.26
Rest2	4.14	2.40	3.23	2.16	.97	.34	.40
Post EEG Fp2							
Rest1	3.40	4.61	3.13	1.96	.58	.57	.24
WordReading	12.95	19.83	4.62	4.18	1.48	.16	.54
ColorNaming	14.71	19.65	4.71	4.19	1.78	.10	.65
Inhibition	11.54	14.99	4.55	3.43	1.63	.13	.60
Switching	12.17	14.02	5.20	3.03	1.75	.10	.64
Fatigue	12.15	15.46	7.86	6.75	.90	.38	.34
Rest2	4.72	4.07	3.53	2.13	.91	.37	.34

Table 9

Descriptive Statistics for EEG F3 Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	*SD*	*M*	*SD*	*t* (22)	*p*	*d*
Pre EEG F3							
Rest1	.67	.37	1.69	2.55	-1.31	.22	-.58
WordReading	2.10	2.73	1.35	1.17	.84	.41	.35
ColorNaming	1.91	1.54	1.64	1.53	.44	.67	.18
Inhibition	1.57	1.19	1.53	1.53	.08	.94	.03
Switching	2.14	1.67	1.36	.98	1.36	.19	.56
Fatigue	2.42	2.43	1.49	1.64	1.08	.29	.44
Rest2	.96	.64	.96	.86	.01	.99	.002
Post EEG F3							
Rest1	.57	.29	1.20	1.34	-1.51	.16	-.64
WordReading	1.61	2.09	1.07	1.13	.76	.46	.30
ColorNaming	1.79	1.98	.82	.59	1.68	.11	.61
Inhibition	2.08	1.96	.89	.41	2.14	.05	.78
Switching	2.42	2.08	.89	.41	2.20	.05	.80
Fatigue	1.54	1.75	2.53	4.59	-.71	.48	-.29
Rest2	1.30	2.00	.93	.63	.58	.57	.23

Table 10

Descriptive Statistics for EEG F4 Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	*SD*	*M*	*SD*	*t* (22)	*p*	*d*
Pre EEG F4							
Rest1	.70	.37	1.72	2.56	-1.31	.17	-.56
WordReading	2.61	2.86	2.10	2.33	.47	.65	.19
ColorNaming	2.52	1.95	2.49	2.98	.02	.98	.009
Inhibition	2.04	1.59	2.51	3.00	-.33	.75	-.14
Switching	2.51	1.85	1.96	1.74	.73	.47	.30
Fatigue	2.86	2.54	2.42	2.92	.40	.70	.16
Rest2	1.04	.63	1.03	.88	.04	.97	.01
Post EEG F4							
Rest1	.58	.27	1.74	2.24	-1.70	.12	-.73
WordReading	2.61	3.84	1.46	1.55	.93	.36	.38
ColorNaming	2.84	3.79	1.11	.90	1.60	.13	.58
Inhibition	2.76	2.91	1.76	1.65	1.56	.14	.58
Switching	3.04	2.91	1.76	1.64	1.35	.19	.51
Fatigue	2.36	2.88	2.88	4.68	-.33	.75	-.13
Rest2	1.31	2.02	1.42	1.48	-.15	.88	-.06

Table 11

Descriptive Statistics for EEG F7 Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	*SD*	*M*	*SD*	*t* (22)	*p*	*d*
Pre EEG F7							
Rest1	.98	.54	2.20	3.45	-1.16	.27	-.50
WordReading	2.08	3.26	1.27	1.31	.78	.45	.32
ColorNaming	1.50	1.24	1.41	1.23	.16	.88	.07
Inhibition	1.16	.79	1.35	1.10	-.49	.63	-.20
Switching	2.31	2.61	1.56	1.81	.81	.43	.33
Fatigue	2.10	2.89	.97	.92	1.23	.23	.51
Rest2	1.46	1.19	1.34	1.16	.24	.81	.10
Post EEG F7							
Rest1	.80	.47	1.50	1.84	-1.22	.25	-.52
WordReading	.95	1.10	.76	.94	.45	.66	.19
ColorNaming	1.03	.97	.67	.54	1.08	.29	.44
Inhibition	1.53	1.68	1.02	1.16	.84	.41	.35
Switching	2.11	2.30	1.03	.82	1.58	.13	.59
Fatigue	.87	.95	2.00	4.26	-.93	.36	-.38
Rest2	.98	.54	2.20	3.45	-1.16	.27	-.50

Table 12

Descriptive Statistics for EEG F8 Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	*SD*	*M*	*SD*	*t* (22)	*p*	*d*
Pre EEG F8							
Rest1	1.31	.86	1.81	2.37	-.70	.49	-.26
WordReading	3.94	4.95	3.89	5.48	.02	.98	.01
ColorNaming	3.68	3.64	4.59	6.77	-.42	.68	-.18
Inhibition	2.99	3.18	4.35	6.61	-.65	.52	-.27
Switching	4.21	4.30	3.65	3.99	.32	.75	.13
Fatigue	2.61	1.80	4.49	6.04	-.95	.36	-.43
Rest2	1.93	1.28	1.71	1.12	.43	.67	.18
Post EEG F8							
Rest1	1.00	.62	1.60	1.63	-1.22	.24	-.51
WordReading	3.80	5.25	1.7	1.46	1.53	.15	.55
ColorNaming	4.00	5.26	1.54	1.49	1.60	.13	.58
Inhibition	3.75	4.18	1.98	1.81	1.37	.20	.51
Switching	4.04	4.16	2.00	1.36	1.66	.12	.60
Fatigue	3.27	4.03	3.82	4.03	-.26	.80	-.11
Rest2	1.67	2.16	1.80	1.59	-.15	.88	-.06

Table 13

Descriptive Statistics for EEG T3 Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	*SD*	*M*	*SD*	*t* (22)	*p*	*d*
Pre EEG T3							
Rest1	.30	.23	1.80	3.21	-1.55	.15	-.69
WordReading	1.16	3.26	.41	.43	.75	.46	.31
ColorNaming	.50	.75	.65	.76	-.47	.64	-.19
Inhibition	.25	.18	.59	.64	-1.71	.11	-.76
Switching	1.18	2.21	.82	1.50	.46	.65	.18
Fatigue	1.18	3.32	.27	.31	.91	.37	.37
Rest2	.58	1.05	.76	1.13	-.39	.70	-.16
Post EEG T3							
Rest1	.43	.47	1.29	1.96	-1.41	.19	-.63
WordReading	.32	.37	.52	.91	-.72	.48	-.29
ColorNaming	.46	.51	.28	.15	1.24	.23	.47
Inhibition	.92	1.30	.42	.62	1.16	.26	.47
Switching	1.30	1.77	.52	.69	1.36	.19	.56
Fatigue	.28	.36	1.59	4.64	-.93	.37	-.42
Rest2	.30	.23	1.80	3.21	-1.55	.15	-.69

Table 14

Descriptive Statistics for EEG T4 Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	*SD*	*M*	*SD*	*t* (22)	*p*	*d*
Pre EEG T4							
Rest1	.34	.17	1.79	2.78	-1.72	.12	-.74
WordReading	1.11	2.64	.87	.81	.29	.78	.12
ColorNaming	.57	.52	1.11	1.00	-1.71	.10	-.70
Inhibition	.36	.19	1.07	.96	-1.63	.13	-1.04
Switching	1.22	1.99	1.03	1.13	-2.44	.03	.12
Fatigue	1.41	3.69	.67	.81	.28	.78	.27
Rest2	.62	1.05	.80	1.01	.66	.52	-.17
Post EEG T4							
Rest1	.29	.23	1.24	1.76	-1.78	.10	-.77
WordReading	.49	.53	.54	.85	-.17	.87	-.07
ColorNaming	.63	.60	.36	.22	1.47	.16	.54
Inhibition	1.06	1.33	7.0	1.18	.68	.50	.28
Switching	1.38	1.79	.95	1.72	.59	.56	.24
Fatigue	.40	.41	1.75	4.61	-.97	.35	-.43
Rest2	.85	1.97	.98	1.33	-.18	.86	-.08

