GARDENING AND ART PROVIDE PSYCHOLOGICAL BENEFITS TO HEALTHY WOMEN

By

RAYMOND ODEH

A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2018
I dedicate this thesis to the future of horticultural therapy and the use of gardening as a valid therapeutic modality recognized by the World Health Organization and medical communities across the world.
ACKNOWLEDGMENTS

The present thesis experiment took an immense amount of time and focus to plan, prepare, and execute. Without the support of an interdisciplinary collaboration of researchers, practitioners, and donors this project surely would not have been possible. First and foremost, I would like to express my gratitude to my major advisor, Charles Guy, for his vision and mentorship throughout these past two years, for his patience, and for his generosity with his advice, time, and expertise. Next, I would like to thank all of the members of my supervisory committee: Dr. Sara Jo Nixon, Dr. Craig Tisher, Dr. Thomas Colquhoun, and Ms. Elizabeth Diehl. Each member of the committee has contributed their expertise to advance the experimental design, develop the protocol, and enhance the methodology of this study. A very special thank you goes to our collaborators in the Arts in Medicine program. I would like to thank director, Ms. Jill Sonke, for partaking in our vision by allocating the time of artists Ms. Kristine Sullivan and Mr. Dylan Klempner to our study. Ms. Sullivan and Mr. Klempner were vital in conducting the art intervention, I thank both of them for sharing their artistic expertise. To my hardworking team of undergraduate student assistants, a huge thank you goes out to Maria Espinosa, Caitlyn Norton, Dianela Perdomo, Kaylee Rosario, and Hannah Terzi for their tireless assistance throughout data collection and processing. Thank you to Mr. Robert Prather for experimental design guidance and help with obtaining assessment instruments. Also, thank you to Dr. Craig Tisher and Ms. Jennifer Weis for agreeing to assist with cardiovascular incidental findings and mental health incidental findings, respectively. For their guidance with statistical processing, I thank Mr. James Colee with IFAS Statistical Consulting and Dr. Yi Guo and Mr. Qian Li with Health Outcomes & Biomedical Informatics, Institute for Child Health Policy, and CTSI. Mr. Li
was extremely helpful for running the multivariate statistics on the blood pressure and heart rate data and assisting in interpretation of the large data set.

During the development of this project several other sources of guidance need to be recognized for their support. I would like to thank the Clinical and Translational Science Institute for their guidance on recruitment protocol, and I appreciate the recruitment consultation from Ms. Lauren Light and recruitment services from Healthstreet. Also, I am extremely grateful for the design of the study flyer, beautifully executed by the talented Ms. Tracy Bryant with UF IFAS Communications. For her generous training in consenting protocol and study tracking and distributing study flyers, thank you to Ms. Deborah Morrison for all of her time. Thank you to Dr. Jamie Conti for advising me on cardiology and on the implementation of various types of physiological instruments.

This research would not have been possible without the generous contributions of monetary and material donations, time and talents to the study. A special thanks goes to the Horticultural Research Institute and the Gene and Barbara Batson Endowed Nursery Fund for partial support of my graduate stipend and tuition. Specifically, I want to thank Dr. Jill Calabro and Ms. Jennifer Gray for facilitating communications with HRI and AmericanHort. Also, thank you to Florida Nursery Growers and Landscape Association and the IFAS Dean for Research for grant support to hire undergraduate student assistants to help conduct the interventions and collect and process data. Thank you to the Wilmot Gardens administration for permissions to use space in their conference center and therapeutic horticulture greenhouse facilities for conducting the gardening and art intervention sessions. Thank you specifically to business manager
Bailey Hillman for her patience and flexibility with scheduling meetings and intervention sessions at the Wilmot facilities and distributing the study recruitment materials. Also, thank you to the Department of Environmental Horticulture for office space and supporting the study in various ways; specifically, Mr. Alex Lopez for advertising the study on departmental bulletins, Mr. Brian Owens for ordering gardening supplies and assistance with care of experimental plants, Ms. Megz Keathley for IT support, Dr. Sandy Wilson for her advising, and Dr. Bart Schutzman for advice and IT assistance. Also, thank you for extension support from Ms. Wendy Wilbur and Ms. Denise DeBusk for help in advertising the study with their networks, and Ms. Wilbur for her generous contributions of succulent plant materials to the study. A huge thank you goes to Burpee Seeds, Johnny’s Seeds, Hatchett Creek Farm, Garden Gate Nursery, and Lowe’s Home Improvement for donating seeds, succulent plants and gardening containers for the gardening sessions. I am also very thankful to Ms. Pam Bartley and QualityMetric for providing licenses and access to scoring materials for the SF-36v2 for this Master’s student research. Also, I would like to thank the American Psychological Association for permission to use the PSS and Mind Garden for their permission to use the STAI. Thank you to the patient and helpful employees at the IRB01 offices for all of their assistance in answering lots and lots of questions, Ms. Becky McFerrin, Ms. Cheryl Dykeman, Ms. Alllison Faunce, Ms. Kimberly Foli, Ms. Jamie Mayfield, and Ms. Ivana Simic. Also, Ms. Elizabeth Plantadosi with OR-Clinical Research was helpful with the registration of the study at ClinicalTrials.gov. I would like to thank the team who helped process the fiscal accounts for this study including Ms. Cindy Olejownik for help with posting the Federal Work Study job posting and hiring student assistants, Ms. Tammy
King for setting up the HRI Grant, and Ms. Candy Palmer for setting up the accounts. I am grateful to both Ms. Stacy Dorsonne and Ms. Piannys Rosario with University Treasury Management for processing human subject payment cards. Thank you to Ms. Justine Henry and the Haile Farmer’s Market for providing a table at their market for study participants recruitment. I would also like to thank the uplifting cohort of graduate students in the Department of Environmental Horticulture. The graduate students in my department have provided a welcoming and supportive environment for learning and developing these past two years. Also, I would like to thank my family, especially my mother, for listening to me and providing love and support.

Last, but certainly not least important, thank you to each of the study participants who volunteered their time each week for the four weeks of the gardening and art interventions. Without each of the study volunteers, the present research would not have been possible.
TABLE OF CONTENTS

ACKNOWLEDGMENTS......................................................................................................................... 4

LIST OF TABLES ................................................................................................................................. 10

LIST OF FIGURES ............................................................................................................................... 11

ABSTRACT ............................................................................................................................................ 12

CHAPTER

1 LITERATURE REVIEW ................................................................................................................... 14

   Dimensions of Health ..................................................................................................................... 14
   Origin and Theories of Human-Plant Interactions ...................................................................... 15
   Theories of Human-Art Interactions ............................................................................................... 19
   Horticultural Therapy .................................................................................................................... 20
   Art Therapy ....................................................................................................................................... 24
   Horticultural Therapy and Art Therapy as Complex Interventions .......................................... 25
   Types of People-Plant Interactions ............................................................................................... 26
   Types of People-Art Interactions .................................................................................................... 28
   Physiological Benefits .................................................................................................................... 29
      Gardening ..................................................................................................................................... 29
      Art-making .................................................................................................................................... 34
   Psychological Benefits .................................................................................................................. 36
      Gardening ..................................................................................................................................... 36
      Art-making .................................................................................................................................... 38
   Social Benefits ............................................................................................................................... 40
      Gardening ..................................................................................................................................... 41
      Art-making .................................................................................................................................... 43
   Psychometric Instrumentation ...................................................................................................... 44
      Perceived Stress Scale ................................................................................................................... 45
      Profile of Mood States .................................................................................................................. 46
      Beck Depression Inventory ......................................................................................................... 47
      State-Trait Anxiety Inventory ....................................................................................................... 48
      Satisfaction with Participation in Discretionary Social Activities ............................................. 49
      SF-36.............................................................................................................................................. 49
   Cardiac Instrumentation .................................................................................................................. 50

2 INTRODUCTION ................................................................................................................................... 53

3 MATERIALS AND METHODS ....................................................................................................... 56

   Overview .......................................................................................................................................... 56
   Participants/Sample Population/Study Subjects ............................................................................ 57
**LIST OF TABLES**

<table>
<thead>
<tr>
<th>Table</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>List of gardening and art intervention sessions with associated visit numbers. .. 75</td>
</tr>
<tr>
<td>3-2</td>
<td>Administration order and schedule of psychometric assessment instruments.... 76</td>
</tr>
<tr>
<td>3-3</td>
<td>Timeline sequence for the eight experimental gardening and art intervention sessions. ................................................................. 77</td>
</tr>
<tr>
<td>4-1</td>
<td>Baseline demographic characteristics for the randomly assigned gardening and art treatment groups .......................................................... 93</td>
</tr>
<tr>
<td>4-2</td>
<td>Gardening and art groups self-report psychometric assessment statistics. .... 94</td>
</tr>
<tr>
<td>4-3</td>
<td>F table from a two-way repeated measures ANOVA for each psychometric instrument................................................................. 95</td>
</tr>
<tr>
<td>4-4</td>
<td>Self-report psychometric instrument adult normative values. .................. 96</td>
</tr>
<tr>
<td>4-5</td>
<td>POMS 2 subscale statistics based on pairwise comparisons from a time by intervention group repeated measures ANOVA........................................ 97</td>
</tr>
<tr>
<td>4-6</td>
<td>Treatment effect size calculations using Cohen's d............................... 98</td>
</tr>
<tr>
<td>4-7</td>
<td>Means and standard deviations of the starting and ending heart rates per session ........................................................................ 99</td>
</tr>
<tr>
<td>4-8</td>
<td>Means and standard deviations of the starting and ending systolic and diastolic blood pressures per session....................................... 100</td>
</tr>
<tr>
<td>5-1</td>
<td>List of unsolicited study subject comments during the sessions. .............. 122</td>
</tr>
</tbody>
</table>
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>PROMIS social health framework</td>
<td>52</td>
</tr>
<tr>
<td>3-1</td>
<td>Study experimental design.</td>
<td>78</td>
</tr>
<tr>
<td>3-2</td>
<td>IRB-approved study flyer for posting on public bulletin boards.</td>
<td>79</td>
</tr>
<tr>
<td>3-3</td>
<td>IRB-approved study digital flyer.</td>
<td>80</td>
</tr>
<tr>
<td>3-4</td>
<td>Information sheet to provide more information about the study if requested.</td>
<td>81</td>
</tr>
<tr>
<td>3-5</td>
<td>Photographs of selected gardening intervention sessions.</td>
<td>82</td>
</tr>
<tr>
<td>3-6</td>
<td>Photographs of selected art intervention sessions.</td>
<td>83</td>
</tr>
<tr>
<td>4-1</td>
<td>Bonferroni corrected pairwise comparisons of POMS 2 TMD pre-intervention, mid-intervention, and post-intervention scores for gardening and art intervention</td>
<td>101</td>
</tr>
<tr>
<td>4-2</td>
<td>Bonferroni corrected pairwise comparisons of PSS pre-intervention, mid-intervention, and post-intervention scores for gardening and art intervention</td>
<td>102</td>
</tr>
<tr>
<td>4-3</td>
<td>Bonferroni corrected pairwise comparisons of BDI-II pre-intervention, mid-intervention, and post-intervention scores for gardening and art intervention</td>
<td>103</td>
</tr>
<tr>
<td>4-4</td>
<td>Time course or dosage responses for the POMS 2 Total Mood Disturbance logarithmic regression trends with respect to gardening or art intervention</td>
<td>104</td>
</tr>
<tr>
<td>4-5</td>
<td>Time course or dosage responses for the PSS logarithmic regression trends with respect to gardening or art intervention</td>
<td>105</td>
</tr>
<tr>
<td>4-6</td>
<td>Time course or dosage responses for the BDI-II logarithmic regression trends with respect to gardening or art intervention</td>
<td>106</td>
</tr>
</tbody>
</table>
Abstract of Thesis Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Master of Science

GARDENING AND ART PROVIDE PSYCHOLOGICAL BENEFITS TO HEALTHY WOMEN

By

Raymond Odeh

August 2018

Chair: Charles Guy
Major: Horticultural Sciences

Health broadly comprises wellness in three focal dimensions: physical, mental and social. Much of the existing literature in the area of horticultural therapy and people-plant interactions has lacked experimental comparisons and contrasts between gardening and other allied therapeutic modalities for virtually all populations. Additionally, many studies fail to assess the three dimensions of health to explain the overall therapeutic potential of a gardening intervention. This lack of clarity for the overall therapeutic potential of gardening is also absent for a healthy, general population which is necessary to establish a baseline for the health benefits of gardening for any population. In this randomized, controlled trial an active, concurrent control group was implemented to compare health outcomes associated with engaging in group-based gardening and group-based art activities for healthy study subjects. Treatment-based outcomes for perceived stress, total mood disturbance, depression symptomatology, state and trait anxiety, quality of life, social satisfaction, cardiovascular and physical health factors were investigated using a battery of screening questionnaires, self-reported psychometric assessments and cardiovascular physiology monitoring for a population of healthy women randomly assigned to either a gardening
or art group. Appraisal of the results from the four-week interventions consisting of eight one-hour sessions yielded evidence of treatment outcomes that supports both gardening and art as effective therapeutic interventions to improve mental health in terms of indicators of perceived stress, mood disturbance, and depression symptoms. Neither gardening, nor art treatments resulted in improved blood pressure or heart rate during individual sessions or following the completion of the four-week interventions, but the art group showed elevated diastolic blood pressure following the eight art sessions. These results provide evidence that support both gardening and art as effective health interventions that are therapeutic and may further enhance the mental health and well-being of healthy women. Furthermore, this study’s findings provide a possible explanation for why about fifty percent of American adults engage in some form of gardening or plant care as a leisure-time activity.
Plants predate modern day *Homo sapiens*. Plants as autotrophic organisms, provide the foundations of life for humans and all other animal species inhabiting this planet. It is inescapable that our species has relied on plants for survival and fitness throughout the millions of years of our co-evolution together. This literature review explores this human relationship with plants, and more specifically how gardening tasks have been, and can be, used to achieve important therapeutic outcomes. To begin, this review discusses the general dimensions of health, reviews the origins and theories involved with nature contact and gardening that serve to promote health benefits, and then delves into the specific health outcomes and tools to measure such outcomes in the area of human-plant interactions.

**Dimensions of Health**

Health, broadly defined, encompasses each of three domains: physical, mental and social. The World Health Organization Constitution (1946) defines health as: “a *state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.*” This definition of health informs the experimental design and methodology discussed in this research. Shifts in perspectives on health and causes of mortality have led to health-related research moving away from an exclusive biomedical model to a biopsychosocial model for health (Hartig et al., 2014). The biopsychosocial approach takes the biomedical model and incorporates the additional domains of social support and psychological stress (Hartig et al., 2014).
Origin and Theories of Human-Plant Interactions

As a nomadic, hunter-gatherer species, *Homo sapiens* trekked across extensive distances to acquire foods in the form of mainly plants and occasional small and mega fauna to sustain essential nutrients and caloric intakes required for survival. Since the major advancements in the domestication of plants in the early Neolithic period and at the emergence of civilization, cultivation of plants and gardens has been an integral element in our adaptive ability and survival as a human species. Gradually, humans learned how to grow plants more efficiently and selected plant species and traits that would most benefit us nutritionally. Beyond food and nutritional sustenance, protective bodily and structural coverings, essential oxygen production, and medicinal properties, plants have provided a number of services that have entered into human psychological, social, and cultural realms. As early as Babylonian times, gardens were created for aesthetic purposes, enjoyment, and expression of power. As people moved from place to place, they brought important food crops with them to propagate and produce nutritional sustenance in new frontiers across the globe. The trade of economically important and nutritionally relevant crops between civilizations fostered an agricultural revolution that continues to this day. This agricultural revolution has been an important element to improve our lives and the human condition.

It is important to recognize that our connections to and contacts with nature have become more scarce over time as global urbanization provides destruction and barriers to the accessibility of natural settings and environments. At this point, it is also important to define nature as it will be used in this review. Nature has had many representations throughout the extant literature, speaking to the subjective nature of the term (Hartig et al., 2014); however, here, nature is defined in accordance with Bratman
and colleagues (2012) as the “areas containing elements of living systems that include plants and nonhuman animals across a range of scales and degrees of human management, from a small urban park through to relatively ‘pristine wilderness.’”

A case has been made that through learning and evolutionary processes, interactions with natural environments and living organisms, and our dependence upon nature for various ecological services, we are programmed to be innately attracted to nature. Described in the Biophilia Hypothesis, humans evolved with and depend upon nature, and consequently have an affinity or “innate tendency to focus on life and lifelike processes” (Wilson, 1984).

Although several mechanistic pathways and theories have been suggested (Frumkin et al., 2017), two theories dominate the area of research involving human interactions with nature and plants: the Attention Restoration Theory (ART) (Kaplan and Kaplan, 1989; Kaplan, 1995) and the Stress Recovery Theory (SRT) also known as the Psychoevolutionary Theory (Ulrich, 1983). It is proposed that the ART and SRT operate synergistically, and strong evidence supports both of these attentional and stress-related psychological pathways (Berto, 2014).