Table 15

Descriptive Statistics for EEG P3 Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	*SD*	*M*	*SD*	*t* (22)	*p*	*d*
Pre EEG P3							
Rest1	.27	.19	1.20	2.60	-1.13	.29	-.52
WordReading	1.27	3.25	.52	.53	.72	.48	.30
ColorNaming	.65	.72	.63	.55	.07	.95	.03
Inhibition	.40	.20	.73	.63	-1.61	.14	-.73
Switching	1.30	2.14	.65	.67	.93	.37	.39
Fatigue	1.94	5.29	.44	.47	.89	.38	.37
Rest2	.61	1.12	.80	1.15	-.40	.70	-.17
Post EEG P3							
Rest1	.33	.25	.95	1.74	-1.12	.29	-.52
WordReading	.49	.38	.28	.13	1.90	.08	.69
ColorNaming	.57	.40	.34	.17	1.84	.08	.71
Inhibition	1.05	1.33	.32	.15	1.96	.07	.70
Switching	1.35	1.73	.41	.21	1.94	.08	.71
Fatigue	.37	.29	1.81	4.95	-.92	.38	-.43
Rest2	.90	2.07	.67	1.10	.32	.75	.14

Table 16

Descriptive Statistics for EEG P4 Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	*SD*	*M*	*SD*	*t* (22)	*p*	*d*
Pre EEG P4							
Rest1	.27	.17	1.49	2.53	-1.60	.14	-.69
WordReading	1.26	3.08	.60	.51	.70	.49	.29
ColorNaming	.68	.70	.80	.69	-.45	.66	-.18
Inhibition	.46	.25	.79	.62	-1.64	.13	-.69
Switching	1.31	2.10	.63	.47	1.14	.27	.42
Fatigue	2.05	5.62	.52	.52	.90	.38	.37
Rest2	.61	1.10	.66	.84	-.12	.91	-.05
Post EEG P4							
Rest1	.32	.19	.91	1.65	-1.18	.27	-.51
WordReading	.49	.37	.50	.73	-.06	.96	-.02
ColorNaming	.63	.47	.38	.22	1.72	.10	.64
Inhibition	1.11	1.31	.38	.23	1.98	.07	.72
Switching	1.35	1.65	.46	.26	1.91	.08	.70
Fatigue	.41	.35	1.69	4.50	-.94	.37	-.41
Rest2	.87	1.87	.65	1.08	.36	.72	.14

Table 17

Descriptive Statistics for EKG RMSSD Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	*SD*	*M*	*SD*	*t* (22)	*p*	*d*
Pre EKG RMSSD							
Rest1	31.77	30.86	43.32	24.26	0.75	.46	.31
WordReading	30.50	22.13	48.67	32.43	1.31	.20	.55
ColorNaming	28.74	22.79	48.21	27.65	1.73	.09	.72
Inhibition	33.50	27.18	51.95	29.26	1.36	.19	.57
Switching	31.70	24.65	48.31	35.19	1.14	.27	.48
Fatigue	28.31	23.43	45.38	35.63	1.22	.24	.51
Rest2	40.94	26.82	54.80	33.88	0.81	.43	.34
Post EKG RMSSD							
Rest1	34.16	15.23	55.18	34.24	1.90	.08	.74
WordReading	31.38	13.50	53.77	30.02	2.11	.05	.82
ColorNaming	30.41	11.86	51.92	32.08	2.01	.07	.78
Inhibition	28.87	12.06	51.04	30.86	2.04	.06	.80
Switching	28.80	10.73	48.69	30.26	1.97	.07	.77
Fatigue	30.14	12.48	44.90	25.51	1.85	.08	.72
Rest2	37.94	14.58	63.52	37.75	1.96	.07	.76

Table 18

Descriptive Statistics for EDA Across Test Times, Groups, and Trials of Cognitive Task

Variable	Comparison (n = 13)		Experimental (n = 11)				
	M	SD	M	SD	t (22)	p	d
Pre EDA							
Rest1	13.58	6.57	13.52	5.07	-.58	.57	-.24
WordReading	13.21	6.14	12.14	4.47	-.51	.62	-.21
ColorNaming	12.62	5.74	11.52	4.23	-.58	.57	-.24
Inhibition	12.33	5.63	11.54	4.21	-.45	.33	-.18
Switching	12.07	5.11	11.66	4.31	-.26	.80	-.11
Fatigue	13.1	6.16	11.56	4.54	-.69	.50	-.28
Rest2	11.27	4.68	10.83	4.19	-.24	.82	-.10
Post EDA							
Rest1	11.9	7.3	15.04	4.72	.82	.42	.33
WordReading	12.21	7.02	13.52	3.92	.66	.52	.27
ColorNaming	11.69	6.96	12.74	4.27	.53	.60	.22
Inhibition	11.47	6.9	12.23	4.43	.36	.72	.15
Switching	11.60	6.79	12.17	4.45	.29	.78	.12
Fatigue	12.43	7.62	12.62	4.89	.12	.91	.05
Rest2	10.81	6.02	11.06	4.16	.19	.85	.08

A multivariate analysis of variance (MANOVA) was conducted to determine the effect of Centering Prayer on physiological measures of EEG, EKG, and EDA experiences between groups over time. All assumptions of these tests were met.

MANOVA results of the EEG revealed a main interaction among groups, test times, Stroop-like trials, and channels, Wilks' $\lambda = .49$, $F(1,22) = 1.49$, $p = .01$, multivariate $\eta_p 2 = .06$. Results of MANOVA persisted when controlling for the frontal-pole channels Fp1 and Fp2, Wilks' $\lambda = .76$, $F(1,22) = 1.05$, $p = .04$, multivariate $\eta_p 2 = .04$. Refer to Table 19 for detailed results of the MANOVA analysis for EEG measures.

MANOVA results of the EKG showed a significant difference between trials, Wilks' $\lambda = .25$ $F(1,22) = 8.22$, $p < .001$, multivariate $\eta_p 2 = .76$. A trending towards significant interaction was found among test times and Stroop-like trials, Wilks' $\lambda = .53$ $F(1,22) = 2.42$, $p = .07$, multivariate $\eta_p 2 = .46$. Group differences also trended towards significance, Wilks' $\lambda = .63$ $F(1,22) = 2.99$, $p = .10$, multivariate $\eta_p 2 = .13$. Refer to Table 20 for detailed results of the MANOVA analysis for EKG measures.

MANOVA results of the EDA revealed a significant interaction between groups and Stroop-like trials, Wilks' $\lambda = .47$ $F(1,22) = 2.36$, $p = .03$, multivariate $\eta_p 2 = .53$. Refer to Table 21 for detailed results of the MANOVA analysis for EDA measures.

Effect Size Analyses

Due to the small sample size and resulting low Power, follow-up effect size analyses were conducted in order to assess the interactions of group and time for the two dependent variables. The effect size employed in this analysis is the Pre-Post Control design mean-difference calculation (*d*ppc), described by Morris (2008). See Appendix G for detailed description of dpcc.

Table 19

MANOVA for EEG Across Test Times, Groups, and Trials of Cognitive Task

Variable	Wilkes λ	MS[a]	F (1,22)	*p*	$\eta_p 2$
EEG					
Time	.99	40.99	.27	.61	.01
Group	.53	674.65	.95	.34	.04
Trial	.40	250.53	4.00	.01*	.60
Channel	.30	2184.04	3.40	.02*	.70
Time X Group	.97	110.20	.72	.40	.03
Time X Trial	.93	4.88	.20	.97	.07
Time x Channel	.38	3.48	2.34	.08	.62
Trial X Group	.64	82.86	1.49	.24	.36
Trial X Channel	.62	52.56	7.68	< .001*	.27
Channel X Group	.60	190.11	.96	.51	.40
Time X Trial X Channel	.72	20.14	.35	.75	.02
Time X Trial X Group	.69	87.45	1.82	.10	.08
Trial X Channel X Group	.58	225.13	1.21	.29	.05
Time X Trial X Channel X Group	.76	3.96	1.05	.04*	.04

Note. [a] MS = Mean Square. * $p < .05$.

Table 20

MANOVA for EKG RMSSD Across Test Times, Groups, and Trials of Cognitive Task

Variable	Wilkes λ	Mean Square	F (1,21)	*p*	$\eta_p 2$
EKG RMSSD					
Time	.99	120.67	.07	.79	.004
Group	.63	23376.82	2.99	.10	.13
Trial	.25	1162.95	8.22	< .001*	.76
Time X Group	.98	746.62	.45	.51	.02
Time X Trial	.53	174.17	2.42	.07	.46
Trial X Group	.74	43.77	.93	.50	.26
Time X Group X Trial	.77	207.14	.79	.27	.23

Note. * p <.01.

Table 21

MANOVA for EDA Across Test Times, Groups, and Trials of Cognitive Task

Variable	Wilkes λ	Mean Square	F (1,24)	p	$\eta_p 2$
EDA					
Time	1.00	5.62	.003	.95	<.001
Group	.67	.001	< .001	.999	< .001
Trial	.20	30.51	10.12	< .001**	.80
Time X Group	.97	85.22	.77	.39	.03
Time X Trial	.84	1.26	.48	.84	.16
Trial X Group	.47	2.36	2.95	.03*	.53
Time X Group X Trial	.71	4.24	1.03	.45	.29

Note. * p < .05. ** p <.01.

Table 22 shows the *d*ppc effect sizes for the two groups across two times for all of the EEG channels on all of the Stroop activities. The pattern of *d*ppc results for the physiological measures resulted in a range of effects, from no effects to large effects that were positive and negative in direction between the experimental and comparison group (Cohen's *d* ranged from -.80 to 1.39). Of note, the experimental group's mean electrical power showed most positive effects of change across the brain for the more cognitively challenging Stroop-like trials of inhibition and switching (Cohen's *d* ranged from .14 to 1.39). Furthermore, results suggest the comparison group had larger effects in the change of their heart rate variability and electrodermal activity (Cohen's *d* ranged from -.57 to .09) across trials.

Table 22

The dppc Effect Sizes Based on Treatment and Comparison Groups in the Pre-Post Periods for all of the EEG Channels on all of the Stroop Activities

Variable	Stroop Tasks						
	Rest 1	Word Reading	Color Naming	Inhibition	Switching	Fatigue	Rest 2
EEG Fp1	-.29*	.38*	.38*	.43*	.34*	.10	-.18
EEG Fp2	.25*	.40*	.53**	.41*	.36*	.18	-.19
EEG F3	.28*	-.13	.43*	.81***	.36*	-.63**	.10
EEG F4	-.08	.18	.58**	.73**	.34*	-.26*	.30*
EEG F7	.27*	-.35*	.23*	.57**	.16	-.80***	-.15
EEG F8	-.07	.43*	.66**	.74**	.40*	.29*	-.21*
EEG T3	.35*	-.53**	.51**	1.08***	.25*	-.73**	-.22*
EEG T4	.32*	-.22*	1.13***	1.27***	.14	-.70**	.04
EEG P3	.21*	-.31*	.35*	1.37***	.19	-.80***	.29*
EEG P4	.44*	-.43*	.60**	1.39***	.14	-.76**	.60**
EKG RMSSD	-.21*	-.33*	-.09	-.13	-.07	.09	-.32*
EDA	-.57**	-.43*	-.40*	-.29*	-.18	-.29*	-.13

Note. * Absolute value of small effect size between 0.2-0.49. ** Absolute value of medium effect size between 0.5-0.79. *** Absolute value of large effect size above 0.8

Chapter 4

Discussion

The collection of statistical analyses evidences a complex, mixed pattern of results concerning the overall hypothesis that the practice of Christian meditation would produce changes in individuals compared to non-practitioners. Some of the global changes in functioning predicted were not found. Interestingly, the findings seem to support the idea that Christian meditation affects the nonconscious components of functioning, such as the electrical outputs found in our brain, our heart, and our skin. However, the more obvious changes predicted in conscious functioning of mood and spiritual experiences were not supported by the data. Below is a discussion on some particulars around the phenomena found in this study, beginning with group differences that were found before testing began. What the results may imply is also discussed in terms of effects on Christian higher education, spirituality, and Christian psycho-physiological functioning in general. Those implications will be interpreted with caution given the limitations of the study; nevertheless, this study begs future questions to be sought after, and for spiritual practices to be a focus of scientific investigation.

Group Differences Pre-test

Students reported being more anxious and depressed at the start of their spring semester in this particular year than at the beginning of their fall term. Furthermore, the students in the spring semester self-reported a significantly greater frequency of daily spiritual experiences than students in the fall. These groups were different from the outset concerning their conscious

experiences of their emotional status and spirituality. The reasons for these pre-test differences are unknown. I speculate the differences in time of year seems to be the simplest answer for why their scores were different at the time of pre-test, as students beginning their spring semester in January may experience their emotional status as more distressing during the darker months of the year. In terms of their spiritual experiences, students in the spring semester may have benefitted from a semester of attending a religiously affiliated university. This study placed students participating during the spring semester in the comparison group, thereby requiring statistical compensation to effectively analyze the differences between these groups at post-test in a meaningful way. Despite the statistical control of this confounding factor, this result creates a significant limitation for the study. Group differences were not found at pre-test for the other measures.

Main Findings

Symptoms of Psychopathology

Results suggest practitioners in the fall term self-reported a lesser decrease of symptoms associated with anxiety and depression compared to the non-practitioner students in the spring semester. The students that did not practice Centering Prayer self-reported a significant decrease in symptomology over time, while those that did practice Christian meditation did not show changes in symptoms of psychopathology between pre- and post-test, indicating their symptoms of psychopathology remained stable through the course of their practice.

Daily Spiritual Experiences

Meanwhile, the frequency of self-reported daily spiritual experiences did not show changes over time for either group. The reports of daily spiritual experiences from students in the spring term remained comparatively greater than students in the fall. Surprisingly, the way the

novice practitioners responded to the questions about daily spiritual experiences suggests Centering Prayer did not change their conscious experience of God in their daily life.

Satisfaction with Life

More group differences were found at post-test for the student's self-reports of their subjective satisfaction with life. Non-practitioners of Centering Prayer noted a decrease in their satisfaction in life compared to those that practiced. That is, the students that did not engage in Christian meditation were less satisfied with their life after their spring term was completed. However, practitioners of Centering Prayer did not note significant changes in their satisfaction with life over time, indicating, much like their symptoms of psychopathology, their experience of satisfaction remained stable through the course of their practice.

Neuronal Electrical Output

An interaction effect was found for measurements of brain activity across the domains of groups, time, brain regions, and stressful cognitive trials. This speaks to the complexity of understanding the effects of spiritual practices from a subjective, self-report perspective compared to the more objective results of physiological statuses. While both sources of information are important, the physiological measures appeared to be more sensitive to the changes that occurred after 5 weeks of prayer. The interaction discovered indicates changes in the brain occur over time for frequent practitioners of Centering Prayer when they engage in stressful cognitive tasks. Further analysis revealed the differences that contribute to the interaction are not as straightforward as predicted. Human understanding of our own emotional status at a conscious level may not match what our physiological being experiences.

For one, both groups showed differences over time; meaning that regardless of practicing prayer or not, students perform differently to cognitive tasks the second time they are presented

the challenge. Likewise, all participants responded differently to the different trials, producing more brain activity during trials that are designed to be more challenging, and less activity during rest phases, practice trials, and a fatigue trial repeating a practice round. This demonstrates that the physiological measures were measuring what was expected and thus provide some confidence in the outcomes. Furthermore, a predictable practice effect and a predictable increase in neuronal activity with more challenging cognitive tasks shows that the participants were appropriately engaged in the study.

Viewed in conjunction with Centering Prayer, though, these learners seem to respond to the task with different brain activity than those that did not practice Christian meditation. Those that practiced Centering Prayer showed elevated brain activity on easy tasks, such as during the rest phases and practice trials—their brains appeared to be more active when not being challenged cognitively. The inverse occurred during the stressful moments of the Stroop-like task. Practitioners of Centering Prayer performed the most challenging trials with less brain output. That is, prayers spent less energy during the most challenging portions and more energy during the least challenging. This is a critical finding as the finding shows what is believed that mindfulness and Christian disciplines enable practitioners to do. The increased brain activity during easier tasks indicates engagement, and as the cognitive tasks increase in difficulty, those with brains trained in mindfulness were able to more efficiently manage their brain expended energy.