The Attention Restoration Theory involves the replenishment of mental resources which is attributed to viewing or interacting with a restorative setting such as nature. ART utilizes the distinction between information processing through voluntary and involuntary attention. Voluntary attention, also referred to as directed attention, can be controlled, focused, and directed at will and requires significant cognitive resources which may lead to mental fatigue. However, involuntary attention may not be under the control of the individual, and perhaps is associated with automatic responses to external
stimuli. It is suggested that directed attention requires conscious effort and has distinct connections to the frontal and parietal neural networks, while involuntary attention may not require deliberate effort and has markedly less reliance on activation of frontal and parietal regions (Kaplan and Berman, 2010). The cognitive resources required for these forms of attention have not been definitively identified. The Attention Restoration Theory indicates that “soft fascination” or intrinsically interesting stimuli present within nature can restore neurocognitive resources allowing the reallocation of such resources for enhanced directed attention capacities and recovery from mental fatigue. Mental fatigue can lead to increased risk for stress-related symptomatology, and is described as being connected to the depletion of directed attention capacities. Furthermore, Steven and Rachel Kaplan proposed four elements that an environment ought to provide for the setting to proficiently provide a restorative effect: fascination; extent; being away; and compatibility (Kaplan, 1995). Fascination is described above. Extent can be described as the scale and magnitude of the experience within an environment. Being away relates to the level of separation one may feel from the routines and contacts of daily experience. Compatibility focuses on the degree to which an environment is relevant and matches the individual’s preferences. All of the four restorative elements of an environment can be provided by a natural environment.

Ulrich’s SRT model similarly involves the aesthetics of natural areas and their positive influences on human affective and stress responses to passive experiences in nature and natural environments. Ulrich postulates that the restorative and healing ability of natural areas is an unconscious and autonomic response, and could even occur in simulated natural areas. Such benefits from or by nature according to Ulrich’s
perspective are associated with safe and familiar places that promote enhancements in positive affect and physiological stress. Stress Reduction Theory phenomenon is proposed to be connected to our evolutionary history, specifically related to stimuli processing and arousal responses. According to a meta-analysis of 32 studies, the collective empirical evidence supports Ulrich’s Stress Reduction Theory (McMahan and Estes, 2015). Although there were a great deal of differences in experimental designs and methodologies in the 32 studies selected and examined by McMahan and Estes, findings from their analysis indicated improvements in positive affect and to a lesser degree reductions in negative affect in groups exposed to natural areas compared to control groups. In addition, this meta-analysis reviewed the difference in exposure to real natural areas compared to simulated natural areas, and they found real nature resulted in larger treatment effect sizes related to enhancements in positive affect compared to exposure to simulated nature. Although the evidence appears to be clear, more research should be performed with standard methodologies and assessment instruments to produce a more robust body of evidence in support of this theory.

Although the literature is not conclusive with respect to the restorative cognitive and stress-related benefits of nature contact (Sullivan and Kaplan, 2016), it does provide numerous accounts linking interactions with plants and positive health benefits related to mental fatigue, stress, social connectedness, and physical health (Frumkin et al., 2017). Described in the extant literature, an exhaustive number of studies provide support for various health benefits associated with nature and plant interactions for many population subgroups, to name a few: healthy individuals (Hawkins et al., 2011); children (McCurdy et al., 2010); adults with dementia (Detweiler et al., 2009; Lee and
Kim, 2008), patients with stroke (Kim et al., 2003); individuals with mental health diagnoses (Cipriani et al., 2017; Gonzalez et al., 2009, 2010, 2011); the elderly (Detweiler et al., 2012); individuals with intellectual and learning disabilities (Lee, 2010) and even astronauts on long-duration space missions (Odeh and Guy, 2017). The breadth of research on various subgroups suggests that the health benefits of contact with nature and participation in plant-related activities may extend to any person.

**Theories of Human-Art Interactions**

Art-making, defined as “the process of creating art or craft” happens in various formats and settings (Ennis et al., 2017). Art-making has a long history in our evolutionary past, dating to when humans lived hunter-gatherer lifestyles and created carved sculptures and drawings and petroglyphs on the walls of caves circa 70,000 years BCE or perhaps as early as 164,000 years ago (Morriss-Kay, 2010). Some scholars suggest that artistic creativity could have its origin as early as 500,000 BCE (Zaidel, 2013).

Art has expanded in form and meaning throughout the ages, but a salient message remains that making art is a form of creative expression and meaning-making (Ennis et al., 2017). Due to the paucity of empirical evidence and in some cases the assertion that conducting such empirical or clinical studies involving health outcomes is unnecessary and inappropriate (Scher and Senior, 2000; Baum, 2001), there exists a lack of theoretical framework and therefore mechanistic pathways purported to explain art-making as a therapeutic or restorative agent in any of the aforementioned health dimensions (See “Dimensions of Health”). Specific theories, such as the conceptual framework presented in the field of positive psychology and the theory of flow, have been proposed for population subgroups exhibiting unique diagnosis-related
symptomatology e.g. for breast cancer diagnosis (Puig et al., 2006); however, a widely accepted theoretical construct in art-making interventions remains unknown. This speaks to the idea that art-making and art therapy is often implemented as a complementary and alternative medicine (CAM) therapy, rather than a stand-alone therapeutic modality (Boehm et al., 2014). Our relationships to various art forms is elusive and based on the specific art form discussed in the literature, whether that be engagement with music, movement-based creative expression, expressive writing, or visual arts. From an evolutionary perspective, as brain size increased, so did art-related artifacts which supports the advancing prevalence of artistic creativity, mostly in the forms of intricate tools and body decorations (Morriss-Kay, 2010). Morriss-Kay also makes the argument that as evolutionary advances in cognition progressed, so did the ability to express artistic creativity in two and three dimensions. Furthermore, art is posited to have developed from our animalistic tendencies of courtship and dominance behaviors which led to music, dance, and body adornments with increasingly symbolic meaning as cognition developed. Although a theoretical framework to explain the biopsychosocial associations between art-making and health has not been provided, there still exists a number of health benefits associated to the making of art including positive influences on mental fatigue, psychological outcomes, social connectedness, and physiological indicators of stress (Ennis et al., 2017; Stuckey and Nobel, 2010; Van Lith et al., 2013; Uttley et al., 2015a).

**Horticultural Therapy**

The field of horticultural therapy (HT) emerged as an area of practice and rehabilitation for veterans returning from World War II; however, HT has roots as early as 1812, when Dr. Benjamin Rush observed and mentioned the use of garden exposure
as a means by which psychiatric patients may achieve therapeutic outcomes, in general. Modern practice and research in the area of HT is based on the theoretical frameworks of ART and SRT, and touts the therapeutic effects of active engagement or directly interacting with nature in a planned and documented treatment intervention led by a trained professional. Anecdotal accounts and qualitative studies investigating various treatment outcomes for diverse client profiles boomed in the years following the 1950s; however, the amassed studies widely varied in experimental setting, sample characteristics, and methodological approaches.

Horticultural therapy also has origins in occupational therapy and now has an international reach, mostly in industrialized countries, with practice and research occurring in countries including, but not limited to, the United States, South Korea, Norway, Australia, United Kingdom, Switzerland, and Japan. According to Park and colleagues (2016), South Korea leads the global research efforts with 92.5% of the research papers on horticultural therapy, including theses and dissertations, followed by the U.S. with 5.5%. With such a global span in research and practice comes a broad spectrum of barriers related to language, terminology, and sociocultural differences i.e. publication of research in different languages (91.7% of research was written in Korean and only 8.3% in English) and in some cases the absence of agreement on terminology referring to the same concept (Park et al., 2016). An authority on HT practice in the United States, the American Horticultural Therapy Association (AHTA), defines HT as “the participation in horticultural activities facilitated by a registered horticultural therapist to achieve specific goals within an established treatment, rehabilitation, or vocational plan. Horticultural therapy is an active process which occurs in the context of an
established treatment plan where the process itself is considered the therapeutic activity rather than the end product” (AHTA, 2018). A similar and more common practice, likely due to the series of unanswered questions (Frumkin et al., 2017) associated with the therapeutic dimensions and characteristics of the HT intervention, is therapeutic horticulture (TH). Less structured, TH is defined as “the participation in horticultural activities facilitated by a registered horticultural therapist or other professionals with training in the use of horticulture as a therapeutic modality to support program goals. Therapeutic horticulture is the process through which participants enhance their well-being through active or passive involvement in plant and plant-related activities” (AHTA, 2018). The major distinctions between HT and TH involve the credentials of the program leader, the specificity of the goals of the intervention, and the level of passive or active involvement of the client.

According to a survey with 303 respondents, including 192 self-identified gardeners, key motivational factors for gardening were elucidated, namely: intellectual enhancement, stimulus-avoidance, friendship building, social interaction, physical fitness, skill-development, and creativity (Ashton-Shaeffer and Constant, 2008). In fact, a growing body of evidence supports the use of gardening tasks to achieve specific treatment goals. The targeted goals of a horticultural therapy program can vary depending on the client profile receiving treatment. In general, treatment goals may encompass enhancement of physical health, mental health, and/or social interactions. Review of specific benefits of programming in HT is detailed in “Physiological Benefits”, “Psychological Benefits”, and “Social Benefits” sections of this thesis document. Perhaps as varied as the benefits achievable by horticultural therapy are the population
subgroups served in HT programs. According to a recent systematic review and meta-analysis, HT has shown positive health outcomes for patients with mental and physical disabilities, veterans, youth, elderly, and with general populations (Cipriani et al., 2017; Soga et al., 2017). Additionally, recent research efforts aim to decompose the complexity of experience held within HT and gardening interventions with increasingly more robust approaches. This is evident, with four randomized controlled trials, considered the “gold standard” in empirical and clinical evidence, reported in 2014 by Kamioka and colleagues.

While in their meta-analysis Soga and colleagues (2017) tout the positive health-related effects of gardening revealed by the differentiation in effect sizes comparing gardening treatment and control conditions, the studies contained in their review have notable experimental design flaws and methodological heterogeneity, including insufficient controls. This leads to the possibility of confounding variables potentially compromising these findings, such as inconsistent randomization to treatment and control conditions and variable sample characteristics i.e. gender, age, and medical diagnosis. This heterogeneity in experimental design and methodology is characteristic of the HT literature in general. These inconsistencies in the peer-reviewed literature, together with a diverse array of assessment instruments implemented to measure health outcomes, lack of reporting detailed accounts of the HT intervention sessions and environmental conditions, and small sample sizes in studies, leave many questions unanswered. The following key questions provide opportunities to enhance the empirical evidence in HT research.
1. Which population subgroups can be most benefitted by HT programming? Can all population subgroups benefit from HT programming? Can healthy people benefit from engaging in HT?

2. To what extent does social connectedness, physical exertion, and stress reduction relate to or mediate health outcomes in HT?

3. To what extent does an individual’s demographic profile (i.e. socioeconomic status, age, gender, ethnicity, culture, etc.) mediate health outcomes achievable by HT?

4. What dosage requirements of HT programming i.e. duration and frequency are needed to return the most positive health outcomes for different population subgroups, across different physical, mental, and social health challenges? What HT activities provide optimum therapeutic outcomes and the largest treatment effects?

5. To what extent does personal preference and individual’s life history influence health outcomes in HT programming?

**Art Therapy**

The peer-reviewed literature in art therapy (AT) lacks strong empirical methodologies and theoretical frameworks, and there appears to be a division with art therapist practitioners between empirical and anecdotal evidence as the necessary direction for the future of art therapy research (Van Lith, 2015). In the literature, much of the evidence to support arts in healthcare and art therapy is anecdotal, and lacks strong experimental methodologies.

Art therapy, similar in scope to HT, has a global reach with respect to research and practice. An authority in the United States, the American Art Therapy Association (AATA), defines art therapy as, “an integrative mental health and human services profession that enriches the lives of individuals, families, and communities through active art-making, creative process, applied psychological theory, and human experience within a psychotherapeutic relationship” (AATA, 2018). Also, similar to HT, AT must be facilitated by a trained art therapist who supports the achievements of
various health outcomes associated with physiological, psychological and social factors. Art therapists must undergo strict educational requirements, including achievement of a master’s level graduate degree with coursework focused on studio art-making, developmental psychology, group therapy, research methodology, and multicultural perspectives. Additionally, the AATA has established credentialing and licensure procedures depending on location of the prospective art therapist. This differs from the HT registration process, as art therapists must pass a license examination administered by a third-party certification board.

**Horticultural Therapy and Art Therapy as Complex Interventions**

While pharmacological interventions are often simple interventions with one component clearly defined, such as the active ingredient in a drug, with possibility for experimental randomization between two or more blinded treatment and control groups with the possibility of double-blind approaches to control for biases; complex interventions, such as horticultural and art therapies, pose experimental challenges that require careful attention (Campbell et al., 2000). In general, complex interventions refer to interventions containing: multiple interacting components; varied efforts in delivering and receiving the intervention; numerous target subgroups, including many health statuses and demographic profiles; multiple and variable outcome measures; and flexibility in adapting the intervention when appropriate (Craig et al., 2008). Craig and colleagues (2008) identified the importance of “process evaluation” referring specifically to the importance of outlining the causal mechanisms and theoretical framework, assessing the implementation, and discussing the contextual components associated with the intervention. Furthermore, Moore and colleagues (2015) detail the specific recommendations involving the planning, design and conduct, analysis, and reporting of
complex interventions. With this definition, both gardening and art-making (Uttley et al., 2015a; b) qualify as complex interventions. As in other complex interventions, the quality of gardening and art interventions is influenced by resource allocation which can be influenced by political atmospheres such as federal spending and sociocultural priorities. Such influences can create challenges associated with experimental manipulations, samples sizes and characteristics, and thus internal and external validity and transferability of results to practice and updating policy. Specifically, gardening and art encompass interacting components of physical engagement, social interaction, knowledge acquisition, creativity, and leisure skills training. Furthermore, delivery of gardening and art-making interventions requires extensive planning and coordination; assessment of various health outcomes to evaluate intervention effects; and a great deal of variability in the execution and tailoring of setting-specific delivery of interventions.

**Types of People-Plant Interactions**

People-plant interactions are a daily part of life for most people, and have been since the origin of our species. A variety of terms exist to explain the different types of people-plant interactions. In a review by Stigsdotter and colleagues (2011) many terms were identified which have been developed over the years describing the settings in which therapeutic interventions may occur including, but not exhaustively limited to: restorative gardens or landscapes (Gerlach-Spriggs et al., 1998), healing gardens (Cooper-Marcus and Barnes, 1999), therapeutic gardens or landscapes (Kamp, 1996; Kavanagh and Musiak, 1993), sensory gardens (Haller, 2004), care farms (Hassink and van Dijk, 2006), community gardens (Hassan and Mattson, 1993), and urban green therapeutic spaces (Cooper-Marcus and Barnes, 1999; Burls, 2008). Additionally, many
terms were identified which have been used to describe the therapeutic intervention occurring in these settings including, but not exhaustively limited to: Shinrin-yoku or forest bathing (Park et al., 2010), therapeutic horticulture, horticultural therapy (Relf, 1992), social and therapeutic horticulture (Sempik et al., 2003), ecotherapy (Burls 2007, 2008; Clinebell, 1996), conservation therapy (Hall, 2004), nature-assisted therapy or nature-guided therapy (Burns, 1998), nature therapy (Berger and McLoed, 2006), ecological psychotherapy (Wilson, 2004), care farming or green care including green exercise (Hassink and van Dijk, 2006), and human issues in horticulture (Relf and Lohr, 2003). Two categories of people-plant interventions can be distinguished: passive interventions, when interacting with nature and plants is limited to viewing, smelling, hearing, and experiencing technological nature or physically being in the presence of plants and nature; and active interventions, when interacting with plants is in the form of indoor or outdoor unstructured, semi-structured, or structured gardening or horticultural activities. Although different terminology has been used to describe the setting or intervention in each of these representations of the literature, all share the commonality that contact with plants or nature allows for the acquisition of various health outcomes to the clients served. Additionally, a number of the terms listed above share many of the same features, and at times, overlap completely. For example, therapeutic horticulture, a term used commonly in the U.S. is quite similar, if not indistinguishable, from social and therapeutic horticulture. For future research in this area, a considerable effort is necessary to standardize approaches and terminology when appropriate to allow for comparability, replicability, and generalizability of the diverse data sets to allow for clinical, practical, and policy applications.
Another topic discussed widely in the literature is synthetic, artificial, or technological nature as a comparable substitute for the therapeutic benefits achievable by real nature encounters (Bowler et al., 2010; Kahn et al., 2009). With the rise in technological advances, more people are using technology and in greater doses. This is also true in children, where using greater doses of technology, such as more “screen time” may directly compete with actual doses of nature interaction and play (Radesky and Christakis, 2016). Along with advances in technology comes greater possibilities, for example, possibilities to simulate with multiple sensory dimensions the experience of walking and being in natural settings. This allows for experimental protocols to use technological nature as a proxy for research efforts and work to decompose the mechanisms associated with the health outcomes linked with nature in a more controlled environment, but does this bring about concerns? Can technological nature replace real nature experience fully, partially or little to not at all? For the scope of this review, whenever possible focus will be placed on active interventions in various structural formats and in various settings which involve gardening and horticultural activities.

**Types of People-Art Interactions**

Art-making allows for a variety of contexts including music, movement-based art such as dance, expressive writing, verbally-oriented art such as drama presentation, and visual art such as painting (Stuckey and Nobel, 2010). Art in its multiple contexts and with its various purposes is presented in a number of forums for passive interactions or viewing such as museums, public and community spaces, concert venues, prisons, and hospitals to name a few (Uttley et al., 2015a). For the scope of this review, visual art forms will be discussed specifically, as this is the approach most
parallel and comparable to the experience of nature and plants, as they are both physical, involving sensory and motor function; social, involving group settings and social connectedness; and cognitive, allowing for knowledge acquisition, attention-related resource management, and creative expression.

**Physiological Benefits**

Human physiology refers to the extent to which the human anatomy functions normally in response to internal and external stimuli. Improvements in physiological health outcomes i.e. cortisol levels, skin conductance, blood pressure, heart rate, sleep cycles, and pain tolerance provide evidence for an intervention’s effectiveness at influencing an individual’s health status, and have the potential to unveil or suggest mechanistic pathways for health benefits. The following sections review the literature on gardening and art-making interventions for the various physiological benefits of each type of intervention.

**Gardening**

Robust research efforts involving physiological parameters associated with active people-plant interactions, such as gardening and HT, is limited; therefore, passive people-plant interactions, are included in this review to discuss the relative physiological benefits of being in the presence of natural environments. Haluza and colleagues (2014) reviewed the literature on physiological measures used to assess nature contact in an attempt to perform a systematic review and possible effects estimate; however, they found that considerable heterogeneity in physiological methods were used and instead performed a narrative review identifying brain activity, cardiovascular system, endocrine system, and immune function as the main systems addressed in the literature.
A seminal study conducted by Ulrich in 1984 reviewed medical records of 46 hospital patients recovering from gallbladder surgery who were either in a patient room with a view of trees or a view of a brick wall. Ulrich matched those patients that met eligibility criteria by age, sex, smoking status, weight level, and floor level, and found that patients assigned to the rooms overlooking trees had shorter post-operative recovery periods and required significantly fewer dosages of moderate and strong pain medication than the patients overlooking a brick wall. The results of this novel study have been supported in similar studies, where patients with plants and flowers in their rooms showed reduced levels of fatigue, systolic blood pressure, heart rate, and pain medication dosage following an abdominal surgery, compared with no changes for the patients who did not have plants in their rooms (Park and Mattson, 2008; 2009).

Cardiovascular functioning is an important factor in health. Results from several different studies indicate that improvements in cardiovascular functioning can be observed in a short time period after viewing or working directly with plants. Additionally, blood pressure may be used as an indicator for acute stress, but other factors such as genetic predisposition and coping strategies may also contribute to physiological stress responses (Steptoe, 2008). Wichrowski and colleagues (2005) found after only one HT session, touring a greenhouse and potting a plant, heart rate decreased significantly, while for an attention control, an educational course of equal duration, such statically significant changes were not observed in heart rate. After viewing a stress-inducing video, subjects experienced significant increases in physiological arousal as measured by spontaneous skin conductance response (SCR), pulse transit time (PTT), and frontalis muscle tension (EMG) (Ulrich et al., 1991).
During a recovery period of ten minutes, subjects who viewed natural scenes had significant decreases in the stress indicators above and these decreases were greater than subjects who viewed urban scenes of traffic and pedestrian-dominated shopping areas. Supportive results found by Laumann and colleagues (2003) suggest that after viewing a video of nature, subjects exhibited slowing of heart rate responses and lengthening of interbeat intervals according to a study comparing attention and heart responses between a video of urban and natural scenes of equal duration.

Identifying key connections within the brain and activations associated with nature contacts and gardening may provide evidence to unveil potential mechanistic pathways involved with health benefits. Bratman and colleagues (2015) found that for generally healthy subjects a 90-minute nature walk significantly reduced blood perfusion to the subgenual prefrontal cortex (sgPFC), while an urban walk showed no change in perfusion to the sgPFC. Coupled with their findings of decreases in self-reported rumination, these results suggest a passive experience in nature reduces rumination, a maladaptive behavioral response to stress, and serves as a potential underlying mechanism. Beyond rumination, decreases in activation of the sgPFC may also indicate other beneficial affective responses related to negative mood (Mayberg et al., 1999) and rejection by peers (Masten et al., 2011). The sgPFC includes the perigenual anterior cingulate cortex (pACC) region, where Lederbogen and colleagues (2011) observed increased neural activity for subjects born and living in rural areas, characterized by fewer people and generally more opportunities for nature experiences, and related neural activity to decreases in social stress responsivity.
Studies have also addressed bodily changes and physical outcomes associated with gardening programs. In a non-randomized, controlled study, Verra and colleagues (2012) reported significant improvements of self-reported pain in a successive cohort study of patients with chronic pain diagnoses based on the West-Haven-Yale Multidimensional Pain Inventory. While the control group of this study received the usual pain management program consisting of medication, physical therapy, and psychotherapy, the treatment group received this usual pain management program with the addition of seven, one-hour sessions of group-based horticultural therapy. Patients in the four-week HT group benefited with significantly greater SF-36 physical and mental health component scores than the usual pain management control group. In another study with similar treatment components, significant sleep and agitation improvements were seen for dementia patients after a four-week indoor gardening program consisting of planting containerized plants and maintaining them (Lee and Kim, 2008). Based on a sampling of 23 patients, significant improvements in wake up after sleep onset, nap duration, nocturnal sleep time, and nocturnal sleep efficacy, following the four weeks twice daily indoor gardening tasks. In a cross-sectional study, lower body mass index scores and greater lung function were observed in a group of allotment gardeners compared with groups of indoor exercisers, outdoor walkers, and home gardeners, although differences were not significant at \( p=0.05 \) (Hawkins et al., 2011). Supporting this study, Zick and colleagues (2013) found that after controlling for age, gender, and year of measurement, community gardeners had lower BMI scores and were less likely to be overweight than their siblings and neighbors who did not participate in gardening activities.
Salivary cortisol concentration responses are a commonly used biological indicator of stress, where lower levels are associated with reduced feelings of stress (Hellhammer et al., 2009). According to a recent study with a study population of female youth, three weeks of weekly floral arranging significantly decreased salivary cortisol concentrations (Lee et al., 2018). Cortisol concentrations remained at lower levels for six weeks following the three weeks of planting and floral pressing activities. In a highly controlled study, after stress induction 30 healthy gardeners were randomly assigned to read indoors or garden in their allotment plot (Van den Berg and Custers, 2011). The gardening and reading conditions both resulted in significant decreases in salivary cortisol levels from the stressful event to following the interventional activity; however, reductions in cortisol levels were more pronounced from the midpoint to post-assessment for the gardening condition. To control for the various settings of HT, researchers in another study performed a randomized, controlled trial (RCT) with 18 elderly women living in a group home (Rodiek, 2002). Subjects were randomly assigned to perform the same task in one of three conditions: inside the group home without plant images, inside a conference room at a garden without plant images, or outside in a garden. Significant two-fold decreases in salivary cortisol levels were observed for the group in the outdoor garden, but no changes were observed in cortisol for either of the indoor groups. This suggests that engagement in tasks outdoors in a garden setting may provide greater therapeutic effects than an indoor built environment setting. Similarly, Kotozaki in two RCTs found a significant two-fold decrease in cortisol levels following an 8-week HT program for women (2014), and a significant decrease in cortisol levels after an 8-week HT program for elderly women (2013). Conversely, in a
RCT, veterans dealing with substance abuse were assigned to an HT treatment group or occupational therapy (OT) control group. Results revealed cortisol levels dropped by 12% for the HT group after 3 weeks; however, results should be reviewed carefully, as the OT results were unusable due to insufficient quantities of saliva on samples and the HT results were not significant at alpha=0.05 based on a repeated measures ANOVA (Detweiler et al., 2015). These results show a positive trend in cortisol indicators of stress. Perhaps this study was too underpowered to detect changes, as 37% of the sample population dropped out before completion of the study.

**Art-making**

Physiological measures of health outcomes have not been commonly used to characterize treatment effects in art-making studies. Based on a systematic review of the art therapy literature for cancer patients, Puetz and colleagues (2013) found significant reductions in aggregate self-reported levels of pain. Further inspection of the existing literature returned only one conference proceeding (Virago and Dunkley, 2008) and two randomized, controlled studies (Mische Lawson et al., 2012; 2016) using physiological instruments.

One controlled trial randomly assigned blood and marrow transplant patients to an art-making intervention (n=14), music intervention (n=11), or control group (n=14) (Mische Lawson et al., 2016). Nurses recorded vital signs (temperature, blood pressure, heart rate, and respiration rate) and participants completed self-report measures of cancer symptoms (Therapeutic-Related Symptoms Checklist, TRSC) and anxiety (STAI) before and after their assigned 60-minute intervention. No significant changes before and after any of the interventions were reported. With a three-group pre-post design, this study was particularly underpowered to detect treatment effects.
Based on their power calculation, fifteen patients were needed for each intervention condition to detect changes; however, issues related to recruitment precluded them from achieving desired participant numbers and sufficient power.

The same research group conducted an earlier experiment with the same patient profile, but instead used a pre-post crossover design, where the same patients underwent both an art-making intervention and control condition with at least one day between conditions (Mische Lawson et al., 2012). Data were collected before and after each of the experimental conditions with outcome measures including the State-Trait Anxiety Inventory (STAI), Therapeutic-Related Symptom Checklist (TRSC), and salivary cortisol levels. Significant improvements were observed for the art condition on the TRSC, specifically the symptoms related to feeling sluggish, concentration, shortness of breath, and pain. Although researchers also found significant decreases in salivary cortisol levels for both art and control conditions, several concerns and limitations should be considered. The crossover design has potential for carry-over effects from the previous condition, and the collection of cortisol between 9:00 a.m. and 12:00 p.m. has the potential to be biased by diurnal changes in cortisol levels.

In another pre-post study design, melanoma patients underwent weekly sessions of art therapy over six months (Virago and Dunkly, 2008). In this case, immunoglobulin A (IgA) in saliva was used as an immunological marker for stress, where IgA levels increase in response to acute stress. Investigators reported significant increases in salivary IgA levels from pre-intervention to post-intervention. Based on the limited detail of the conference proceedings it is impossible to assess the rigour and robustness of the outcomes of this study’s protocols and results.
Psychological Benefits

Human psychology refers to the interactions between human behaviors and mental and environmental stimuli. The following sections review the literature for gardening and art-making interventions for various psychological benefits of each type of intervention.

Gardening

Perhaps among the most reported of health dimensions in the peer-reviewed literature is the psychological benefits of nature contact and gardening. According to a critical review of the mental health benefits of gardening, Clatworthy and colleagues (2013) identified ten studies that passed critical appraisal methodologies, indicating evidence supporting significant reductions in depression and anxiety symptomatology and enhancements in attentional-capacity and self-esteem. Investigation in this area is primarily quantified implementing standard self-report instruments; however, qualitative approaches such as structured and semi-structured interviews and planned observations are also used to address questions not otherwise captured.

Horticultural or nature interventions have been shown to improve mood states or affect. One clear study recruited 107 post-operative cardiac patients to participate in a randomized control trial (RCT) comparing one hour of HT (n=59) to one hour of patient education (n=48). Investigators found that total mood disturbance (TMD), a calculation derived from mood subscales on the Profile of Mood States (POMS), improved significantly for the gardening group, but showed no change for the control group even though baseline pre-intervention scores were equal between the groups (Wichrowski et al., 2005). More specifically, the gardening group experienced significant improvements (p<0.001) on all subscales of the POMS i.e. Tension, Depression, Anger, Vigor,
Fatigue, and Confusion, while the control group exhibited no changes in subscale scores. A less common and less powerful measure of affect, the Positive and Negative Affect Schedule (PANAS), was used by Van Den Berg and Custers (2011) in a RCT comparing gardening with reading as recovery strategies following a stressful stimuli. Baseline, post-stress event, and post-intervention measurements with the PANAS were collected for the gardening and reading conditions. Investigators found that positive mood increased significantly from post-stress to post-intervention for the gardening group, while no significant changes were observed for the reading group. Negative mood, although slightly improved in both groups, showed no significant changes for either group. Significant positive affect improvements based on the PANAS were also observed after twelve weeks of therapeutic horticulture twice per week (Gonzalez et al., 2011) and in an 8-week gardening intervention of a RCT (Kotozaki, 2014).

Depression, anxiety and stress are highly associated conditions. In a repeated measures, single-group study, Gonzalez and colleagues (2011a) pooled the results from two studies investigating the effects of gardening based on common psychometric assessment instruments including the Beck Depression Inventory (BDI) for depression symptoms, State-Trait Anxiety Inventory (STAI) for anxiety severity, PANAS, and Perceived Stress Scale (PSS). Results from the 12-week therapeutic horticulture intervention, with a pooled sample of 46 clinically depressed adults, indicated significant decreases from baseline to post-intervention for scores on the BDI, STAI State subscale, PANAS positive affect subscale, and PSS. It is also worth noting that these results remained significantly changed from baseline at a 3-month follow-up (n=41) for scores on the BDI, PANAS positive affect subscale, and PSS. Supporting these
findings, Kam and Siu (2010) found that ten consecutive days of gardening significantly decreased depression and anxiety symptoms more than work-related activities based on comparison of baseline to post-intervention differences between subscale scores of the Depression Anxiety Stress Scale 21 (DASS21). With this sample of twenty-four psychiatric patients randomly assigned to engage in gardening or work-related activities, investigators also found greater decreases on the stress subscale of the DASS21 for the gardening treatment and compared to the attention control (p=0.05). Similarly, Vujcic and colleagues found a gardening intervention resulted in greater improvements than a control intervention of art and occupational therapy on the DASS21 stress subscale after four weeks (Vujcic et al., 2017). In another study with a sample of 39 students assigned to gardening and 35 students assigned to a non-active control, Lee and colleagues (2004) found STAI state anxiety scores reduced nearly 6 points and trait anxiety scores reduced nearly 5 points after the twelve-weeks of gardening. Although these are seemingly significant results with a strong experimental design; without statistical testing, these results are not as convincing as they could have been. Using other various instruments, gardening and nature intervention studies have demonstrated significant decreases in depression symptomatology (Son et al., 2004; Lee et al., 2008; Sahlin et al., 2015), anxiety severity (Son et al., 2004; Lee et al., 2004; Kim et al., 2004; Sahlin et al., 2015; Weng and Chiang, 2014), and perceived stress (Dijkstra et al., 2008; Hawkins et al., 2011).

**Art-making**

According to a review by Van Lith and colleagues (2013), psychological benefits are among the most investigated outcomes in the art-making empirical evidence literature. Review of RCTs involving creative art therapies, including dance, drama,
music, writing and art interventions, yielded findings of improvements in anxiety, depression, and quality of life according to aggregated effect size estimations (Puetz et al., 2013). Interestingly, based on the same aggregate data from cancer patients, art-making led by a creative arts therapist provided weaker benefits to anxiety-related symptoms than art-making led by someone else (Puetz et al., 2013). Investigators were uncertain about the cause of this result; however, they note it may have to do with the training of the therapists or attitudes and acceptance of alternate practices within medical settings.

A number of art intervention studies have used measures of self-reported mood states, anxiety, and depression. In a randomized, controlled trial, Monti and colleagues (2006) assigned 111 female cancer patients to an eight-week wait-list control group (n=55) or mindfulness-based art therapy (MBAT) group (n=56). The MBAT program consisted of meditation practices and art activities, so there was a number of interacting components of the intervention. Pre- to post-intervention results indicate significant improvements on the general health, vitality, social functioning, and mental health subscales of the SF-36 for the MBAT group. Additionally, results from the Global Severity Index (GSI) and Symptoms Checklist Revised (SCL-90-R) indicate improvements for overall GSI and all subscales of the SCL-90-R, indicating reductions in anxiety, depression, and hostility. In a study with less variability in the data, thirty-nine female breast cancer patients in Florida were randomly assigned to a creative arts therapy group (n=20) or a wait-list control (n=19) for a four-week intervention (Puig et al., 2006). The POMS was used to capture change in mood states before and after the intervention. Participants in the art treatment had significantly lower levels of anxiety,
depression, anger, and confusion than the control group according to results of the POMS subscales. In a shorter intervention study of just three consecutive days, subjects with post-traumatic stress disorder were randomly assigned to three twenty-minute sessions of drawing objects or three twenty-minute sessions of drawing mandalas representing their feelings (Henderson et al., 2007). Baseline, after the last drawing, and one-month follow-up scores were acquired for self-reported depression, anxiety, post-traumatic stress, spiritual meaning, and limbic languidness symptoms. Changes from the after last drawing time point to one-month follow up on the Post-Traumatic Stress Disorder Scale (PDS) were significant for mandala participants, but not for the drawing control group. No significant changes between time points were captured for the BDI or STAI for either group, indicating symptoms of depression and anxiety were unaffected by the short drawing interventions. In contrast, the BDI was sensitive at detecting significant influences on depression symptomatology for male inmates in a RCT comparing an eight-week art intervention to a non-active, concurrent control condition (Gussak, 2006). The art intervention pre- to post-intervention BDI scores decreased more than the control group. In another RCT, art-making once per week for five weeks was attributed to enhancements in quality of life for a group of cancer patients (total n=41) undergoing chemotherapy (Svensk et al., 2009).

Social Benefits
Healthy social experience refers to many interacting constructs including, but not limited to, social integration, social support, and cultural interplay that individuals or groups experience (Cohen, 2004). The following sections review the literature in gardening and art-making interventions for the various social benefits of each type of
intervention. See Figure 1-1\textsuperscript{1} for a conceptualization of social health framework developed in conjunction with the development of PROMIS instruments to measure social functioning (Hahn et al., 2010).

**Gardening**

Access to nature and gardening have been linked with various types of healthy social interactions and relationships (Kuo, 2015). Healthy social interaction has been captured by many terms in the literature including social cohesion, social support, social capital, and sense of community (Hartig et al., 2014). Although these terms can be defined differently, many times they are used without distinction. In this review social support and social capital will be used interchangeably as describing an individual’s degree of social connections and relationships. Social cohesion and sense of community will refer to a group’s connectedness and shared values. Overall, the literature lacks clarity with respect to the relative contributions the social aspects of gardening programs may contribute to health outcomes, and often lacks quantitative metrics to assess social elements of programs, instead instituting interview, observation, and focus group techniques (Draper and Freedman, 2010; Okvat and Zautra, 2011).