This effect was more pronounced in certain brain regions than others. Specifically, portions of the brain involved with decision making, cognitive labeling, emotional regulation, memory, and perceptual reasoning had a variable electrical response for prayers. The pattern was consistent across regions described above, but with larger effects. For instance, diodes measuring

the electrical activity of regions around the superior parietal and superior temporal lobes showed greater changes than other regions for prayers. The effects on the temporal and parietal regions were large during the most stressful task. This suggests Centering Prayer most affected regions associated with perceptual reasoning, sensation awareness, emotional regulation, and memory involving fluency, sequencing, and logic.

That Centering Prayer had this effect on the brain is unsurprising given the plethora of literature documenting the neural processes of various types of meditation that align with this studies results (Fletcher et al., 2010; Lee et al., 2018; Newberg, 2010). Differences in the frontal lobe align with Newberg's findings (2010) that Buddhist mediation increases functioning in lobules associated with emotional regulation, attentional concentration, and executive decision making. Likewise, these findings align with the results of Fletcher et al. (2010) who documented changes in brainwaves in the temporal lobe during yoga, and Lee et al. who noted the increased activity in the parietal lobe during many types of mediation. What is surprising is that this study found differences in across regions in the frontal, parietal, and temporal lobe for a single type of meditation. Furthermore, the above studies documented results for long-term practitioners considered masters of their practice, whereas this study found such results among novice practitioners. The finding fits with the theory that Centering Prayer melds the three main functions of various mediations (phenomenological awareness, attentional concentration, and transcendental observation) in one practice.

Electrical Heart Rate Variability

Large effect sizes were found for interactions between groups over time and across trials, although they were not found to be statistically different. At post-test alone, prayers trended towards having higher heart rate variability across trials than non-prayers. When analyzing the

degree of effect size change, however, non-prayers showed a greater change in a decrease in their heart rate variability over time. Much like the effect seen for satisfaction with life, Centering Prayer tended to prevent heart rate variability from decreasing in response to stressful tasks. Heart variability is a measurement of heart rate regulation and demonstrates physiologically the hearts ability to respond more appropriately to contextual factors by decreasing faster when not stressed and increasing more rapidly during stressful experiences. From a polyvagal perspective, the heart's ability to variably beat is a measure of the effectiveness to which the nervous system switches between parasympathetic and sympathetic modes (Siegel, 2007). The results concerning the large effect sizes suggest Centering Prayer may increase the heart's ability to variably respond to changes of the nervous system between parasympathetic and sympathetic arousal. This suggests that prayers were less distressed by the tasks in which they were engaged. Centering Prayer discipline appears to enable a person to face challenging cognitive tasks without undo physiological stress.

Electrodermal Activity

Prayers' electrodermal activity was found to respond with significantly more response across stressful trials than non-prayers. This effect was not found to be associated with time. In fact, the students in the non-praying group showed larger effects as their electrodermal activity decreased to the cognitive tasks between the times of testing. Generally, electrodermal activity is a measure of the skin's response to stress: higher outputs mean a greater response to stress. This finding seems to suggest practitioners of Centering Prayer had a heightened skin response across trials and responded similarly over time. Considering the other findings about the praying group—of stable emotional status, stable satisfaction with life, and stable heart rate variability—

this result about prayers' electrodermal activity staying relatively the same suggests more evidence of a stabilizing effect.

Interpretation of Findings

Taken together, these findings seem to suggest the Christian form of mediation of Centering Prayer generally reflects the physiological and psychological processes found in other forms of meditative prayer. The three dimensions of meditation known as phenomenological awareness, attentional concentration, and transcendental observation seem to be operating within Centering Prayer in a complex way, especially phenomenological awareness and attentional concentration. More than anything, this study gives evidence that Centering Prayer as a form of meditation acts as a stabilizer of functioning for novice practitioners, rather than an improver of functioning.

Changes in attentional concentration were seen in the electrical responses of the frontal lobe. These prayers' brains were less active during the cognitive task. Where one could have predicted a sustained practice of concentrated attention would evoke an increase electrical neural output during a stressful task, this study found Centering Prayer produced a calming effect. Prayers performed with the same accuracy and timing as non-prayers, but with less expended neural energy. That is, it took prayers less neuro-electrical energy to perform difficult tasks. This suggests an improvement in attentional concentration as prayers became more effortless or efficient in their use of brain power. More specifically, regions of the brain used to process and experience emotions, especially negative ones, were less active during stressful tasks. In this way, Centering Prayer served as a regulating practice that supports less effortful, more peaceful mindful concentration.

The phenomenological awareness theorized as a component of meditation can be evidenced in this study as well. Prayers showed more neural activation when not stressed. Meanwhile, their heart rate response and skin conductance did not appear to change. One way to interpret these data is that prayers' bodies were neither desensitizing to stimulation previously provided nor overly stressed by the stimulation. When provided moments of rest, these prayers were more alert and active than their counterparts. When cognitively stressed they showed calmer responsiveness, and when given a novel stimulus at the end through the easy fatigue trial they were more aware of the change. In a complex way, Centering Prayer made Christian meditators aware as well as calm in their awareness.

These points spark a final consideration: prayer served to stabilize participants' functioning in this study. Except from changes seen in the brain, much of the data suggests prayers *did not* change compared to non-prayers. This infers that such phenomena of physiological stabilization correspond with the psychological stabilization of anxiety, depression, and satisfaction with life. Centering Prayer does not necessarily improve functioning according to these results. The prayers of this study remained more physiologically and psychologically level, aware, and responsive to the given moment of the study than their comparative group of non-prayers.

Perhaps most surprisingly concerning the stabilizing effect is that the prayers likely did not experience this shift consciously. They did not report more spiritual experiences, nor did they report an increased level of functioning as measured by psychopathological symptoms, satisfaction with life, or cognitive ability. Their brain activity showed the predicted results, not their subjective reports. The prayers remained in good functioning throughout the study in a way that was not consciously noticeable to them but was discernable on a physiological level. I

hypothesized Centering Prayer would have a panacea effect that would globally improve the lives of those that practiced Centering Prayer. While novice prayers' neural response is exciting, this study shows prayers have nuanced and remarkably unremarkable response to practicing contemplative prayer five times a week.

This finding fits within the literature explaining the process of contemplative practices, such as Centering Prayer, mindfulness, and meditation. Siegel (2007) stated contemplation is a state of *presence* that arises from the body up because it is a "form of internal attunement" (p. 132). Contemplative practitioners consciously attune to themselves through concentration and mindfulness, but the result of that begins through physiological changes of electrochemical neural reactions originating in the midbrain. Wang and Tan (2016) likewise suggested such practice is "learning to be mindful of the sacrament or sacredness of the present moment, and surrendering to God and [God's] will" (p. 73). Coe (2014) noted the effectiveness of Christian contemplative practices is not grounded in a human's ability to reach out to the divine, or to bridge the gap between the divine and mundane with our own human efforts. Rather, Coe stated contemplative action from a Christian perspective is an honest recognition of human limitation while inviting awareness to perceive the action and presence of God already occurring. From a neurotheological perspective, Centering Prayer is effective due to a prayers willingness to witness the initiative taken by God toward the prayer, not because of the efforts of the mind. As such, perhaps a prayers' body first experiences God's action in and around them before the conscious mind can discern the difference. This certainly seemed to be the case in this study.

Implications

Christian religious practitioners or religious organizations can take note of this study because it implies important considerations about the use and effectiveness of the contemplative

practice of Centering Prayer. For one, this prayer may not change prayers' lives in a sensational way. Centering Prayer is unlikely to produce noticeable, drastic, or swift effects in daily spiritual experiences. As Coe (2014) suggested, though, this may be a theological advantage to the practice. The practice does not seek to coerce, plea, or bargain with God for the beneficial effects of prayer, thereby disavowing the ability to earn the grace and mercy of God through the prayers' actions. Centering Prayer is helpful because the practice's sustained, concentrated awareness of the presence of God evokes slow, peaceful stabilization. A paradox of faith is involved here in that humans cannot earn the favor of God through their behavior, but their behavior that seeks God finds God's favor rewarding them. As a result, Christian practitioners of Centering Prayer can expect this practice to help sustain and stabilize them. This is important when considering many Christian sects continue to consider contemplative practices with wariness. If all rewards come from the divine, then this study helps clarify that the contemplative practice of Centering Prayer can be divinely rewarded.

The practice of Christian beliefs in higher education is another area where this study helps clarify the effects of prayer for sustained concentration and studying. Students that practice Centering Prayer are unlikely to dramatically improve test scores. Though students in Christian settings could reasonably expect an improved ability to focus due to the diminished energy output needed to concentrate during stressful moments. Students may find themselves feeling more attuned and responsive to their studies, and better able to be present while resting before and after studying. Again, the effect of Centering Prayer is likely indirectly helpful. By providing a context of a regulated mindset, Centering Prayer enables studying to be more efficient.

For those practicing Christian beliefs in psychotherapeutic context, this study adds to the plethora of literature describing the effects of mindful practices for therapeutic purposes. Blanton

(2019) outlined four approaches to integrating Christian contemplative practices into psychotherapy: (a) embrace secular mindfulness practices, (b) adapt secular mindfulness practices with Christian phrases, (c) offer Christian contemplative practices alongside secular mindfulness practices, and (d) use a Christian contemplative-oriented approach to clinical work. This study empirically helps add to the conversation about a practice that could be implemented with a Christian contemplative-oriented approach to counseling as we learn the physiological effects of contemplative prayer. This effect is offered to Christian practitioners with caution, however. Centering Prayer as a practice, again, is unlikely to reduce the conscious awareness of symptoms based off this sample of participants. Yet, the practice of Centering Prayer could allow for the necessary ability of emotional regulation to grow for the cognitive processes involved with personality change to occur. This study supports from a Christian perspective a bottom-up approach to psychotherapy and neurotheology.

Limitations

These implications and interpretations of the data should be interpreted with some caution. The internal validity of this study is questioned due to the nature of the quasi-experimental design. The stabilizing, regulating effects seen in the experimental group can reasonably be assumed to be due to the practice of Centering Prayer, but not certainly. These groups were not the same, and the large confound concerning the time of year these students participated was not controlled for in this study. Such differences beg the question about how comparable these groups truly were.

Findings are also limited due to the relatively homogeneous sample. These were young, white, Christian college students from a private, Christian university in the Pacific Northwest. Furthermore, there was a lack of randomization of the participants to the groups. These students

elected to attend a higher education class about Christian Discipleship in which this study took place—would students from a general psychology course, or people that were not students at all have similar results? Would students that practiced Centering Prayer in the spring have responded differently than the students in the fall? These questions highlight the uncertain external validity of this study. Obviously, no supreme certainty can be gained from any study, but this study in particular implies just a beginning of a scientific inquiry into the psycho-physiological effects of Centering Prayer.

In the same realm of limitations revealed by research philosophy, the sample was small. Statistically speaking, the conclusions of the study are made with caution for the potential occurrence of both a type 1 and 2 error. Limited statistical significance was found in this study, bringing into question the confidence with which these results are presented. However, large effect sizes on such a small sample indicated these phenomena are likely occurring and producing significant effects for participants.

Lastly, there are limitations to the measurements themselves. Self-reported measures may not be sensitive and subtle enough in this case to withstand the learning effect common to pre-post designs. EEG, too, are an imprecise instrument to measure the brain. This study only implies which regions and functions were affected during the course of the study. Additionally, the interpretation of EEG, HRV, and EDA data is limited to the field's current understanding of what electrical outputs in the body actually mean. EDA, for example, has been cited as a measurement of stress, which makes sense in terms of how skin emits sweat when the nervous system is in a sympathetic state. Does that stress mean something negative, like being worried before a cognitive exam, or is it experienced positively like sweating while holding a romantic

partners hand? Without additional qualitative data about the prayers and non-prayers experience of their cognitive task, this study only offers speculation.

Future directions are linked with these limitations. Ideally, a large, randomized-control trial on the physiological effects of Centering Prayer would provide more confidence. Furthermore, qualitative research could be helpful to tease out what exactly is being consciously experienced by novice prayers. Regardless of the type of research, more research is warranted to begin teasing apart the psychophysiological underpinnings and effects of Christian contemplative prayer. A social experiment might help the field understand how Christian contemplative practices affect interpersonal relationships. Understanding how the practice of Centering Prayer correlates with other forms of Christian practices would be helpful to imbed this research into the wider research on Christian practices as well. This study is a beginning to understanding the complex interactions of Christian contemplative prayer with psychophysiology.

Conclusion

Students that practiced 20 minutes of centering prayer five days a week for five weeks showed stabilizing results compared to students that did not. These prayers had less changes in symptoms of anxiety and depression and remained stable in their satisfaction with life. They performed a cognitive task with more efficient and responsive electrical outputs measures in their brains, hearts and skin while performing the cognitive task with similar accuracy and speed to students that did not regularly pray. These results suggest Centering Prayer activates similar mechanisms as other secular and religious meditative practices that improve phenomenological awareness and attentional concentration. And these effects are experienced from more embodied, nonconscious mechanisms found in our nervous system than our subjective awareness. This study not only gives credence to recent theories about bottom-up processes of mindful presence

and supports the use of bottom-up practices for psychotherapy, but also supports the specific use of religiously-informed practices of meditation for psychophysiological benefits. Important from a diversity perspective, Centering Prayer can be viably seen as a Christian-oriented practice of regulation and stabilization for the lay Christians, Christian students, and Christians seeking psychotherapy. However, due to the limitations of the study design, small sample, and measurement difficulties, future research is needed to more confidently understand how the subjective psychological perspective perceives the brain, heart, and skins response to regular practice of Christian contemplation. Future research will also seek to imbed this knowledge about Centering Prayer within the social, spiritual, and religious contexts within which prayers live their lives.

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Appendix A

Informed Consent

GRADUATE DEPARTMENT OF CLINICAL PSYCHOLOGY
GEORGE FOX UNIVERSITY

CONSENT TO PARTICIPATE IN EEG RESEARCH

You are voluntarily agreeing to participate in electroencephalogram (EEG), electrocardiogram (ECA), and electrodermal activity (EDA) research as a part of your undergraduate course. You may withdraw from this experience at any time, but you will need to complete your required research assignments for your course. Data collection is provided by graduate psychology students who are in training to become doctoral level psychologists. This research is appropriate for recording your body's electrical responses to stimuli. These measures provide no risk to your body but use metal instruments for recording purposes. The instruments will be connected to your scalp, your pam, rib, and neckline. A 24-diode cap will be placed on your head, connected to a strap that will wrap around your chest. Two diodes will be connected to the palm of your non-dominant hand. One more diode will be placed on just under the 2nd rib on your left side, and one more around your collarbone. Alcohol pads will clean the surface of your palm, rib, neck, and forehead. Also, adhesive gel will be applied under each diode. This adhesive gel is washable, but it may become hardened in your hair if left for too long. Finally, two metal ear-clips will be attached to the lobes of your ears. If you are allergic to any metals, please inform the researcher immediately, as a slight rash may be caused by the ear-clips.

You will also be asked to answer some personal questions about your daily lived experience. If you find these questions disturbing, you are encouraged to seek services from any professional agency, George Fox University Health and Counseling Center will provide psychological services to their students free of charge (contact: 503-554-2340). The researcher is willing to answer any questions about these questions and their uses, as well.

The aim of this research is to better understand the mechanisms of the body. Your participation will provide the researcher with invaluable data to do so. The researchers further aim to understand the link of spirituality with physical and psychological functioning. By signing this form, you are agreeing to release the data collected today for use in analysis and publication. However, all personally identifying information gathered is confidential and will not be shared with any persons, including your professor. You will not be penalized in your undergraduate course for not releasing this information.