Improvements in social behaviors are particularly important for individuals with a mental health issue or a cultural barrier, as they may feel isolated and lack skills or self-esteem to engage with others. Gardening in a group setting has been identified as an area for researching the social aspects of plant interactions. In a controlled trial of HT,
1-hour sessions twice per week for five months significantly increased schizophrenic patients’ self-esteem and interpersonal relationship, non-verbal, and substance of conversation subscales of the Social Behavior Scale (Son et al., 2004). Patients who did not receive HT, but went on with daily routines, did not show improvements in self-esteem or social behavior. In a RCT implementing an active, concurrent control condition, significantly greater improvements for social behaviors of individuals with PTSD after eight weeks of HT were measured using the World Health Organization Quality of Life 26 (WHO-QOL26) social score (Kotozaki et al., 2013). Cho and Mattson (2004) used a modified version of the Group Environment Questionnaire to investigate group cohesion and found a significant correlation between positive emotions and group integration on the horticultural tasks. From a qualitative approach, Gonzalez and colleagues (2011) found that over 90 percent of participants with chronic depression reported attributing high importance to the social component of the therapeutic horticulture intervention and social activity, and over 30 percent of participants reported having higher social activity by the end of the intervention and at three month’s follow-up. Although participants reported greater social activity, results of the Therapeutic Factors Inventory Cohesiveness Scale (TFI-CS) showed trends toward greater group cohesion throughout the horticulture session; however, these results were not supported by statistical rigor. This may be due largely to the fact that the TFI-CS assessment was introduced at week four of the intervention with only two weeks remaining to detect effects.

In a review of community use of green spaces, Kuo (2002) found that residential areas with more grass and trees were used more often and children played more in
these spaces and with more creativity. Interestingly, Kuo reports the addition of mature trees to neighborhoods can incrementally enhance a sense of community in residential neighborhoods by encouraging individuals to go outside, feel safer, and develop social ties. These findings are supported by other observational work in neighborhood settings (Sullivan et al., 2004). Furthermore, greater levels of plant material around a residential neighborhood was associated with fewer property and violent crimes. Similarly, de Vries and colleagues (2013) suggest that social cohesion as well as stress can influence the relationship between street vegetation and three aspects of health: general health, health complaints, and mental health. Furthermore, qualitative evaluation of community green spaces suggest these spaces may decrease isolation and promote interracial and intercultural relationships (Shinew et al., 2004; Wakefield et al., 2007).

**Art-making**

Several studies have attempted to quantify the extent to which art-making interventions influence social factors related to health, with many studies employing qualitative approaches to address social wellness. According to Van Lith and colleagues (2013), it is the second most commonly researched benefit of art-making interventions; just behind psychological benefits.

Researchers in one study with a single-group design devised their own questionnaire for social inclusion which they used in conjunction with known measures of mood states (Clinical Outcomes in Routine Evaluation) and empowerment (Individual Empowerment Assessment) to evaluate treatment effects of an art-making intervention. Given this study lacked a control condition, the researchers could not unequivocally attribute the mental health and social inclusion changes to the art intervention (Hacking
et al., 2008). In another study lacking a control group, 51 elderly participants participated in weekly art-making interventions over three years (Phinney, et al., 2014). Measures of social well-being included the Multidimensional Scale of Perceived Social Support and the Community Connections Index: Sense of Community subscale and Community Engagement subscale. Based on paired t-tests, investigators reported significant differences between the before and after measure of the Sense of Community subscale only. However, without a control these findings should be taken with caution. In a qualitative approach involving semi-structured interviews of cancer patients after an art-making intervention, researchers point to social connectedness as a recurring theme (Reynolds et al., 2008). Heiney and Darr-Hope (1999) found similar themes of decreased isolation and enhanced social support following a six-week art intervention for cancer patients.

**Psychometric Instrumentation**

To quantify and objectively characterize the more intangible components of health, self-report questionnaires and psychometric assessments were originally developed in the late 19th century (Vitoratou and Pickles, 2017), and these assessments continue to be developed and refined. Many psychometric and self-reported surveys and questionnaires have been created and utilized to measure and assess social, psychological, behavioral, and medical dimensions of an intervention or treatment modality. Although psychometric assessments can provide valuable information about intervention-related treatment effects, these outcome measures should be interpreted carefully and with all potential limitations and biases correctly identified. Two important concepts should be addressed when reviewing psychometric assessments and self-report questionnaires: reliability and validity. Although there are many subtypes of each
concept, reliability refers to the consistency of the instrument to measure a given behavior, concept, or event, while validity refers to the instrument’s ability to measure the intended behavior, concept, or event instead of other unintentional behaviors, concepts, or events. Strong reliability and validity help reduce the potential for measurement error and erroneous interpretations (Field, 2013, p.12). Five common, reliable, and valid psychometric assessments used to investigate symptoms related to specific diagnosis and conditions in psychological studies are the Perceived Stress Scale (PSS), Profile of Mood States (POMS), Beck Depression Inventory (BDI), State-Trait Anxiety Inventory (STAI), and the SF-36. All five of these instruments were selected for use in the present study. One issue that arises in this area of research is the lack of comparability between different metrics measuring the same phenomenon. In a collaborative and concerted effort to reduce the variability in instrumentation and develop standard psychometric instruments for reporting, the National Institute of Health (NIH) has developed the NIH Toolbox and Patient-Reported Outcomes Measurement Information System (PROMIS) instruments. One additional measure recently developed in this initiative is the PROMIS instrument Satisfaction with Participation in Discretionary Social Activities (SPDSA) which we also used for this study.

**Perceived Stress Scale**

To gain information relative to the perception of stress, the present study used the Perceived Stress Scale (PSS) (Cohen et al., 1983) with a recall interval of one week. The PSS was designed to measure the extent to which an individual considers their life events stressful. According to Google Scholar, the PSS has been cited over 15,000 times, demonstrating it is a widely used psychometric assessment. Based on three large samples implementing the PSS, cumulatively n=6,387, Cronbach’s alpha
reliability coefficients of 0.78, 0.91, and 0.91 were determined for each sample, reflecting the sufficient levels of internal consistency and reliability for items of the PSS (Cohen and Janicki-Deverts, 2012). Compared to the early development of the PSS, the above alpha coefficients echo support from the original calculation of test-retest reliability of 0.84, 0.85, and 0.86 from three samples (Cohen et al., 1983). Cohen and colleagues also provided support for the validity of the PSS by drawing associations between scores on the PSS and stressful life events. Based on calculations from a sample of 2,387 U.S. respondents, normative scores for the PSS were developed and are listed in Table 4-4 (Cohen, 1994). The UF IRB does not list the PSS instrument’s potential for harm or threat. Several nature and gardening intervention studies have used the PSS (Gonzalez et al., 2009; 2010; 2011; Hawkins et al., 2011; Willert et al., 2014) as an indicator of psychological stress.

Profile of Mood States

The present study used the Profile of Mood States (POMS) 2-A® short form instrument (McNair et al., 1981; Shacham, 1983) to assess the mood states of individuals in an effort to examine changes in mood over the course of the treatment. The POMS reports on “at this moment” status with regard to mood disturbance. The Profile of Mood States™ provides self-report scales that allow for the assessment of transient, fluctuating feelings, and enduring affect states. The tool is applicable in settings where sensitivity to change is needed to assess treatment progress monitoring and evaluation. The instrument consists of six subscales: anger-hostility, confusion-bewilderment, depression-dejection, fatigue-inertia, tension-anxiety, and vigor-activity. The vigor-activity subscale is subtracted from the sum of other five negatively-oriented subscales to arrive at the calculation of Total Mood Disturbance (TMD). The
Cronbach’s alpha coefficient for the TMD scale for a normative sample ranged from 0.94 to 0.97 across age and gender. The subscales alpha coefficients ranged from 0.76 to 0.95 (Heuchert and McNair, 2013). The POMS is widely used in studies addressing affective responses and mood changes in many disciplines having been cited more than 8,300 times. See Table 4-4 for normative scores for the POMS. The UF IRB considers the POMS’ potential for participant harm or threat to be of minimal risk. Several studies have used the POMS instrument in people-plant oriented research (Barton and Pretty, 2010; Pretty, 2005; Jo et al., 2013; Lee et al., 2011; Park et al., 2010; Vincent et al., 2010), gardening studies (Wichrowski et al., 2005) and art studies (Puig et al., 2006; Laurer and van der Vennet, 2015).

**Beck Depression Inventory**

To gain insight relative to the intensity of depression symptoms, the present study used the Beck Depression Inventory 2nd edition (BDI-II) (Beck et al., 1988) with a recall interval of two-weeks. The BDI-II has been cited 25,172 times according to Google Scholar, making it one of the most frequently used psychometric assessments. With such a broad reach, the BDI allows for comparison of treatment effects across a variety of interventions and modalities of therapy. Based on a sample of 1,022 respondents, the BDI-II achieved an alpha coefficient of 0.91, representing a high degree of internal consistency (Dozois et al., 1998). Estimations of reliability for college students (0.93) and outpatients (0.92) is supportive of the high internal consistency of the BDI-II (Beck et al., 1996). Details regarding normative values for the BDI-II can be found in Table 4-4. The UF IRB rates the BDI-II’s potential for participant harm or threat related to possible suicidal behavior or ideation as high risk. Therefore, special procedures and precautions must be in place and followed when using the BDI-II to
ensure the safety of study participants. Several studies have used the BDI instrument in people-plant oriented research (Gonzalez et al., 2009; 2010; 2011; Sahlin et al., 2015) and art studies (Gussak, 2006; Henderson et al., 2007).

**State-Trait Anxiety Inventory**

To gain information relative to anxiety symptoms and severity, the present study used the State-Trait Anxiety Inventory (STAI) instrument (Form Y) (Spielberger et al., 1983). The STAI reports on “at this moment” status. Another commonly administered measure, the STAI has been cited over 15,000 times based on Google Scholar estimation and has been used in a number of disciplines to characterize anxiety symptomatology. With such a broad reach, the STAI allows for comparison of treatment effects across a variety of interventions and modalities of therapy. The STAI is made up of two subscales, the State and Trait subscale. Based on a sample of over 5,000 respondents, the reliability of the STAI Trait and State subscales has been estimated by Spielberger and collaborators returning median Cronbach alpha coefficients of 0.90 and 0.93, respectively, suggesting the STAI has strong internal consistency (1983). Review Table 4-4 for details regarding normative values for the STAI. The UF IRB considers the STAI's potential for participant harm or threat to be of medium risk with the possibility of indication of an anxiety disorder. Therefore, special procedures and precautions must be in place and followed when administering the STAI to ensure the safety of study participants. Several studies have used the STAI instrument in people-plant (Lee et al., 2004; Weng and Chiang, 2014; Park and Mattson, 2008; 2009) and art studies (Henderson et al., 2007; Kimport and Robbins, 2012; Laurer and van der Vennet, 2015; Mische Lawson et al., 2012; 2016; Nainis et al., 2006).
Satisfaction with Participation in Discretionary Social Activities

The Satisfaction with Participation in Discretionary Social Activities (SPDSA) PROMIS short form 7a v1.0 instrument was used to assess contentment with participants’ leisure time and affairs with friends, and encompasses a recall interval of one week (Hahn et al., 2010; Cella et al., 2010). According to Hahn and colleagues, Cronbach’s alpha reliability coefficient was found to be above 0.98 for a sample of 768 respondents. Additionally, criterion validity was assessed by evaluating correlations between the SPDSA short form and other known social instruments i.e. SF-36 social functioning subscale and FACT-G, returning moderate to high correlations, 0.43-0.74 (Hahn et al., 2010). The UF IRB does not list the SPDSA’s potential for participant harm or threat. Although SPDSA has not been implemented in previous studies related to art or people-plant interventions, this instrument was used in the current study to capture social functioning related to the gardening and art activities as leisure and discretionary activities.

SF-36

The standard SF-36 Health Survey instrument (Ware and Sherbourne, 1992; Hays et al., 1993) was used to evaluate eight scales that link to physical and mental health over a four-week recall interval. The SF-36 instrument measure is a common general health status survey designed for various applications and is applicable for diverse population subgroups. It is widely used in both clinical and research settings and has been cited in over 30,000 research studies according to Google Scholar. The standard SF-36 has been tested for its psychometric properties and has relatively high values for indications of validity and reliability. Cronbach’s alpha coefficients were calculated for each subscale of the SF-36 with reliabilities ranging from 0.78 to 0.93, all
within an acceptable range to make group comparisons (McHorney et al., 1994).
Overall, the SF-36 is a reliable, valid, and widely comparable assessment instrument. See Table 4-4 for details regarding normative values for the SF-36. This assessment is useful for the interpretation of the effectiveness of psychosocial interventions, as the SF-36 has subscales in social functioning, mental health, and physical functioning which would be useful in understanding behavior changes before, during, and after a horticultural therapy and or art therapy program. The UF IRB does not list the SF-36’s potential for participant harm or threat. Researchers in both people-plant studies (Hawkins et al., 2011) and art-making studies (Monti et al., 2006) have used the SF-36 to investigate changes in participant general quality of life.

**Cardiac Instrumentation**

Physiological measurement instruments are employed to characterize physical health status, and are commonly incorporated in intervention studies and clinical trials to estimate changes in neural activity, hormonal activity, and cardiovascular health. With cardiovascular morbidity being a predominant threat to public health in the U.S., heart rate variability, blood pressure, and pulse are widely collected metrics to assess individual or group physical health. Additionally, heart rate, systolic blood pressure, and diastolic blood pressure are commonly used as indicators of physiological and psychological stress (Tennant, 1996). Standard instruments implemented to measure these cardiovascular health determinants include mercury sphygmomanometer, aneroid devices, and oscillometric instruments. Each method of capturing heart rate and blood pressure has pros and cons. Mercury sphygmomanometers, considered the gold standard in terms of accuracy, require careful use as mercury exposure can have adverse effects to human health. Additionally, some countries have banned mercury.
Aneroid devices are appropriate, but require frequent calibration and are uncomfortable to wear. The oscillometric devices, although less accurate than the other methods, provides the option to collect multiple measurements and store results (Pickering et al., 2005). Additionally, oscillometric devices are available with either arm or wrist cuffs. While wrist cuff measurement is less accurate than upper arm cuff measurement, wrist measurements are less invasive as they produce less pain with the inflation of the cuff. Heart rate and blood pressure monitoring has successfully been used in studies incorporating people-plant interventions (Pretty, 2005; Lee et al., 2011; Park et al., 2010; Vincent et al., 2010; Park and Mattson, 2008; Hawkins et al., 2011; Wichrowski et al., 2005) and at least one study incorporating art interventions (Mische Lawson et al., 2016) to assess changes in cardiac physiological status and indications of physiological and psychological stress.
Figure 1-1. PROMIS social health framework (Hahn et al., 2010).
CHAPTER 2
INTRODUCTION

With urban spaces expanding at rapid rates, more than half of the world’s population is living in urban environments and feeling the pressures associated with generally fewer nature experiences and increased population densities. While urban areas can be hubs of culture by connecting people and promoting healthy behaviors, an urban lifestyle has been linked to rising mental health disorders involving mood, depression, and anxiety (Peen et al., 2010; Lederbogen et al., 2011). From 1990-2010, the negative impact of mental, neurological, and substance abuse disorders increased by 41% with estimates placing these disorders responsible for a 10% loss in years of healthy life across the globe (Patel et al., 2016). Mental disorders affect quality of life associated with impaired functioning, morbidity, and premature mortality, while negatively influencing the national economy. A mental disorder diagnosis is associated with higher rates of unemployment and under-performance in the workplace, lower labor output, production, and economic growth (Chisholm, 2013). Furthermore, in nations across the world, including more developed nations like the U.S., the economic burden of mental health issues and non-communicable diseases is growing. From one macroeconomic projection for the next two decades, the global burden of non-communicable diseases, especially resulting from cardiovascular disease and mental health conditions, represents a cost of over $46 trillion USD which represents a loss of worker productivity and an increase in healthcare costs (Bloom et al., 2011). These mental and physical health challenges in today’s global society, coupled with the associated economic losses across global communities, warrant investigation of innovative solutions for preventative, complementary, and alternative health
interventions. The added pressures of urbanization, modern societies, rapid change, and the rise of non-communicable diseases appear to be relatively recent occurrences with associated health problems considered lifestyle diseases, as many of the harmful effects of urbanization and non-communicable diseases are reversible with shifts in decision-making and habits of an individual, community, and society.

As referenced above, nature contacts, highlighted by the correlation of green space and enhanced mental health (James et al., 2017), are critical to the existence and sustained quality of life of humanity, as it has been since the origin of our hominid ancestors. The intimate relationship between plants and the human species, *Homo sapiens*, has long provided rich benefits to our well-being and survival in the form of nutrition, shelter, and other tools for medicinal, mental, and sociocultural fortification. Indeed, theoretical frameworks have been proposed to explain such evolutionary relations that exist between people and plants, including the Biophilia Hypothesis, Attention Restoration Theory, and Stress Reduction Theory (Wilson, 1984; Kaplan and Kaplan, 1989; Ulrich, 1984). Supporting these theories is a substantial body of empirical evidence suggesting the therapeutic benefits of nature contact (Berto, 2014; Frumkin et al., 2017) and, more specifically, the cultivation of plants in the form of gardening (Soga et al., 2017). In fact, evidence supports gardening as a health intervention in its own right with reported physical, mental and social benefits. For this very reason, many studies have employed gardening as a therapeutic modality for those individuals or groups experiencing some form of physical, mental, or social ailment, disease, or disorder in a practice commonly referred to as therapeutic horticulture or horticultural therapy.
Most of the evidence for the therapeutic benefits of gardening supports horticultural therapy for specific subgroups such as people with depression (Gonzalez et al., 2011), anxiety (Clathworthy et al., 2013), mood disturbances (Cipriani et al., 2017) and cardiovascular conditions (Wichrowski et al., 2005) and many more, but there is a lack of empirical evidence that supports the therapeutic use of gardening for a healthy, adult population. With healthy study subjects, the present human-subject experiment sought to determine mental health effects associated with gardening compared to another group-based intervention, to assess the social dynamics which may influence these mental health outcomes, and to determine interventional effects on cardiac physiology. This randomized, controlled trial of group-based gardening as a treatment and group-based art as an active, concurrent control provides empirical support for the use of gardening as a mental health intervention. With this work, gardening and art may be valid contenders as vital countermeasures for the deleterious effects of urbanization, modern societies, rapid change, and non-communicable diseases, and should be considered as a public health resource for preventative, complementary, and alternative medicine. With respect to gardening and art as therapeutic modalities for human health and well-being, it seems true that what is old is new again.
CHAPTER 3
MATERIALS AND METHODS

Overview

This study aimed to evaluate the relative psychological, physiological, and social effects associated with engagement in group-based gardening activities, implementing group-based art activities as an active, concurrent control condition with a randomized and controlled true experimental design, see Figure 3-1 for visual representation of the experimental design. Engaging in a group-based gardening activities treatment is a complex intervention with many facets. As conceived for this study, the gardening treatment involved at least five major characteristics: 1, concerted active participation to receive the treatment; 2, being in a group of ten or fewer participants, so participants shared the treatment experience with others, which involved meeting and getting to know a group of peers during the gardening sessions; 3, cognitive engagement to learn new information about gardening; 4, light physical activity; and 5, engaging in interactions with plants as living, growing entities. Because of the complexity of the gardening intervention, a non-concurrent no treatment intervention was not deemed to be an equivalency as a control. A group-based art activities treatment was selected to serve as a true non-gardening equivalent that possessed four of the five major characteristics of the gardening intervention. The art activities were devoid of anything that was plant related.