At any point today, you may decide to stop participating in research. Simply tell the researcher you wish to stop, and all data collection will cease.

If you have further questions about this study, contact the principal researcher, Dr. Glena Andrews, Ph.D. Thank you,

I, _____, have read and understand the above, and consent
(print name) to participate in research. I give my consent to have the data collected today be used for analysis and publication.

Signature: _____ Date: _____

Researcher Signature: _____

Appendix B

Demographic Questionnaire

Age (write in answer):

Gender (check blocks): []Male, []Female, []Prefer not to answer, []Other (please specify)

What socioeconomic status (SES) do you identify as (check blocks)? []Low SES, []Mid SES (Working class), []High SES, []Prefer not to answer, []Other (please specify)

What ethnicity do you identify as (check blocks)? (Please select all that apply) []American Indian or Alaskan Native; []Asian, Chinese, or Pacific Islander; []Black or African American, []Hispanic or Latino, []White or European Heritage, []Prefer not to answer, []Other (please specify)

What is your current academic standing(check blocks)?[]First year (Freshman), []Second year (Sophmore), []Third year (Junior), []Fourth year, or beyond (Senior), []Prefer not to answer

What sexuality do you identify as(write in answer)?

Do you identify with any of the following religions(check blocks)? (Please select all that may apply) []Christianity, []Judaism, []Islam, []Buddhism, []Hinduism, []Native American, []No religion, []Prefer not to answer, []Other (please specify)

If you identified as "Christian," which, if any, of the following denominations do you identify with(check blocks)? (Select all that may apply) []Orthodox, []Catholic, []Protestant, []Lutheran, []Evangelical, []Quaker (Friends Church), []Anglican/Episcopalian, []Methodist, []Baptist, []Anabaptist, []Pentecostal/Charismatic, []Presbyterian, []Latter

Day Saints, []Jehovahs Witness, []Adventist, []Non-denominational, []Prefer not to answer, []Other (please specify)

Appendix C

Copy of Measures

GAD-7
Over the last 2 weeks, how often have you been bothered by the following problems?
Not at all=0, Several days=1, More than half the days=2, Nearly every day=3.

1.Feeling nervous, anxious or on edge 0 1 2 3
2. Not being able to stop or control worrying 0 1 2 3
3. Worrying too much about different things 0 1 2 3
4. Trouble relaxing 0 1 2 3
5. Being so restless that it is hard to sit still 0 1 2 3
6. Becoming easily annoyed or irritable 0 1 2 3
7. Feeling afraid as if something awful might happen 0 1 2 3

PHQ-9
Over the last 2 weeks, how often have you been bothered
by any of the following problems?
Not at all=0, Several days=1, More than half the days=2, Nearly every day=3.

1. Little interest or pleasure in doing things 0 1 2 3
2. Feeling down, depressed, or hopeless 0 1 2 3
3. Trouble falling or staying asleep, or sleeping too much 0 1 2 3
4. Feeling tired or having little energy 0 1 2 3
5. Poor appetite or overeating 0 1 2 3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down 0 1 2 3
7. Trouble concentrating on things, such as reading the newspaper or watching television 0 1 2 3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual 0 1 2 3
9. Thoughts that you would be better off dead or of hurting yourself in some way 0 1 2 3

Satisfaction with Life Scale
Instructions: Below are five statements that you may agree or disagree with. Using the 1 - 7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

- 7 - Strongly agree
- 6 - Agree
- 5 - Slightly agree
- 4 - Neither agree nor disagree
- 3 - Slightly disagree
- 2 - Disagree
- 1 - Strongly disagree

____ In most ways my life is close to my ideal.
____ The conditions of my life are excellent.
____ I am satisfied with my life.
____ So far I have gotten the important things I want in life.
____ If I could live my life over, I would change almost nothing.

Daily Spiritual Experience Scale
The list that follows includes items which you may or may not experience, please consider how often you directly have this experience, and try to disregard whether you feel you should or should not have these experiences. A number of items use the word God. If this word is not a comfortable one for you, please substitute another idea which calls to mind the divine or holy for you.
Many times a day=1, Everyday=2, Most days=3, Some days=4, Once in a while=5, Never or almost never=6

1. I feel God's presence 1 2 3 4 5 6
2. I experience a connect ion with all life 1 2 3 4 5 6
3. During worship, or at other times when connecting with God, I feel joy, which lifts me out of my daily concerns 1 2 3 4 5 6
4. I find strength in my religion or spirituality 1 2 3 4 5 6
5. I find comfort in my religion or spirituality 1 2 3 4 5 6
6. I feel deep inner peace or harmony 1 2 3 4 5 6
7. I ask for God's help in the midst of daily activities 1 2 3 4 5 6
8. I feel guided by God in the midst of daily activities 1 2 3 4 5 6
9. I feel God's love for me directly 1 2 3 4 5 6
10. I feel God's love for me through others 1 2 3 4 5 6
11. I am spiritually touched by the beauty of creation 1 2 3 4 5 6
12. I feel thankful for my blessings 1 2 3 4 5 6
13. I feel a selfless caring for others 1 2 3 4 5 6
14. I accept others even when they do things that I think are wrong 1 2 3 4 5 6
15. I desire to be closer to God or in union with Him 1 2 3 4 5 6

Not Close at all=1, Somewhat Close=2, Very Close=3, As close as possible=4

16. In general, how close do you feel to God? 1 2 3 4

Appendix D

Stimulus List

red: presented in black, red, green, blue, brown, and purple ink

green: presented in black, red, green, blue, brown, and purple ink

blue: presented in black, red, green, blue, brown, and purple ink

brown: presented in black, red, green, blue, brown, and purple ink

purple: presented in black, red, green, blue, brown, and purple ink

XXX: presented in red, green, blue, brown, and purple ink

XXXX: presented in red, green, blue, brown, and purple ink

XXXXX: presented in red, green, blue, brown, and purple ink

XXXXXX: presented in red, green, blue, brown, and purple ink

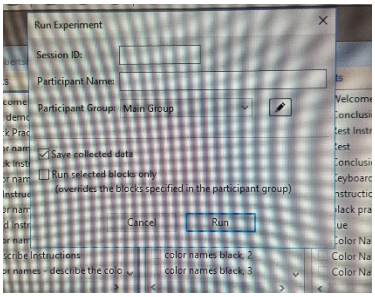
Appendix E

Procedures for Meditation and Stroop Experiment

1. Turn all computers and BIOPAC towers.
2. Print consent and EEG recording forms.
3. Follow the steps for Powering Participant Computer
4. Follow the steps for powering the reading computer
5. Greet participant.
6. Obtain consent.
7. Have participant complete the "Well Being and Spirituality" Survey
8. Apply EDA, ECG, and EEG apparatuses
9. You will be prompted to calibrate Channel 11, the EDA. Disconnect Channel 11 from the participant, click "Calibrate", and then reconnect Channel 11 to the participant.
10. The brainwaves will start appearing on screen, at which point you can see if any are clear and responsive, fuzzy, flat, or all over the place.
    a. Clear and responsive—good to go. Lines will appear thin and respond to facial movement.
    b. Fuzzy – add more gel, tighten cap, make sure the cap is connected to the unit (series of box things where it plugs in)
    c. Flat – add more gel, check to make sure the ear clips are plugged in and hooked up properly
    d. All over the place – the cap is either unhooked or the connector is dusty. Unhook it, blow in it like a Nintendo cartridge, and reconnect.
11. Once good brainwaves are established on the AcqKnowledge program, click "Run" on Superlab at the Participant's computer.
12. Remind the participant to remain as still as possible.
13. Ensure you document on the EEG Recording sheet all the times for the start and end of experiment blocks: rest 1, trial 1-7, and rest 2.
14. Document any environmental anomalies: participant behavior (questions, laughing, crying, nose itching, rocking in chair, etc.), noisy hall ways, fire drills, program malfunctions, etc.
15. Answer any questions the participant may have with minimal responses, such as:
    a. Participant: "How much should I write in this block?"
    b. Researcher: "Put as much as you feel comfortable with?"
16. Follow up with the participant about their experience: did they have any troubles or make consistent mistakes? Do they have any questions? Was there anything that was upsetting for them?
17. Show participant to a restroom where they can get cleaned up.
18. Prep for new participant or shut down for the day (see shut down procedures in EEG Lab Guide).