The gardening and art intervention groups engaged in eight scheduled, pre-planned group activity sessions presented over a four-week period. Self-report psychometric assessment and cardiovascular monitor data were collected from both groups at baseline, during the interventions, and at follow-up to allow for appraisal of
selected time course of treatment effects. More specifically, six self-report psychometric instruments and wrist cuff blood pressure monitoring were used throughout the respective interventions. Univariate and multivariate approaches were used to analyze statistical separations and effect size estimations for the two experimental conditions. The following sections detail the methodology used to arrive at our results and the conclusions discussed in later sections of this thesis.

**Participants/Sample Population/Study Subjects**

The current study established a set of inclusion criteria involving a sample of healthy women between the ages of 26 and 49 years. Subjects included in the study reported being pre-menopausal, non-smokers, non-gardeners, non-artists, below a body mass index of 32, not negatively affected by any chronic conditions in their normal daily lives, and not allergic to pollen, plants or plant-based foods, did not abuse alcohol, did not use recreational drugs, and did not abuse prescription medications. To allow for greater comparisons between the current study and a previous pilot study, the current inclusion criteria closely paralleled the criteria set forth in a prior pilot study (IRB201400425) conducted by principal investigator Charles Guy PhD, study coordinator Christine Penman MS, and an interdisciplinary network of research collaborators from the University of Florida.

The reasons for selecting an all-female, wellness study population are several-fold. There are known cultural, societal and sex differences in the way males and females respond to interactions with plants, and these factors are reflected in part by well-known differences in consumer and eating patterns. For example, a higher percentage of men eat meat and certain types of poultry than women, whereas a higher percentage of women eat fruits and vegetables (Shiferaw et al., 2012). Research on
modern-day hunter-gatherer societies suggests evolutionary-based sex differences in labor where women daily forage and gather fruits, tubers and other available food sources, while men hunt for game as needed (Marlowe, 2007). Along similar lines, Japanese men were less favorable to the presence of street-side flowers compared to trees when compared with women (Todorova et al., 2004). More women than men agreed with statements that gardening is peaceful/tranquil and plants make them feel calmer/more relaxed in a study of attitudes towards plants and gardening (Relf et al., 1992). Women exhibited a stronger flower color preference than men when purchasing geraniums (Behe and Nelson, 1999). In a study of images of natural environments versus urban settings, Ulrich and colleagues (1981) found significant sex differences in the responses of women versus men with respect to positive affect and attentiveness. Both responses declined more when women viewed urban scenes compared to men. In a study of garden centers and mass merchandisers, it was found that 85 percent of shoppers were female and 58 percent were between the ages of 25 and 55 years (Yue and Behe, 2009). According to the Society of American Florists, men spend more money on floral gifts, and more men than women buy roses and floral arrangements valued above $30 USD. In contrast, women buy a wider range of floral gifts at a lower cost, and more women than men buy less expensive loose or bunched flowers, floral arrangements, flowering plants and dish gardens (http://www.safnow.org/).

Additionally, there appears to be evidence from several fMRI studies for sex differences in stimulus processing in the brain, particularly with respect to responses to various stimuli including visual stimuli (Klein et al., 2003; Wrase et al., 2003; Smeets et al., 2006; Garn et al., 2009; Frank et al., 2010). Moreover, it may be that some of the
best-documented benefits of working and interacting with plants align well with disorders known to be more prevalent in women such as rumination, depression, anxiety, multiple sclerosis, chronic fatigue syndrome, general fatigue, sleep disturbances, certain eating disorders, and celiac disease (Eaton et al., 2012).

It was anticipated that over the time course of the experimental treatment, participants’ menstrual cycle may contribute to variability in some of the experimental results; however, all women were premenopausal so hormonal fluxes and potential mood shifts may be observed for all subjects. A study population of a single sex, in this case only women, is expected to reduce experimental variability and increase the probability of detecting physiological and psychological effects of the experimental treatment (McCarthy et al., 2012). Furthermore, limiting health-related risk factors such as alcohol abuse and cigarette consumption likely reduced experimental variability and embodied a relative wellness study population allowing for greater internal validity of the experiment. If changes can be observed in a healthy population, then the interventions may have equal or greater utility for use in clinical populations where scores may have more variability and more potential for identification of statistical separation before and after an intervention.

**Recruitment and Assignment**

Following University of Florida (UF) Institutional Review Board (IRB) approval of study protocols (IRB201701647) and study registration with ClinicalTrials.gov (https://www.clinicaltrials.gov/) (ClinicalTrials.gov Identifier: NCT03266120), a recruitment campaign for the study began in August 2017, approximately two months prior to the planned start of the gardening and art interventions. Based on power calculations from a pilot study in 2015 (Penman, 2015), sample size estimations for
each psychometric assessment were conducted leading to recruitment aims of twenty individuals in each experimental condition. The primary method implemented for this study’s community recruitment efforts targeted key locations in Gainesville, Florida to distribute flyers following recommendations based on consultation with a HealthStreet clinical study coordinator and review of the Clinical and Translational Sciences recruitment resource list. See Figure 3-2 for a copy of the flyer distributed to various community and public flyer boards including farmer’s markets, UF campus buildings, public libraries, parks, coffee shops, and grocers. Digital flyers were also prepared and distributed to local community organizations i.e. Center for Gender, Sexualities, and Women’s Studies research, the University Women’s Club, the Alachua County Extension Service, and the Florida Master Gardeners Program to share with their respective constituencies (see digital flyer in Figure 3-3). Additional recruitment efforts included community outreach services by HealthStreet and posting study details on UF StudyConnect and ResearchMatch.org. Other recruitment procedures approved by the IRB included use of a GoogleAd service, public service radio advertisement, and newspaper advertisement; however, these methods were deemed unnecessary given the number of phone call inquiries received from flyer-generated interest, and were not used in the recruitment campaign. Informational flyers were available upon request to provide additional written details about the study and the inclusion criteria (see Study Recruitment Informational Sheet in Figure 3-4).

**Informed Consent Procedure**

When interested community members contacted the study coordinator by phone, they followed an IRB-approved script when answering or returning phone calls (see Gardening and Art Study Phone Script in Appendix A). The phone conversation and
pre-screen included a brief description of the study, inquiry of the community member’s interest and availability for participation, and initial pre-screen assessment of eligibility requirements. Individuals who met basic eligibility criteria were invited to schedule an in-person interview at a private location i.e. a private office or room in Fifield or Mehrhof Hall on the UF campus. After two months of recruitment and dispersal of several rounds of paper flyers to community boards, a total of 101 phone calls were received regarding interest in the study.

Forty-four individuals agreed to attend individual in-person meetings with the study coordinator (Mr. Raymond Odeh). During Visit 1, each volunteer was first consented (see Study Informed Consent form in Appendix B) and then asked to fill out two questionnaires, one for eligibility screening and a second for collection of demographic information (see Study Eligibility Screening Questionnaire in Appendix C and Study Demographic Questionnaire in Appendix D). After volunteers signed the informed consent and completed the two questionnaires, the study coordinator informed the study volunteers that an email would be sent to communicate information on the volunteer’s status in the study. All forty-four volunteers who came to Visit 1 willingly signed the consent form and completed the two questionnaires described above. Study volunteers were given phone numbers to contact the study coordinator or principal investigator if they had questions about their status in the study. Of the forty-four women consented, two women were found to be ineligible for the study based on the aforementioned inclusion criteria. Specifically, one woman was excluded because of a chronic condition negatively influencing daily activities and the other woman had a BMI greater than 32. Of the remaining forty-two eligible women, three were found
conditionally-eligible. Specifically, two conditionally-eligible women had allergies to plants or plant parts, so they could only be randomly assigned to the art intervention group. The other conditionally-eligible woman had extensive art experience, so could only be randomly assigned to the gardening intervention group.

**Randomization**

Thus, forty-two eligible and conditionally-eligible women were randomly assigned to either the gardening or art intervention. The randomization process was performed by the study coordinator who first assigned each of the forty-two women a unique five-digit identification number. The forty-two identification (ID) numbers were then each printed on a 1” square piece of paper and cut out. The square cutouts were shuffled, then placed in a brown paper bag and shaken thoroughly. Without looking in the bag, twenty-one cutouts were drawn from the bag one-by-one with the bag being shaken between all drawings. These twenty-one cutouts were placed in one pile, and the twenty-one remaining cutouts were taken from the bag and placed in a second pile.

Next, two 1” square pieces of paper were printed and cut out with intervention group labels “GG” and “AG” for gardening group and art group, respectively. The two 1” cutouts were placed in the same brown paper bag and shaken. Before drawing one group labeled cutout, one pile of twenty-one ID codes was selected and determined to be the group assigned with the first drawn group label cutout. The group label cutout remaining in the bag was assigned to the second pile. The “GG” group label cutout was drawn first and assigned to pile 1; therefore, the twenty-one ID codes in pile 1 were assigned to the gardening intervention and the pile 2 ID codes to the art intervention.

Two out of the three conditionally-eligible women were assigned to a group in which they were pre-determined to be ineligible, one in each of the two groups; therefore, they
were excluded from the study. This resulted in twenty women randomly assigned to the gardening intervention and twenty women randomly assigned to the art intervention. Based on each study participant’s availability on Mondays and Wednesdays or Tuesdays and Thursdays for the biweekly sessions, from information gathered in the eligibility questionnaire, they were assigned to attend intervention sessions on days that best matched with each participant’s respective schedule. This resulted in an even split of women assigned to intervention sessions on either set of days i.e. twenty women assigned to Monday and Wednesday sessions and twenty women assigned to Tuesday and Thursday sessions.

The forty randomly assigned study subjects were each sent an email detailing their assigned intervention and inviting them to attend an orientation session, Visit 2, either on Monday or Tuesday, depending on which days they were designated to participate in the study. Subjects assigned to the gardening intervention were asked to meet at the therapeutic horticulture greenhouse complex at the Wilmot Gardens, while subjects assigned to the art intervention were asked to meet in the Conference Center at Wilmot Gardens. These are two separate buildings located about 25 meters from each other. The two women not assigned to an intervention were informed they were not selected for participation in this study. Neither the researchers nor study subjects were blinded to the intervention group assignment due to the logistical impossibility of such a procedure. Study participants randomly assigned to the gardening intervention had no contact with or knowledge of participants in the art intervention.

The gardening activities intervention was delivered by the Study Coordinator. Physiological monitoring and psychometric assessments were administered by the
study coordinator with assistance from trained undergraduate student study staff members. The art activities intervention was delivered by two Artists-in-Residence from the UF Health Shands Arts in Medicine Program. Physiological monitoring and psychometric assessments were administered by the PI and study coordinator with assistance from trained undergraduate student study staff members.

**Orientation and Interventions**

Subjects interacted with study staff on eleven occasions. To simplify discussion of these separate occasions, a numbering system is used to name each of these occasions with Visit 1 referring to consenting and eligibility screening, Visit 2 referring to orientation to the study and baseline self-report and cardiac data collection, Visits 3 through 10 referring to the eight gardening or art intervention sessions, and Visit 11 referring to the follow-up session when final self-report and cardiac physiological data were collected. Visit 2 began on October 9, 2017 and Visit 11 ended on November 9, 2017 (see Table 3-1 for a list of gardening and art sessions with associated visit numbers).

A one-hour orientation session, Visit 2, included a facilities tour, parking instructions, explanation of experimental procedures, and introductions of study subjects to the study staff and the other subjects in the same intervention group. Baseline psychometric assessments and heart rate (HR) and blood pressure (BP) measurements were also collected during Visit 2 (see Administration Schedule of Psychometric Assessments in Table 3-2 for a timeline of administration of psychological assessments and the order in which each appeared in the assessment packet). After brief introductions and explanation of study protocols, blood pressure monitors were distributed to each subject for initial data collection (see “Cardiac Measurements” for
data collection procedures). At the end of the orientation session, each subject was given the pre-assembled packet of six self-report psychological assessments. Upon completion of the assessment packet and a second collection of HR and BP measurements, gift cards were provided to each subject at this session, with $20 USD loaded on the card the following day and reloaded with an additional $20 USD on the sixth and tenth visits for a total of $60 USD upon completion of the study. Subjects assigned to the art intervention were also given a free copy of the *The Artist’s Handbook* by Ray Smith, 3rd edition, (2009) that provided general background information on the art media and tools used in the art activities. The purpose for supplying the handbook was to provide a more complete art and educational experience to complement the hands-on activities taking place in the conference center. Subjects in the gardening intervention were given a free copy of the *Florida Gardener’s Handbook* by MacCubbin and colleagues (2012) that provided general background information on the plants and materials used in the gardening activities. The purpose for supplying the handbook was to provide a more complete gardening and educational experience to complement the hands-on activities in the greenhouse.

Participants receiving the gardening intervention were asked not to visit parks or botanical gardens and not to engage in gardening activities outside of the study gardening sessions. Gardening participants were also asked not to visit gardening websites on the Internet and confine any reading about plants, gardens, and gardening to the *Florida Gardener’s Handbook* they received. Participants receiving the art intervention were asked not to visit art galleries, art museums, or arts and crafts events, and not engage in any art activities outside of the study art sessions. Art intervention
participants were also asked not to visit art-related websites on the Internet and confine reading about art and art activities to the *The Artist’s Handbook* they received. The eight bi-weekly gardening or art intervention sessions were administered during Visits 3 through 10 (see the List of Gardening and Art Intervention Sessions in Table 3-1 for specific details about session activities and the Intervention Session Component Timeline in Table 3-3 for the general structure of an intervention session). Images of selected sessions are also available (see Figure 3-5 for a panel of images from the gardening intervention and Figure 3-6 for a panel of images from the art intervention).

The components of each intervention session were kept consistent throughout the eight sessions, with the first ten minutes involving greeting subjects and measurement of BP and HR in triplicate. This was followed by a ten minute introduction to the activity, thirty minutes of the activity, and ten minutes at the end for clean-up and collection of BP, HR and any required intermediate psychometric assessment administration by the protocol. Therefore, each intervention session duration was about one hour. Additionally, gardening and art activities were selected based on each activity’s physicality, sensory stimulation, and knowledge acquisition. During the course of the gardening and art interventions, the principal investigator traveled between the two concurrent sessions to assess and confirm experimental comparability.

Following the conclusion of each art session, the leader and study staff of the session recorded de-identified notes of informal observations made during the session (see Appendix E for the Post-Session Review Form Gardening and Art Study). The review considered general group interest, engagement and participation in the activities, and recalled unsolicited feedback from unidentified participants such as “I had fun” or “I
liked planting seeds” or “I liked last week’s activity better than today’s,” or whether participants were interactive with other participants in the group activities.

**Gardening Intervention**

Participants randomly assigned to the gardening treatment group received eight individual gardening activity sessions (see List of Gardening and Art Intervention Sessions in Table 3-1), over a period of four weeks with two sessions per week. The individual sessions took place at 5:30 p.m. DST (visits 2-9), or at 5:30 pm EST (visits 10 and 11) in the greenhouse at Wilmot Gardens on Mondays and Wednesdays or on Tuesdays and Thursdays. The gardening sessions were conducted inside the Wilmot Gardens 2700 sq. ft. greenhouse to increase control of and uniformity of environmental conditions compared to conducting outdoor sessions. Ambient conditions for temperature and humidity in the greenhouse were recorded at the beginning and end of each gardening session to provide information about the environmental conditions over the duration of the intervention. Temperature and humidity conditions were used to calculate the heat index (Steadman, 1979) during the sessions ([http://www.wpc.ncep.noaa.gov/html/heatindex.shtml](http://www.wpc.ncep.noaa.gov/html/heatindex.shtml)). An evaporative cooling system and automated, adjustable shade cloth were used to keep the greenhouse in a comfortable temperature range for participants, and water fountains were located nearby for participants to keep hydrated throughout the sessions. Outside weather conditions during the scheduled gardening sessions were noted as sunny, overcast, hot or cold, and with low or high humidity. A restroom was readily accessible in the adjacent lobby of the greenhouse. The individual sessions were designed to fit together within the larger context of the overall experimental intervention. The experimental intervention was configured to introduce and reinforce a limited number of different
gardening and horticultural themes that included: propagation that was presented in two forms, planting seeds (2 sessions) and vegetative propagation by cuttings/divisions (2 sessions); transplanting (2 sessions); and simulated harvest (2 sessions). The emphasis and reinforcement of the selected gardening themes was achieved using different types of plants with different uses and characteristics in the various sessions. The activities for all of the individual sessions were designed to involve a similar level of physical, cognitive and social engagement to filter out differential, competing, or interacting effects in these aspect areas. Participants received a guide booklet containing details of the eight sessions that provided instructions and information for each of the gardening activities (see Gardening Intervention Handbook/Manual in Appendix F). The Gardening Manual provided a detailed description of the educational, social and physical purposes, and goals and benefits associated with the eight gardening sessions. A registered, master-level horticultural therapist (Co-Principal Investigator) reviewed each gardening activity and the overall experimental treatment intervention. A horticulture Master’s student and study coordinator led each individual gardening activity session with help from study staff.

Art Intervention

Participants randomly assigned to the art comparison group received eight individual art activity sessions, see List of Gardening and Art Intervention Sessions in Table 3-1, over a period of four weeks with two sessions per week. The individual art sessions took place at the same time of day as the gardening sessions in the Wilmot Gardens conference center, either on Mondays and Wednesdays or on Tuesdays and Thursdays. The conference center was an air-conditioned conference space of 1032 sq. ft. that has the capacity to comfortably fit approximately 35 seated people. The
conference center was equipped with tables and chairs, a kitchenette, water fountains, and accessible bathrooms. The activities for all the individual art sessions were designed to involve approximately the same level of physical, cognitive and social engagement as the gardening intervention in an effort to filter out differential competing interacting effects in these aspect areas. Participants received a guide booklet containing details of the eight sessions and provided instructions and information for each of the art activities, see Art Intervention Handbook/Manual in Appendix G. The Art Intervention Handbook/Manual provided a detailed description of the educational, social and physical purposes, goals and benefits associated with the eight art sessions. Each art activity was designed, reviewed, and administered by two professional artists-in-residence from the UF Arts in Medicine program.

**Self-Reported Health Assessment Evaluation**

The POMS 2-A short form, PSS, BDI-II, STAI-AD, SPDSA and SF-36 instruments were administered prior to the beginning and following the completion of the gardening and art sessions treatment regime during Visits 2 and 11. In addition, for both the gardening and art groups the POMS 2-A short form and PSS instruments were administered on a weekly basis at the conclusion of the 2nd, 4th, 6th and 8th gardening and art sessions during Visits 4, 6, 8 and 10 to provide a time-course of mood and stress status, respectively, during the experiment. The BDI-II was administered at the conclusion of the 4th and 8th gardening and art sessions during Visits 6 and 10 to provide information on the depression symptomatology status during the course of the experimental regime. To protect the privacy of data collected in these instruments, packets were preassembled with coversheets on the front and back of the packet of instruments. The study subjects were also instructed not to include any personal
identifying information in the packets even if individual instruments asked for such information. Subjects were also instructed to take their time when responding to the questions, to read each set of instructions for the different questionnaires carefully noting the different recall intervals for each assessment which was highlighted in yellow, and indicate with an “X” if they wanted to change an answer on any one question. The approximate time to complete all six self-report questionnaires was 35 minutes.

When subjects completed these self-report assessments, either the study coordinator or principal investigator reviewed the assessments for completion. Whenever the Beck Depression Inventory 2nd Edition (BDI-II) or State-Trait Anxiety Inventory (STAI) were administered, the study coordinator or principal investigator scored the BDI and reviewed questions on the BDI-II and STAI before the subjects departed the session to ensure answers didn’t indicate suicidal ideation, severe depression, or anxiety symptomatology. More specifically, if the raw score of the BDI-II was above 30 or responses of 1, 2, or 3 on question 9 were identified for any subject, then a trained counselor was to be called immediately. Similarly, if the responses to questions 25, 29, 31 or 38 on the STAI indicated elevated levels of anxiety symptoms, then a trained counselor would be called for professional guidance with respect to steps to take to insure the well-being of the study subject. During the course of data collection, no incidental findings for the BDI-II or STAI for any participant were identified.

**Cardiac Measurements**

Monitoring blood pressure using a wrist cuff monitor is minimally invasive given the small structure of the device and its placement on the easily accessible wrist (Pickering et al., 2005). Accuracy information in the user manual for the Omron Wrist Blood Pressure Monitor model BP652N (HEM-6300-Z) reports blood pressure (BP)
accuracy within 2 percent of the reading and heart rate accuracy within 5 percent of the reading (Omron, 2014). According to Omron, these accuracy results are based on a sample of 85 subjects. In an instrument validation study conducted by Takahashi and colleagues (2013), Omron RS3 (HEM-6130-E) wrist BP monitors, the European equivalent to the Omron BP652N, met the 2007 validation standards of the European Society of Hypertension, meaning that differences between BP results from this Omron device and the standard mercury sphygmomanometer were within 3 mm Hg. These findings also fulfill the criteria set forth by the American Association for the Advancement of Medical Instrumentation where the mean difference between the BP device and the standard mercury sphygmomanometer must be less than 5 mm of Hg.

For the current study, analysis of heart rate (HR) and BP monitoring variability was conducted with ten replicates of readings with two subjects to assess whether the Omron monitors were within an acceptable range of variability. Of the two sets of ten replicates, the average standard deviation for systolic BP was 5.8 mm Hg, for diastolic BP was 3.5 mm Hg, and for HR was 2.2 beats per minute (bpm).

HR and BP readings were acquired in triplicate at the beginning and end of visits 2 through 11 i.e. the orientation session, eight gardening and art intervention sessions, and the follow-up or post-intervention session. To collect the HR and BP, each subject had an assigned and numbered monitor and was instructed to secure their assigned Omron Wrist Blood Pressure Monitor to their right wrist, removing jewelry if applicable and clothing as necessary. Study staff ensured appropriate and uniform fit, and placement of monitors on subjects. While sitting in their chairs, subjects were instructed to relax, place feet flat on the ground, rest right elbow on a terry cloth cushion and
elevate the monitor level equal to that of the heart. Once in position, subjects were instructed to press “Start/Stop” button to begin the reading and ensure the blue light indicated that the monitor was indeed level with their heart.

HR and BP readings were reviewed by study staff before subjects left to ensure no readings were above 180 mm Hg for systolic BP, 110 mm Hg for diastolic BP, or 100 bpm for HR. A medical doctor was identified to call if any readings were above these levels. No incidental findings were reported for HR or BP.

Subject Completion of Study

To allow for data analysis and a complete data set, and as described in the IRB approved study protocol, the study coordinator and principal investigator included an individual’s data if she missed fewer than three out of the eight intervention sessions. Those study subjects upon missing a third gardening or art intervention session were withdrawn from the study.

Immediately following notification of the study subjects of their group assignment and experiment start date, four subjects voluntarily withdrew from the study and indicated that they were no longer available to participate in the study. All four of these subjects had been assigned to the Monday and Wednesday gardening intervention sessions. One additional subject withdrew their participation after completion of the second gardening session due to family commitments. Two subjects were withdrawn from the art intervention group for missing three art intervention sessions. One additional subject in the art intervention missed follow-up, Visit 11.

Data Analytics/Statistical Analysis

Five undergraduate student study staff members assisted in entering participant coded data from the six paper-administered psychometric assessments into an Excel
database. Data entry was performed in pairs with one individual reading items from each assessment while a second individual entered the responses into a master spreadsheet using Excel. After each line of data was entered, the study staff member entering the data would read back the entered responses to the study staff member reading the data to ensure the data were entered correctly and without errors. Throughout the data entry and analysis process, any removable devices or files with subject data were protected under lock and key and/or encrypted with passwords to ensure subject privacy. Files containing data or PHI were never removed from the premises of the PI’s or study coordinator’s office on either a memory stick, hard drive or mobile device. This same data entry procedure was used to enter POMS 2 data into the Multi-Health Systems Online Assessment Center which calculated seven subscale scores based on item responses. In the same way, data was entered for the SF-36v2 in a template spreadsheet and submitted into the Optum® PRO CoRE software for processing the mental and physical component and subscale calculations for the SF-36. The PSS (items 4, 5, 7, 8) and STAI (STAI-State items: 1, 2, 5, 8, 10, 11, 15, 16, 19, 20; STAI-Trait items: 21, 23, 26, 27, 30, 33, 34, 36, 39) both required reverse scoring of several items prior to final score calculations. Responses from each of the BDI-II and SPDSA psychometric assessments were summed according to the assessment procedure.

Standard univariate and multivariate tests were conducted to evaluate statistical separations between gardening and art group scores and from baseline scores to follow-up scores for each intervention group. Furthermore, effect size estimations for
each of the six self-report assessments were determined by the Cohen’s $d$ calculation, reflecting magnitudes of change between gardening and art groups.

Prior to statistical testing, psychometric score data were assessed for normality, homogeneity of variance and sphericity by histogram inspection, Levene’s Test, and Mauchly’s Test, respectively. A two-way (intervention group X time) repeated measures analysis of variance (RM-ANOVA) with main effects decomposition was used to statistically compare differences in baseline scores, changes from baseline to post-intervention scores, and differences in post-intervention scores between experimental groups for the six self-report psychometric assessments. Mean differences were considered significant at $p<0.05$ after adjustments for multiple comparisons with the Bonferroni correction. The IBM SPSS Statistics package version 25 was used to run these univariate statistics.

Generalized mixed linear models controlling for age were conducted to analyze the diastolic BP, systolic BP, and heart rate data. Generalized mixed linear modelling is a multivariate approach, considered the “gold standard” for biomedical inference testing. These models permit statistical comparisons between the gardening and art cardiac data with respect to time and controlling for age. SAS version 9.4 was used to run these multivariate tests and calculate fit models. Using similar methods, additional mixed models were run to compare the differences within the eight intervention sessions and ten total sessions (including the pre-intervention and post-intervention sessions) for the gardening and art interventions separately to determine whether BP and HR intra-session changes were significantly different from 0 (no change) at $p<0.05$. 
Table 3-1. List of gardening and art intervention sessions with associated visit numbers.

<table>
<thead>
<tr>
<th>Visit Number</th>
<th>Session Number</th>
<th>Art Activity</th>
<th>Gardening Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>Papermaking</td>
<td>Comparing and Planting Herb Seeds</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>Image Transfer</td>
<td>Propagation of Herb &amp; Sensory Plants</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>Visual Storytelling</td>
<td>Transplanting Succulent Plants</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>Linocut Printmaking: Part 1</td>
<td>Propagation of Ornamental Plants</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>Linocut Printmaking: Part 2</td>
<td>Simulated Harvest: Tasting Herbs</td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>Paper Batik</td>
<td>Seeding Fast Germinating Vegetables</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
<td>Mixed Media Collage</td>
<td>Transplanting Herbs &amp; Lettuce</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>Sensation Drawing</td>
<td>Simulated Harvest: Tasting Microgreens</td>
</tr>
</tbody>
</table>
Table 3-2. Administration order and schedule of psychometric assessment instruments. “Yes” indicates assessment was given to subjects.

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Visit 2 Pre</th>
<th>Visit 4</th>
<th>Visit 6</th>
<th>Visit 8</th>
<th>Visit 10</th>
<th>Visit 11 Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>POMS 2</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PSS</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>BDI-II</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>STAI</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SPDSA</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SF-36v2</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: No psychometric assessments were administered during visits 3, 5, 7, and 9.
Table 3-3. Timeline sequence for the eight experimental gardening and art intervention sessions.

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Session Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min</td>
<td>Participants arrival and sign-in</td>
</tr>
<tr>
<td>0-10 min</td>
<td>Participants individually review previous activities (i.e. plant growth or art projects), session leaders greet subjects and assemble group, heart rate and blood pressure measurements recorded</td>
</tr>
<tr>
<td>10-20 min</td>
<td>Educational module, session leaders give introduction to activity, demonstration of activity as warranted (with reference to booklet, instruction sheet, resource material handouts)</td>
</tr>
<tr>
<td>20-50 min</td>
<td>Gardening or art activity, questions and dialog with session leader, communication and interactions with other participants in the session</td>
</tr>
<tr>
<td>50-60 min</td>
<td>Clean-up, heart rate and blood pressure measurement recorded, POMS and PSS assessments (even-numbered sessions) and BDI (sessions 4 and 8), sign out and departure</td>
</tr>
<tr>
<td>60-85 min</td>
<td>Session leaders session review, evaluation and record observations (study staff only)</td>
</tr>
</tbody>
</table>
Figure 3-1. Study experimental design.

*Profile of Mood States 2nd Edition Adult Form (POMS); Perceived Stress Scale (PSS); Beck Depression Inventory 2nd Edition (BDI); State-Trait Anxiety Inventory Forms; Satisfaction with Participation in Discretionary Social Activities PROMIS Short Form v1.0; SF-36v2 Health Survey 3rd Edition

**Blood Pressure and Heart Rate monitored with Omron 7 Series Wrist Blood Pressure Monitor
Gardening & Art Research Study
for Women Ages 26-49

The UF/IFAS Environmental Horticulture Department at the University of Florida is seeking healthy women between the ages 26-49 with little to no gardening or art experience. Volunteers will participate in hands-on gardening or art sessions over a 5-week period. Sessions will occur biweekly and each last about one hour. Participants may receive plants, art, educational materials, and Visa gift cards as compensation.

For more information, please contact Ray at (352) 273-4525.

Figure 3-2. IRB-approved study flyer for posting on public bulletin boards.
The UF/IFAS Environmental Horticulture Department at the University of Florida is seeking healthy women between the ages 26-49 with little to no gardening or art experience. Volunteers will participate in hands-on gardening or art sessions over a 5-week period. Sessions will occur biweekly and each last about one hour. Participants may receive plants, art, educational materials, and VISA gift cards as compensation.

For more information, please contact Ray at (352) 273-4525.
Information Sheet Gardening & Art Study

Basic Eligibility Requirements:

a) You have to be between the ages of 26 and 49 and premenopausal
b) You must be in good health and have an average height to weight ratio (BMI less than 32)
c) You cannot be pregnant prior to study enrollment
d) You cannot be a regular gardener or regularly engage in arts and crafts
e) You cannot regularly use addictive or recreational drugs or abuse alcohol
f) You must be available Mondays and Wednesdays OR Tuesdays and Thursdays at 5:15pm

Are you eligible? Here is more information about the study:

• Free gardening or art program designed for women ages 26-49.
• Purpose of this program is to see if working with plants or art can affect people’s lives.

Gardening or Art Sessions occur:

• At Wilmot Gardens on the University of Florida campus
• Twice each week for 1-1.5 hour sessions for a total of 11 visits
• From October to November (approximately 5 to 6 weeks)
• On Monday & Wednesdays or Tuesday & Thursdays at 5:15pm

For participation, you may receive:

• VISA gift cards to compensate you for travel expenses
• Plants or art that you have worked on during the program
• A gardening or art guide book

Figure 3-4. Information sheet to provide more information about the study if requested.
Figure 3-5. Photographs of selected gardening intervention sessions.
Figure 3-6. Photographs of selected art intervention sessions.
CHAPTER 4
RESULTS

Statistical analyses of treatment group changes before-to-after and between two comparable interventions of the present randomized and controlled experimental study permitted the testing of the following three hypotheses:

1. The group-based gardening intervention will provide different therapeutic outcomes related to self-reported mood states, perceived stress, depression symptomatology, anxiety severity, and general health status for healthy women, than the group-based art intervention.

2. Self-reported satisfaction with participation in discretionary social activities will improve for both group-based gardening and art interventions.

3. Engaging in group-based gardening and art interventions will reduce heart rate and systolic and diastolic blood pressure for healthy women.

**Study Subject Demographics**

Table 4-1 shows the comparison of the demographic characteristics for the garden and art treatment groups. Based on independent samples t-tests, random assignment of study participants resulted in two fundamentally equivalent gardening and art intervention groups to begin the experiment with respect to age, socioeconomic details, and other demographic factors. The average age of the participants was approximately 33 years, they were well-educated, and had an average household income that was above the median income for Alachua County, Florida. They cared on average for approximately two plants, consumed low amounts of alcoholic beverages, did not smoke, and had BMI scores (Nuttall, 2015) that were within the normal range. In the screening process, the participants self-rated their current physical and mental health as 7.6/7.8 and 8.1/8.3 for the gardening/art groups, respectively, on a scale of 1 to 10 with 10 being perfect health. The racial makeup of the groups was 2.5% American Indian/Alaskan Native, 5% Black, 17.5% other race, 25% Asian, and 50%
White. Of these racial classifications, 27.5% also identified as having a Hispanic or Latino ethnic identity, while 72.5 percent identified as not having a Hispanic or Latino background. This racial and ethnic profile is similar to the profile of the Florida population with the exception of the present sample having a smaller proportion of Blacks and a greater proportion of Asians (US Census, 2016).

**ANOVA (Significance/Hypothesis Testing and Treatment Effects)**

Assumptions associated with parametric testing were assessed for this data set including normality and homogeneity of variance. Table 4-2 provides descriptive statistics related to within and between intervention group differences pre- to post-intervention for the POMS 2, PSS, BDI-II, STAI, SF-36, and SPDSA psychometric instruments based on two-way group by time repeated measures ANOVA (RM-ANOVA) pairwise comparisons.