Powering the Participant Computer

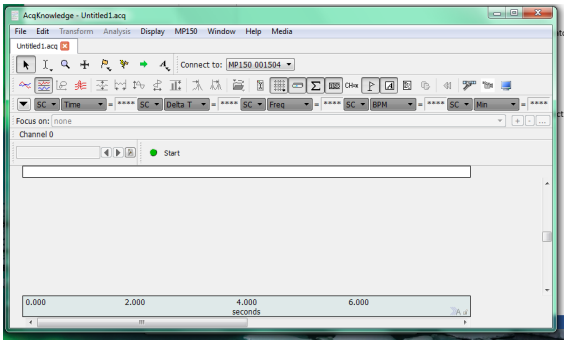
1. Boot it up
2. Log in
3. Double click the folder on the desktop titled, “Robertson”
4. Open the file, “Experiment”
5. Open the programs: “Robertson Stroop Experiment,”
6. Select “Experiement” from the top toolbar, then select “Run,” from the subsequent drop down menu.
7. This will open the Superlab program for the experiment:



8. Insert Session ID as a four-six digit # comprised of the numerical order the incoming participant is for that day followed by the month and day. For example, 1828 is the Session ID for the first participant on August 28th.
9. Insert the Participant Name as the first and last initials of the participant, followed by the month/day of administration (i.e. SR8/28).
10. Ensure the check box before “Save Collected Data” is the ONLY check box marked.
11. Minimize Superlab.
12. Open the program: “Well-being and Spirituality Survey”
13. Ensure the “cheat sheet” for the Stroop Task is still stuck the bottom of the monitor:

Powering the Readings Computer (the one you sit at as the administrator)

1. Boot it up
2. Log in
3. Double click the folder on the desktop titled, “Robertson”
4. Open the file, “Robertson Template”
5. This will open up AcqKnowledge viewer /reader mode:



6. Select “File” from the top toolbar, then select “save as” from the subsequent drop down menu.
7. Save the file as the participants first and last initials followed by the month and day of administration (i.e. SR828).
8. At this point, you are ready to measure brainwaves. Make sure you have done everything in the other guide (hooked them up to the EEG, GSR, and ECG) **before clicking “Start”**

Appendix F

EEG Event Record Form

Initials of Participant: _____ Name of Evaluator: _____

Date: _____ Handedness: _____

Time:_____ Physical Conditions/Medications: _____

Calibration

Note any abnormalities or technical issues:

Rest 1 (5 min)

Beginning time (seconds) of Acknowledge:_____

End time of Acknowledge:_____

Note any abnormalities or technical issues:

Trial 1—Black Practice

Beginning time (seconds) of Acknowledge:_____

End time of Acknowledge:_____

Note any abnormalities or technical issues:

Trial 2—Color Names Black

Beginning time (seconds) of Acknowledge:_____

End time of Acknowledge:_____

Note any abnormalities or technical issues:

Trial 3—Color Names XXXX

Beginning time (seconds) of Acknowledge:_____
End time of Acknowledge:_____

Note any abnormalities or technical issues:

Trial 4—Read the Color

Beginning time (seconds) of Acknowledge:_____

End time of Acknowledge:_____

Note any abnormalities or technical issues:

Trial 5—Describe the Color

Beginning time (seconds) of Acknowledge:_____

End time of Acknowledge:_____

Note any abnormalities or technical issues:

Trial 6—Color Switching

Beginning time (seconds) of Acknowledge:_____

End time of Acknowledge:_____

Note any abnormalities or technical issues:

Trial 7—Black Fatigue

Beginning time (seconds) of Acknowledge:_____

End time of Acknowledge:_____

Note any abnormalities or technical issues:

Rest 2 (5min)

Beginning time (seconds) of Acknowledge:_____

End time of Acknowledge:_____

Note any abnormalities or technical issues:

Appendix G

Detailed Description of *d*pcc.

The *d*ppc effect size reports the difference in pre-post change scores for the treatment and control groups. The formula for *d*ppc is shown in Figure 1 and represents the pre-post change for the treatment group minus the pre-post change for the control group divided by the pooled error.

$$\Delta = \delta_T - \delta_C = \frac{(\mu_{T,post} - \mu_{T,pre}) - (\mu_{C,post} - \mu_{C,pre})}{\sigma}.$$

Figure 1. The formula for *d*ppc (Morris, 2008) represents the pre-post change for the treatment group minus the pre-post change for the control group divided by the pooled error.

The *d*ppc is interpreted using the same cut-off values as Cohen's *d'*; values between zero and .2 indicate no effect, values between .2 and .5 indicate a small effect, values between .5 and .8 indicate a moderate effect, and values which exceed .8 indicate a large effect. A positive effect size value results if the change score for the treatment group is larger while a negative value results if the control group has a larger change score.

Appendix H

Curriculum Vitae

Education

Psy.D. Clinical Psychology (projected) May 2022
George Fox University

M.A. Clinical Psychology May 2019
George Fox University

B.S. Psychology May 2017
George Fox University
Honors: *Summa Cum Laude*

Professional Experience

Internship, Samaritan Health Medical Group 2021-Present
Rotations:
Integrated Behavioral Health in Primary Medical Care;
Bariatric Surgery Weight Management Clinic
Supervisors: Petra Zdenkova, PsyD and Bella Vasoya, PsyD

Pre-internship Practicum, Willamette Family Medical Center 2020-2021
Integrated Behavioral Health in Primary Medical Care
Supervisors: Ross Bartlett, PhD and Karim Afzal, PhD

Supplemental Practicum, Behavioral Health Crisis Consultation 2019-2021
Willamette Valley Medical Center and Providence-Newberg Medical Center
Supervisors: Luann Foster, PsyD, William Buhrow, Jr. PsyD, and Mary Peterson, PhD, ABPP

Supplemental Practicum, Behavioral Health Center 2020-2021
Assessment Clinic, George Fox University
Supervisors: Glena Andrews, PhD, ABPP, Kenneth Logan, PhD

Practicum 2, Health and Counseling Center 2019-2020
George Fox University
Supervisors: William Buhrow, Jr, PsyD and Luann Foster, PsyD

Electroencephalography Laboratory Assistant 2019-2020
Neurophysiological Assessment, George Fox University
Supervisor: Glena Andrews, PhD

Supplemental Practicum, Geriatric Group Therapy 2019-2020
Friendsview Retirement Center

Supervisors: Glena Andrew, PhD, ABPP

Practicum 1, Rural Child and Adolescent Services 2018-2019
Yamhill-Carlton Intermediate School
Supervisor: Elizabeth Hamilton, Ph.D.

Supplemental Practicum, Neurocognitive Concussion Assessment 2018-2019
Newberg Youth Football League and George Fox University
Supervisors: Christopher Koch, PhD, and Kristina Kays, PsyD

Homeless Liaison Chaplain 2017-Present
Salem Leadership Foundation
Supervisor: Douglas J. Vincent, M.Div

Challenge Course Facilitator 2016-2020
Camp Tilikum Retreat Center
Supervisor: Amy Watson

Outreach Ministries Intern 2016-2017
Spiritual and Intercultural Life Department
George Fox University
Supervisor: Rusty St. Cyr, M.S.

Youth Outreach Specialist 2016
YCAP Youth Outreach Services
Supervisor: Kate Stokes, M.S.W.

Research Assistant 2015-2016
Portland Psychotherapy Clinic
Supervisors: Jason Luoma, Ph.D., Paul Guinther, Ph.D., & Melissa Platt, Ph.D.