The POMS 2 Total Mood Disturbance (TMD) is a calculation of an individual’s general mood based on six subscales. Specifically, TMD is calculated by subtracting the positive mood subscale, Vigor-Activity, from the sum of the five negative mood subscales i.e. Anger-Hostility, Confusion-Bewilderment, Depression-Detection, Fatigue-Inertia and Tension-Anxiety. The POMS 2 also has a separate Friendliness scale which indicates a respondent’s level of positive feelings toward other people. Higher scores on the negative subscales indicate greater negative mood states in each category of mood; thus, lower scores indicate improvements in mood categories. Conversely, higher scores on the Vigor and Friendliness subscales indicate higher energy and positive interpersonal feelings, respectively; therefore, higher scores indicate improvements in these mood states. Higher scores on the PSS indicate greater perceived stress; therefore, lower scores indicate improvements related to self-reported
stress. Higher scores on the BDI-II indicate the presence of greater depressive symptomatology, whereas score reductions denote improvements in depressive symptoms. The STAI has two subscales, the state and trait subscale. State anxiety is considered a momentary emotional reaction to either internal and/or external trigger(s), while trait anxiety is thought to describe a person’s personality characteristics that are more stable over time. Higher scores on the STAI subscales indicate higher levels of anxiety; thus, lower scores indicate improvements in feelings of anxiety.

Statistically significant decreases on scores for the POMS TMD, PSS, and BDI-II were observed post-intervention for both the gardening and art intervention groups, see Table 4-3 for the RM-ANOVA F table for the six psychometric instruments and see Table 4-2 for the pre-intervention to post-intervention comparisons. A statistically significant decrease on the STAI Trait subscale was observed for the gardening group, while no such statistical separation was observed for the art group pre- to post intervention. Similarly, the STAI State subscale score decreased for the gardening group yielding a p-value of p=0.057 when adjusted for multiple comparison that was just above the p=0.05 standard for accepting a difference between group means. However, the art group showed no statistically significant changes for the STAI State subscale. Changes in pre- to post-intervention scores for both groups for the physical or mental components of SF-36 and the SPDSA were not statistically significant. Although some changes in pre-intervention to post-intervention scores were only reported in the gardening group, no pairwise comparisons between the gardening and art group scores were statistically separated at the post-intervention assessment. Table 4-4 lists the available normative scores for the six psychometric assessments with respect to
specific populations and subgroups. Comparing the present study scores to normative scores reveals that our study subjects weren’t experiencing noteworthy mental or physical health disturbances at the baseline measurements according to pre-intervention mean scores for five of the six psychometric assessment instruments. Normative scores for healthy adults are not available for the SPDSA assessment instrument. When coupled with the screening inclusion and exclusion criteria, the self-report assessments indicate that the study population consisted primarily of healthy women.

The POMS 2 subscales pre-intervention to post-intervention comparisons are included in Table 4-5. Both gardening and art groups improved with respect to mood shifts related to confusion, fatigue, and tension; however only the gardening group improved in the anger category. No statistically significant changes were found for either group for the depression subscale or either of the two positive mood subscales, Vigor and Friendliness.

**Treatment Effect Size (Magnitude of Change)**

Cohen’s $d$ was used to calculate treatment effect size for the gardening and art groups with respect to mean score changes on the six psychometric instruments. As shown in Table 4-6, a range of treatment effect size was observed in both the gardening and art intervention groups based on magnitude of changes in mean scores from pre-intervention to post-intervention for all of the psychometric assessments. Larger treatment effects were observed, based on Cohen’s $d$ statistic for the gardening group compared to the art group on the POMS 2 TMD, PSS, BDI-II, STAI State and Trait subscales, SF-36 mental and physical health subscales and SPDSA.
Dosage Effects for Gardening and Art Psychometric Scores

Of the six psychometric assessments, three assessments, namely the POMS 2, PSS, and BDI-II, were completed by the participants during the course of the interventions at pre-selected, defined intervals based on assessment recall times. The POMS 2 and PSS were given at weekly intervals, while the BDI-II was given every two weeks, as the assessments have a one-week and two-week recall interval, respectively. Pairwise comparisons were conducted within the RM-ANOVA framework; however, when all six PSS and POMS measures were placed in the RM-ANOVA model, the sample size reduced from 15 and 17 in the gardening and art group, respectively, to 11 and 11. With such a reduced sample size from missing data in the time course measurements, the RM-ANOVA was not sufficiently powered to detect differences between all of the time points. To increase the power of the ANOVA, three time points were used to rerun the test, namely, pre-intervention, mid-intervention, and post-intervention scores with a sample size of 14 subjects in each group and time point for the POMS 2, PSS, and BDI-II. These three time points returned statistically significant results for the pairwise comparison of time. Results from these pairwise comparisons for POMS 2 TMD, PSS, and BDI-II are detailed in Figure 4-1; Figure 4-2, and Figure 4-3, respectively. One noteworthy trend between the POMS 2, PSS, and BDI-II indicates that treatment effects for the gardening group may have been achieved from the midpoint to the end of the intervention rather than from the baseline to midpoint. Treatment effects were not observed within the first two weeks of the intervention for the gardening group, but rather in the last two weeks. Conversely, the art group showed no treatment effects related to mood states or depression symptomatology according to these pairwise comparisons; however, perceived stress scores were reduced over time.
The art group reductions in perceived stress, PSS scores, were reported from the baseline to the midpoint, but not from the midpoint to the end of the intervention. This suggests that for the art group, treatment effects were obtained early in the first two weeks of treatment, but stagnated in the last two weeks of the intervention.

To provide a visual representation and further understand the relationship between the changes in scores for all time points for the POMS 2 and PSS weekly assessments, regression analyses with occasion of measurement as a predictor for group score was run within each group. These graphs are provided to explore the full set of data without data deletions which was one limitation of the RM-ANOVA framework. Figure 4-4 details the association between the weekly measurements of the POMS 2 for the gardening and art intervention groups. For the gardening intervention group, 91.4% of the changes in POMS 2 TMD scores can be described by a logistic function for the occasion of measurement and progression of the intervention based on weekly responses. For the art intervention group, 81.1% of the reduction in the POMS TMD scores can be described by a similar logistic function for the occasion of measurement and progression of the intervention based on weekly responses.

Figure 4-5 details the association between the weekly measurements of the PSS for the gardening and art intervention groups. For the gardening intervention group, 78.0% of the reductions in PSS scores can be described by a logistic function for the occasion of measurement and progression of the intervention based on weekly responses. For the art intervention group, 87.4% of the decreases in PSS scores can be similarly described by a logistic function for the occasion of measurement and progression of the intervention based on weekly scores.
Figure 4-6 details the association between the repeated measurements of the BDI-II for the gardening and art intervention groups. For the gardening intervention group, 99.9% of the decreases in BDI-II scores, again, can be described by a logistic function for the occasion of measurement and progression of the intervention based on bi-monthly responses. For the art intervention group, 88.5% of the decreases in BDI-II scores can be described by a logistic function for the occasion of measurement and progression of the intervention based on responses on the BDI-II.

**Heart Rate and Blood Pressure Mixed Linear Model**

To more clearly understand the contributions of the two interventions on blood pressure and heart rate, age was removed from the variance in separate mixed linear models for diastolic blood pressure, systolic blood pressure, and heart rate. The models incorporated the difference of the pre- to post-session triplicate measurement averages of blood pressure and heart rate. The eight difference or change scores, one for each intervention session, were used in these models to compare the gardening and art intervention group changes in blood pressure and heart rate over time. The models treat time as a continuous predictor of each cardiac parameter.

In the model comparing the groups’ intra-session HR and BP change over the course of the eight intervention sessions or the ten total sessions, i.e. including the pre-intervention and post-intervention measurements, some findings appear to be statistically separated. Table 4-7 contains descriptive statistics for HR and Table 4-8 for the descriptive statistics for diastolic and systolic BP. There is no statistically significant differences between the group interventions for change in HR after modeling the change for the eight activity sessions (p=0.4353) or the ten total sessions (p=0.2402). Similarly, the gardening and art groups exhibited no statistically significant differences in
systolic BP when comparing the intra-session change in systolic BP for the eight activity sessions (p=0.0962), or when comparing the ten total sessions (p=0.7164). Interestingly, when comparing the change for the eight activity sessions, the art group experienced an increase in diastolic BP that is estimated to be 3 mm Hg greater than the gardening group’s change (p=0.0136). These diastolic BP findings were consistent when comparing the change for the ten total sessions with the art group experiencing an increase in diastolic BP that was 2 mm Hg greater than the gardening group’s change (p=0.0203). To further understand these diastolic BP changes for each group, additional models were run to assess if within-group change was statistically different from no change.

To complement the initial statistical model, additional models were constructed to analyze the change within each group throughout the course of the eight intervention sessions and the ten total sessions to identify whether intra-session changes were significantly different from 0 (zero) i.e. no change. The multivariate models for the gardening group, both for the eight intervention sessions and ten total sessions, provided evidence to support that no changes occurred with respect to HR, diastolic BP, and systolic BP throughout the intervention. However, this was not the case for the art group. For HR, although the art group did not have a statistically significant change within the course of the eight intervention sessions (p=0.0668), there was a 2 mm Hg decrease in HR when assessing the change throughout the ten total sessions (p=0.0063). In contrast, the art group had significant increases in diastolic BP, and changes were significant both when modeling change within the eight intervention sessions (2 mm Hg increase, p=0.0017) and the ten total session (2 mm Hg increase,
p=0.0026). While diastolic BP changed significantly throughout the art intervention, systolic BP measurements did not change significantly throughout either the eight intervention sessions (p=0.1789) or the ten total sessions (p=0.9624).
Table 4-1. Baseline demographic characteristics for the randomly assigned gardening and art treatment groups. Independent samples t-test of gardening and art intervention groups at baseline indicated that none of the demographic factors comparing gardening and art groups were significantly different at p<0.05.

<table>
<thead>
<tr>
<th>Category</th>
<th>Intervention</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Gardening</td>
<td>20</td>
<td>33.0</td>
<td>5.7</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>20</td>
<td>32.8</td>
<td>5.6</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Education&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Gardening</td>
<td>20</td>
<td>17.8</td>
<td>2.1</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>20</td>
<td>18.4</td>
<td>3.5</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Income ($1,000 USD)</td>
<td>Gardening</td>
<td>19&lt;sup&gt;b&lt;/sup&gt;</td>
<td>52.6</td>
<td>37.4</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>19&lt;sup&gt;b&lt;/sup&gt;</td>
<td>55.5</td>
<td>41.0</td>
<td>9.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children at Home</td>
<td>Gardening</td>
<td>20</td>
<td>0.2</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>20</td>
<td>0.6</td>
<td>1.1</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Rated Physical Health (1-10 Scale)</td>
<td>Gardening</td>
<td>20</td>
<td>7.6</td>
<td>1.4</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>20</td>
<td>7.8</td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Rated Mental Health (1-10 Scale)</td>
<td>Gardening</td>
<td>20</td>
<td>8.1</td>
<td>1.3</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>20</td>
<td>8.3</td>
<td>1.2</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Plants Cared for at Home</td>
<td>Gardening</td>
<td>20</td>
<td>2.3</td>
<td>2.2</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>20</td>
<td>1.6</td>
<td>2.7</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number Alcoholic Drinks in Average Week</td>
<td>Gardening</td>
<td>20</td>
<td>1.0</td>
<td>1.6</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>20</td>
<td>1.8</td>
<td>1.6</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Cigarettes Smoked in Average</td>
<td>Gardening</td>
<td>20</td>
<td>0.0</td>
<td>0.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.0</td>
</tr>
<tr>
<td>Average Week</td>
<td>Art</td>
<td>20</td>
<td>0.0</td>
<td>0.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>Gardening</td>
<td>20</td>
<td>23.7</td>
<td>3.2</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>20</td>
<td>23.4</td>
<td>3.2</td>
<td>0.7</td>
</tr>
</tbody>
</table>

<sup>a</sup>Grades 1 through 12 account for 12 years of education

<sup>b</sup>N=19; missing data for one subject in each group

<sup>c</sup>t-statistic cannot be computed, because means and SDs of both groups are 0
Table 4-2. Gardening and art groups self-report psychometric assessment statistics, computed from a time by intervention group repeated measures ANOVA, and adjusted for multiple comparisons with the Bonferroni correction.

<table>
<thead>
<tr>
<th>Assessment Instrument(^a)</th>
<th>Intervention</th>
<th>N(^b)</th>
<th>Pre-Intervention Mean (SE)(^c)</th>
<th>Post-Intervention Mean (SE)(^d)</th>
<th>Pre-to Post-Intervention p-value(^e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>POMS TMD</td>
<td>Gardening</td>
<td>15</td>
<td>53.1 (2.4)</td>
<td>46.9 (2.3)</td>
<td>0.018</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>53.5 (2.3)</td>
<td>47.0 (3.3)</td>
<td>0.009</td>
</tr>
<tr>
<td>PSS</td>
<td>Gardening</td>
<td>15</td>
<td>14.9 (1.5)</td>
<td>9.4 (1.6)</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>15.8 (1.4)</td>
<td>10.0 (1.5)</td>
<td>0.001</td>
</tr>
<tr>
<td>BDI-II</td>
<td>Gardening</td>
<td>15</td>
<td>8.2 (1.6)</td>
<td>2.8 (1.3)</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>9.0 (1.5)</td>
<td>5.1 (1.3)</td>
<td>0.009</td>
</tr>
<tr>
<td>STAI-State</td>
<td>Gardening</td>
<td>15</td>
<td>34.3 (2.6)</td>
<td>29.2 (1.9)</td>
<td>0.057</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>32.1 (2.5)</td>
<td>32.1 (1.8)</td>
<td>0.981</td>
</tr>
<tr>
<td>STAI-Trait</td>
<td>Gardening</td>
<td>15</td>
<td>41.0 (2.8)</td>
<td>37.0 (2.4)</td>
<td>0.044</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>36.4 (2.6)</td>
<td>35.9 (2.3)</td>
<td>0.797</td>
</tr>
<tr>
<td>SF-36 Physical Health</td>
<td>Gardening</td>
<td>15</td>
<td>55.3 (1.2)</td>
<td>56.2 (1.2)</td>
<td>0.320</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>16</td>
<td>57.6 (1.2)</td>
<td>58.1 (1.1)</td>
<td>0.624</td>
</tr>
<tr>
<td>SF-36 Mental Health</td>
<td>Gardening</td>
<td>15</td>
<td>45.4 (2.8)</td>
<td>48.5 (2.0)</td>
<td>0.236</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>16</td>
<td>45.4 (2.7)</td>
<td>47.3 (1.9)</td>
<td>0.470</td>
</tr>
<tr>
<td>SPDSA</td>
<td>Gardening</td>
<td>15</td>
<td>23.3 (1.7)</td>
<td>25.3 (1.6)</td>
<td>0.156</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>22.9 (1.6)</td>
<td>24.9 (1.5)</td>
<td>0.131</td>
</tr>
</tbody>
</table>

\(^a\)PSS=Perceived Stress Scale; BDI-II=Beck Depression Inventory 2\(^{nd}\) Ed.; STAI-State=State-Trait Anxiety Inventory State Subscale; STAI-Trait=State-Trait Anxiety Inventory Trait Subscale; SF-36 Physical and Mental Health= Components of SF-36v2 Health Survey 3\(^{rd}\) Ed.; SPDSA= Satisfaction with Participation in Discretionary Social Activities PROMIS Short Form v1.0; POMS TMD=Profile of Mood States 2\(^{nd}\) Ed. Adult Form Total Mood Disturbance.

\(^b\)Number of participants completing all study assessments.

\(^c\)All pre-intervention mean pairwise comparisons between gardening and art intervention groups were not significantly different at \(p<0.05\).

\(^d\)All post-intervention mean pairwise comparisons between gardening and art intervention groups were not significantly different at \(p<0.05\).

\(^e\)Bold font indicates pre- to post-intervention within group means were significantly different at corrected \(p<0.05\).
Table 4-3. F table from a two-way repeated measures ANOVA for each psychometric instrument.

<table>
<thead>
<tr>
<th>Assessment Instrument</th>
<th>$F$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POMS TMD:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>14.07</td>
<td>0.001</td>
</tr>
<tr>
<td>Group</td>
<td>0.01</td>
<td>0.933</td>
</tr>
<tr>
<td>Time*Group</td>
<td>0.01</td>
<td>0.921</td>
</tr>
<tr>
<td><strong>PSS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>25.27</td>
<td>0.000</td>
</tr>
<tr>
<td>Group</td>
<td>0.16</td>
<td>0.692</td>
</tr>
<tr>
<td>Time*Group</td>
<td>0.02</td>
<td>0.899</td>
</tr>
<tr>
<td><strong>BDI-II</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>20.65</td>
<td>0.000</td>
</tr>
<tr>
<td>Group</td>
<td>0.70</td>
<td>0.411</td>
</tr>
<tr>
<td>Time*Group</td>
<td>0.55</td>
<td>0.463</td>
</tr>
<tr>
<td><strong>STAI-State</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>2.04</td>
<td>0.164</td>
</tr>
<tr>
<td>Group</td>
<td>0.018</td>
<td>0.895</td>
</tr>
<tr>
<td>Time*Group</td>
<td>2.14</td>
<td>0.154</td>
</tr>
<tr>
<td><strong>STAI-Trait</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>2.94</td>
<td>0.097</td>
</tr>
<tr>
<td>Group</td>
<td>0.69</td>
<td>0.412</td>
</tr>
<tr>
<td>Time*Group</td>
<td>1.85</td>
<td>0.184</td>
</tr>
<tr>
<td><strong>SF-36 Physical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1.15</td>
<td>0.293</td>
</tr>
<tr>
<td>Group</td>
<td>1.76</td>
<td>0.195</td>
</tr>
<tr>
<td>Time*Group</td>
<td>0.15</td>
<td>0.706</td>
</tr>
<tr>
<td><strong>SF-36 Mental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1.90</td>
<td>0.178</td>
</tr>
<tr>
<td>Group</td>
<td>0.05</td>
<td>0.832</td>
</tr>
<tr>
<td>Time*Group</td>
<td>0.13</td>
<td>0.721</td>
</tr>
<tr>
<td><strong>SPDSA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>4.51</td>
<td>0.042</td>
</tr>
<tr>
<td>Group</td>
<td>0.04</td>
<td>0.851</td>
</tr>
<tr>
<td>Time*Group</td>
<td>0.00</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Note: Time reflects pre-intervention and post-intervention means. Group reflects assignment to gardening or art treatment group. Bold font indicates $p<0.05$. 