Avionics Technician, Petty Officer 2nd Class (AT2; E-5) 2008-2013
United States Navy
Supervisor: Adam Burke, Avionics Technician, Petty Officer 1st Class (AT1; E-6)

Teaching Experience

George Fox University Fall-Spring 2020
Teaching Assistant
Graduate School of Clinical Psychology
Faculty: Andrea Paxton, PhD
Course: Clinical Foundations

George Fox University Spring 2020
Teaching Assistant

Graduate School of Clinical Psychology
Faculty: Kathleen Gathercoal, PhD
Course: Research Design

George Fox University Spring 2020
Teaching Assistant
Graduate School of Clinical Psychology
Faculty: Amber Nelson, PsyD
Course: Theories of Personality

George Fox University Fall 2019
Teaching Assistant
Graduate School of Clinical Psychology
Faculty: Mark R. McMinn, PhD, ABPP
Course: Integrative Approaches to Psychology

George Fox University Fall 2019
Writing Tutor
Graduate School of Clinical Psychology
Faculty: Glena Andrews, PhD, ABPP
Course: Clinical Foundations of Psychotherapy

George Fox University 2015-2017
Work Study
Psychology Department
Supervisor: Carol Jaquith
Courses: General Psychology, Social Psychology, Learning, Statistical Procedures, Research Methods, Advanced Research Methods, Cognition, History and Systems of Psychology, Personality Theories, Lifespan Development, Counseling, Health Psychology, Abnormal Psychology, Neuroscience, Sensation and Perception

Committee Membership

Board Member **2017-Present**
Church at the Park, Salem, OR

Admissions Committee 2017-2019
George Fox University
Committee Chair: Nancy Thurston, PsyD, ABPP

Community Gathering Committee 2018-Present
George Fox University
Committee Chair: Mark McMinn, PhD, ABPP

Awards, Honors, & Scholarships

Award of Special Accommodation—GFU Graduate School of Clinical Psychology	2019
Summa Cum Laude—George Fox University	2017
Bill and Jim DeLapp Scholarship	2017
Transfer Honors Award	2014-17
Deans List—George Fox Psychology Department	2014-17
President's List—Portland Community College	2014
Naval Achievement Medal—US Navy	2013

Offices Held

Chairperson 2019-Present
Community Gathering
George Fox University Graduate School of Clinical Psychology

President 2016-2017
Psi Chi Honor Society
George Fox University

Vice-President 2015-2016
Psi Chi Honor Society
George Fox University

Invited Presentations

Journal Article (Submitted for Review) July, 2020
Virtuous Dialogue Training: A Pilot Study
Teaching of Psychology

Poster Presentation August, 2020
Age Differences in ImPACT Concussion Testing
Division 12, Society for Clinical Psychology
Annual APA Convention, Washinton, DC

Poster Presentation March, 2020
Virtuous Dialogue in Teaching Integration: A Pilot Study
Annual CAPS Convention, Atlanta, GA

Topic Speaker September, 2019
Trauma and Cognitive Processing Therapy
George Fox University Health and Counseling Center
Director: William Buhrow, Jr., PsyD

Poster Presentation August, 2019
The Predictive Relationship of Spirituality and Personality Traits on Subjective Well-Being

Division 36, Society for the Psychology of Religion and Spirituality
Annual APA Convention, Chicago, IL

Poster Presentation August, 2019
Reliability and Test Differences for the ImPACT: Implications for Concussion Testing Programs
Division 12, Society for Clinical Psychology
Annual APA Convention, Chicago, IL

Topic Speaker June 2019
Mental Health First Aid in Camp Counseling
Tilikum Retreat Center
Director: Amy Watson

Guest Lecturer October 2018
Univariate Research and Analysis
George Fox University
Psychology Department
Faculty: Susan O'Donnell, PhD
Course: Research Methods.

Poster Presentation August, 2018
Cognitive Differences from Preseason to End of Season among Youth and College Football Players.
Division 12, Society for Clinical Psychology
Annual APA Convention, San Francisco, CA

Poster Presentation August, 2018
Influential Factors for Conformity to Masculine Responses
Division 51, Society for the Psychological Study of Men and Masculinities
Annual APA Convention, San Francisco, CA

Topic Speaker June 2018
Mental Health First Aid: Recognition and Response of Mental Health Crises
Tilikum Retreat Center
Summer Camp Staff Training
Director: Mandy Schmidt

Guest Lecturer Jan 2018
Classical, Operant, and Social Constructs of Learning
George Fox University
Psychology Department
Faculty: Kelly Chang, Ph.D
Course: General Psychology

Guest Panel Member March, 2018
Calling: Vocational Life Purpose

Undergraduate Senior Capstone Event
George Fox University

Guest Panel Member March, 2017
To Stand, or not to Stand
Multicultural Perspectives, "Matheteis" Event
George Fox University, Department of Spiritual and Intercultural Life

Certifications and Continuing Education

American Heart Association, CPR Certified 2017-Present

Strosahl, K. (2020, Aug.). *Focused Acceptance and Commitment Therapy (fACT) for Primary Care.* Webinar Conference (CE: 15 hours).

American Psychological Association (2020, Aug.). Annual Conference attended via webinar (CE: 5 hours).

Christian Association for Psychological Studies (2019, Mar.). Annual Conference attended in Atlanta, GA (CE: 15 hours).

Stoeber, A. (2020, Feb.). *Targeting Adverse Childhood Experiences by Promoting Resilience in Families*. Spring Colloquium Presentation at George Fox University, Graduate School of Clinical Psychology, Newberg, OR

Forster, C. (2019, Oct.). *Intercultural Communication.* Fall Colloquium Presentation at George Fox University, Graduate School of Clinical Psychology, Newberg, OR

Beldon, T. & Chelton, K. (2019, Sep.) *Rebuilding from the Inside Out: Somatic Interventions for Individuals, Couples, and Groups.* Annual Therapy Workshop at Existential-Humanistic Northwest, Portland, OR.

Worthington, E. (2019, Sep.). *Promoting Forgiveness.* Fall Grand Rounds Presentation at George Fox University, Graduate School of Clinical Psychology, Newberg, OR

American Psychological Association (2019, Aug.). Annual Conference attended in Chicago, IL (CE: 15 hours).

Christian Association for Psychological Studies (2019, Mar.). Annual Conference attended in Dallas, TX (CE: 15 hours).

Marlow, D. (2019, Mar.) *Foundations of Relationships Therapy—The Gottman Model.* Spring Colloquium Presentation at George Fox University, Graduate School of Clinical Psychology, Newberg, OR

Safi, D. & Milkey, A. (2019, Feb.) *Opportunities in Forensic Psychology.* Spring Grand Rounds Presentation at George Fox University, Graduate School of Clinical Psychology, Newberg, OR

Pengelly, S (2018, Oct.). *Old Pain in New Brains*. Fall Grand Rounds Presentation at George Fox University, Graduate School of Clinical Psychology, Newberg, OR

McMinn, L., & McMinn, M. (2018, Sep.). *Spiritual Formation and the Life of a Psychologist: Looking Closer at Soul-Care*. Fall Colloquium Presentation at George Fox University, Graduate School of Clinical Psychology, Newberg, OR

American Psychological Association (2018, Aug.). Annual Conference attended in San Francisco, CA (CE: 15 hours).

Toloyos, C. (2018, Feb.). *Interpersonal Psychotherapy.* Spring Grand Rounds Presentation at George Fox University, Graduate School of Clinical Psychology, Newberg, OR

Vogel, M. (2018, Mar.). *Integration & Ekklesia*. Spring Colloquium Presentation at George Fox University, Graduate School of Clinical Psychology, Newberg, OR

Sodahl, J. (2017, Nov.). *Telehealth*. Fall Colloquium Presentation presented at George Fox University, Graduate Department of Clinical Psychology, Newberg, OR

Gil-Kashiwabara, E. (2017, Oct.). *Using community based participatory research to promote mental health in American Indian/Alaska Native children, youth and families.* Fall Grand Rounds Presentation presented at George Fox University, Graduate Department of Clinical Psychology, Newberg, OR

Dunn, D. (2017, Sep.). *Leadership Training Workshop.* Certificate Course presented at George Fox University, Graduate Department of Clinical Psychology, Newberg, OR

Memberships

American Psychological Association 2017-Present
Student Member

Association for Psychological Science 2015-2017
Student Member

Association for Contextual Behavioral Science 2017-2018
Student Member

Psi Chi Honors Society (inducted) 2016
Student Honoree

Oregon Psychological Association 2017-2018
Student Member