95
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Normative Range</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>POMS 2 TMD</td>
<td>40-59</td>
<td>Heuchert and McNair, 2012</td>
</tr>
<tr>
<td>PSS</td>
<td>13.7*</td>
<td>Cohen and Williamson, 1988</td>
</tr>
<tr>
<td></td>
<td>16.1*</td>
<td>Cohen and Janicki-Deverts, 2012</td>
</tr>
<tr>
<td>BDI-II</td>
<td>9.8</td>
<td>Whisman and Richardson, 2015</td>
</tr>
<tr>
<td></td>
<td>14.6*</td>
<td>Beck et al., 1996 (BDI-II Manual)</td>
</tr>
<tr>
<td>STAI-State</td>
<td>32.9</td>
<td>Nyenhuis et al., 1999</td>
</tr>
<tr>
<td></td>
<td>33.2</td>
<td>Crawford et al., 2011</td>
</tr>
<tr>
<td></td>
<td>35.2</td>
<td>Spielberger, 1983 (STAI manual)</td>
</tr>
<tr>
<td>STAI-Trait</td>
<td>35.6</td>
<td>Nyenhuis et al., 1999</td>
</tr>
<tr>
<td></td>
<td>36.4</td>
<td>Crawford et al., 2011</td>
</tr>
<tr>
<td></td>
<td>34.8</td>
<td>Spielberger, 1983 (STAI manual)</td>
</tr>
<tr>
<td>SPDSA</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Indicates only women were used to calculate the value
Table 4-5. POMS 2 subscale statistics based on pairwise comparisons from a time by intervention group repeated measures ANOVA with the Bonferroni correction.

<table>
<thead>
<tr>
<th>POMS Subscale</th>
<th>Intervention</th>
<th>N</th>
<th>Pre-Intervention Mean (SE)(^a)</th>
<th>Post-Intervention Mean (SE)(^b)</th>
<th>Pre- to Post-Intervention p-value(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anger</td>
<td>Gardening</td>
<td>15</td>
<td>46.9 (1.4)</td>
<td>42.8 (1.9)</td>
<td>0.023</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>49.5 (1.3)</td>
<td>47.2 (1.8)</td>
<td>0.160</td>
</tr>
<tr>
<td>Confusion</td>
<td>Gardening</td>
<td>15</td>
<td>49.4 (2.4)</td>
<td>45.9 (1.9)</td>
<td>0.041</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>51.5 (2.2)</td>
<td>45.2 (1.7)</td>
<td>0.000</td>
</tr>
<tr>
<td>Depression</td>
<td>Gardening</td>
<td>15</td>
<td>50.1 (2.0)</td>
<td>46.6 (1.6)</td>
<td>0.112</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>50.4 (1.9)</td>
<td>46.9 (1.5)</td>
<td>0.092</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Gardening</td>
<td>15</td>
<td>49.8 (1.9)</td>
<td>42.5 (2.0)</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>47.4 (1.8)</td>
<td>42.4 (1.9)</td>
<td>0.040</td>
</tr>
<tr>
<td>Tension</td>
<td>Gardening</td>
<td>15</td>
<td>53.1 (2.6)</td>
<td>45.9 (2.1)</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>50.2 (2.5)</td>
<td>45.8 (2.0)</td>
<td>0.044</td>
</tr>
<tr>
<td>Vigor</td>
<td>Gardening</td>
<td>15</td>
<td>50.9 (2.5)</td>
<td>50.0 (2.7)</td>
<td>0.743</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>49.0 (2.3)</td>
<td>52.2 (2.5)</td>
<td>0.207</td>
</tr>
<tr>
<td>Friendliness</td>
<td>Gardening</td>
<td>15</td>
<td>49.6 (2.4)</td>
<td>50.3 (2.6)</td>
<td>0.782</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>17</td>
<td>48.1 (2.2)</td>
<td>48.8 (2.5)</td>
<td>0.777</td>
</tr>
</tbody>
</table>

\(^a\)All pre-intervention mean pairwise comparisons between gardening and art intervention groups were not significantly different at p<0.05.

\(^b\)All post-intervention mean pairwise comparisons between gardening and art intervention groups were not significantly different at p<0.05.

\(^c\)Bold font indicates pre- to post-intervention within group means are significantly different at corrected p<0.05.
Table 4-6. Treatment effect size calculations using Cohen’s $d$.

<table>
<thead>
<tr>
<th>Assessment Instrument</th>
<th>Intervention</th>
<th>% Change Pre- to Post- Intervention</th>
<th>Effect Size, Cohen’s $d$</th>
<th>Effect Size, Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>POMS TMD</td>
<td>Gardening</td>
<td>-66</td>
<td>0.74</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>-67</td>
<td>0.65</td>
<td>Medium</td>
</tr>
<tr>
<td>PSS</td>
<td>Gardening</td>
<td>-37</td>
<td>1.12</td>
<td>Large</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>-37</td>
<td>0.83</td>
<td>Large</td>
</tr>
<tr>
<td>BDI-II</td>
<td>Gardening</td>
<td>-66</td>
<td>0.99</td>
<td>Large</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>-43</td>
<td>0.60</td>
<td>Medium</td>
</tr>
<tr>
<td>STAI-State</td>
<td>Gardening</td>
<td>-15</td>
<td>0.55</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>0</td>
<td>0.00</td>
<td>No Effect</td>
</tr>
<tr>
<td>STAI-Trait</td>
<td>Gardening</td>
<td>-10</td>
<td>0.36</td>
<td>Small</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>-1</td>
<td>0.05</td>
<td>Very Small</td>
</tr>
<tr>
<td>SF-36 Mental</td>
<td>Gardening</td>
<td>7</td>
<td>0.35</td>
<td>Small</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>4</td>
<td>0.18</td>
<td>Very Small</td>
</tr>
<tr>
<td>SF-36 Physical</td>
<td>Gardening</td>
<td>2</td>
<td>0.17</td>
<td>Very Small</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>0</td>
<td>0.11</td>
<td>Very Small</td>
</tr>
<tr>
<td>SPDSA</td>
<td>Gardening</td>
<td>9</td>
<td>0.36</td>
<td>Small</td>
</tr>
<tr>
<td></td>
<td>Art</td>
<td>9</td>
<td>0.28</td>
<td>Small</td>
</tr>
</tbody>
</table>
Table 4-7. Means and standard deviations of the starting and ending heart rates for the gardening and art groups per session, including the pre-intervention baseline and post-intervention follow-up measurements.

<table>
<thead>
<tr>
<th>Session</th>
<th>Gardening</th>
<th></th>
<th>Gardening</th>
<th></th>
<th>Art</th>
<th></th>
<th>Art</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Start</td>
<td>Mean ± SD</td>
<td>End</td>
<td>Mean ± SD</td>
<td>Start</td>
<td>Mean ± SD</td>
<td>End</td>
</tr>
<tr>
<td>Pre</td>
<td>73 ± 9</td>
<td>71 ± 9</td>
<td>73 ± 10</td>
<td>70 ± 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>75 ± 12</td>
<td>76 ± 14</td>
<td>75 ± 10</td>
<td>74 ± 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>76 ± 13</td>
<td>75 ± 12</td>
<td>71 ± 12</td>
<td>74 ± 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>78 ± 13</td>
<td>78 ± 10</td>
<td>74 ± 12</td>
<td>71 ± 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>78 ± 10</td>
<td>76 ± 11</td>
<td>72 ± 13</td>
<td>72 ± 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>74 ± 11</td>
<td>76 ± 10</td>
<td>76 ± 16</td>
<td>73 ± 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>73 ± 8</td>
<td>77 ± 11</td>
<td>77 ± 14</td>
<td>73 ± 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>81 ± 10</td>
<td>78 ± 12</td>
<td>80 ± 12</td>
<td>77 ± 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>76 ± 10</td>
<td>75 ± 10</td>
<td>75 ± 12</td>
<td>72 ± 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>76 ± 10</td>
<td>74 ± 9</td>
<td>76 ± 13</td>
<td>75 ± 11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: All means are based on triplicate measurements.
Table 4-8. Means and standard deviations of the starting and ending systolic and diastolic blood pressures for the gardening and art groups for each session, including the pre-intervention baseline and post-intervention follow-up measurements.

<table>
<thead>
<tr>
<th>Session</th>
<th>Gardening</th>
<th></th>
<th>Art</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Start Mean ± SD</td>
<td>End Mean ± SD</td>
<td>Start Mean ± SD</td>
<td>End Mean ± SD</td>
</tr>
<tr>
<td>Pre</td>
<td>111 ± 13</td>
<td>113 ± 15</td>
<td>114 ± 14</td>
<td>119 ± 15</td>
</tr>
<tr>
<td></td>
<td>69 ± 8</td>
<td>70 ± 9</td>
<td>71 ± 10</td>
<td>73 ± 11</td>
</tr>
<tr>
<td>1</td>
<td>108 ± 12</td>
<td>108 ± 13</td>
<td>118 ± 14</td>
<td>121 ± 19</td>
</tr>
<tr>
<td></td>
<td>68 ± 10</td>
<td>69 ± 10</td>
<td>72 ± 11</td>
<td>75 ± 11</td>
</tr>
<tr>
<td>2</td>
<td>108 ± 9</td>
<td>106 ± 10</td>
<td>113 ± 12</td>
<td>117 ± 14</td>
</tr>
<tr>
<td></td>
<td>66 ± 7</td>
<td>65 ± 7</td>
<td>71 ± 10</td>
<td>75 ± 14</td>
</tr>
<tr>
<td>3</td>
<td>110 ± 9</td>
<td>108 ± 9</td>
<td>121 ± 19</td>
<td>125 ± 17</td>
</tr>
<tr>
<td></td>
<td>69 ± 6</td>
<td>66 ± 6</td>
<td>73 ± 13</td>
<td>77 ± 13</td>
</tr>
<tr>
<td>4</td>
<td>111 ± 12</td>
<td>108 ± 11</td>
<td>118 ± 16</td>
<td>117 ± 18</td>
</tr>
<tr>
<td></td>
<td>69 ± 8</td>
<td>67 ± 7</td>
<td>71 ± 10</td>
<td>71 ± 11</td>
</tr>
<tr>
<td>5</td>
<td>113 ± 11</td>
<td>114 ± 13</td>
<td>122 ± 17</td>
<td>123 ± 16</td>
</tr>
<tr>
<td></td>
<td>70 ± 6</td>
<td>71 ± 8</td>
<td>74 ± 11</td>
<td>76 ± 11</td>
</tr>
<tr>
<td>6</td>
<td>114 ± 9</td>
<td>112 ± 12</td>
<td>122 ± 17</td>
<td>115 ± 17</td>
</tr>
<tr>
<td></td>
<td>70 ± 6</td>
<td>68 ± 7</td>
<td>71 ± 14</td>
<td>70 ± 13</td>
</tr>
<tr>
<td>7</td>
<td>111 ± 10</td>
<td>109 ± 12</td>
<td>117 ± 16</td>
<td>119 ± 15</td>
</tr>
<tr>
<td></td>
<td>69 ± 7</td>
<td>69 ± 8</td>
<td>71 ± 10</td>
<td>73 ± 11</td>
</tr>
<tr>
<td>8</td>
<td>110 ± 11</td>
<td>112 ± 14</td>
<td>119 ± 17</td>
<td>121 ± 16</td>
</tr>
<tr>
<td></td>
<td>69 ± 9</td>
<td>70 ± 10</td>
<td>73 ± 13</td>
<td>75 ± 13</td>
</tr>
<tr>
<td>Post</td>
<td>110 ± 14</td>
<td>111 ± 13</td>
<td>118 ± 13</td>
<td>112 ± 13</td>
</tr>
<tr>
<td></td>
<td>68 ± 11</td>
<td>67 ± 10</td>
<td>72 ± 10</td>
<td>70 ± 11</td>
</tr>
</tbody>
</table>

Note: Systolic blood pressure values appear above diastolic blood pressure values in each row of data. All means are based on triplicate measurements.
Figure 4-1. Bonferroni corrected pairwise comparisons of POMS 2 TMD pre-intervention, mid-intervention, and post-intervention scores for gardening and art interventions. Repeated measures ANOVA framework decomposed with n=14 for both gardening and art intervention groups. Displayed above brackets are p-values for pair-wise comparisons. No statistically significant separations were observed between gardening and art groups at any time point. Error bars indicate standard error.
Figure 4-2. Bonferroni corrected pairwise comparisons of PSS pre-intervention, mid-intervention, and post-intervention scores for gardening and art interventions. Repeated measures ANOVA framework decomposed with n=14 for both gardening and art intervention groups. Displayed above brackets are p-values for pair-wise comparisons. No statistically significant separations were observed between gardening and art groups at any time point. Error bars indicate standard error.
Figure 4-3. Bonferroni corrected pairwise comparisons of BDI-II pre-intervention, mid-intervention, and post-intervention scores for gardening and art interventions. Repeated measures ANOVA framework decomposed with n=14 for both gardening and art intervention groups. Displayed above brackets are p-values for pair-wise comparisons. No statistically significant separations were observed between gardening and art groups at any time point. Error bars indicate standard error.
Figure 4-4. Time course or dosage responses for the POMS 2 Total Mood Disturbance logarithmic regression trends with respect to gardening or art intervention. Sample size varies between sessions and between groups due to missing data. Error bars represent standard error.
Figure 4-5. Time course or dosage responses for the PSS logarithmic regression trends with respect to gardening or art intervention groups. Sample size varies between sessions and between groups due to missing data. Error bars represent standard error.

<table>
<thead>
<tr>
<th>Intervention Session</th>
<th>Gardening</th>
<th>Art</th>
<th>Log. (Gardening)</th>
<th>Log. (Art)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>16</td>
<td>12</td>
<td>-2.864ln(x) + 15.321</td>
<td>-2.758ln(x) + 14.511</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>6</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gardening: $y = -2.864\ln(x) + 15.321$
$R^2 = 0.7799$

Art: $y = -2.758\ln(x) + 14.511$
$R^2 = 0.874$
Figure 4-6. Time course or dosage responses for the BDI-II logarithmic regression trends with respect to gardening or art intervention groups. Sample size varies between sessions and between groups due to missing data. Error bars represent standard error.
CHAPTER 5
DISCUSSION

As a person becomes physically, mentally, and socially healthier it becomes more difficult to incrementally achieve greater improvements in health status. Such improvements, especially in the mental and social domains of health, are also challenging to quantify and often exist on a continuum of health status where although a person may not be classified as having a disorder or disease that person may feel the negative impacts of their health status and perhaps exhibit maladaptive symptomatology. These two facets of health promotion provide distinct challenges for clinical trials to show improvements in the three domains of health for a healthy population that can be defined as meaningful and significantly influencing quality of life; therefore, such trials are both rare and ambitious. In spite of these barriers, the present study provides compelling empirical support for both gardening and art as promoters of significant and meaningful improvements in mental health for a healthy population of women between the ages of 26 and 49 years. Indeed, a large proportion of the U.S. population, nearly one out of every two Americans according to a 2016 annual estimate by Nielson Scarborough marketing research, engage in some form of gardening. Of those who identify as gardeners, many anecdotal accounts proclaim the therapeutic nature of gardening. While gardening is a popular leisure time activity, art-making is similarly popular with roughly 50% of the adults in the U.S. engaging in some form of art-making or art-sharing, according to the 2012 Survey of Public Participation in the Arts conducted by the National Endowment for the Arts.

Two very important aspects of any human subject experimental study are the demographic profiles of study subjects and the control and treatment group assignment
methodology. The two scientific concepts are relevant when addressing study subject demographic profiles and group assignment in this experiment: internal and external validity. Internal validity refers to the extent to which the experimental design and methods reduce extraneous or confounding variables from influencing the experimental conditions and treatment outcomes. External validity refers to the extent to which the experiment is generalizable to a larger population and to a broader setting outside of experimental controls. In an ideal experiment, internal and external validity are balanced. In human subject experimentation, internal validity can be accounted for by random assignment to control and treatment groups, while external validity can be accounted for by representative and random sampling of a population of interest. With a novel approach in controlling variables and potential for bias by instituting the active, concurrent complex control condition in the form of an art intervention which was carefully matched to the treatment condition with respect to physical, cognitive and social aspects (detailed in the materials and methods section), the present results provide quantitative evidence on the effects of engaging in gardening and the unique therapeutic contributions related to cultivating plants. Importantly, random assignment to control and treatment conditions was performed to provide equivalent groups at the outset of the two experimental conditions. Although random sampling was not conducted in the previous pilot study, recruitment of a well-defined and select group of healthy women was paramount and executed based on a set of eligibility criteria.

Understanding constraints imposed by a small sample-sized pilot study, a central objective in the present experimental design was to control for or limit as many variables as possible, and this included limiting the study population to a single sex of healthy
individuals, in this case, premenopausal women between the ages of 26 and 49 years. The justification for selecting a study composed of healthy women was not limited only to reducing biological variance, but also to knowing that women are generally more strongly responsive to interactions with plants than men on average (Relf et al., 1992). Given the current screening process the population of 40 women was relatively homogeneous. Furthermore, inspection of psychometric scores at baseline indicated that the study population fell within the normative range for a non-clinical, healthy population. Recruiting a population with reduced variability enhanced the chances for detection of statistically meaningful differences resulting from the treatment interventions. Moreover, study subjects assigned to the gardening and art groups started with an equivalent and healthy demographic profile with respect to sex, age, physical, mental and socio-economic status, which permitted valid comparisons between the art and gardening groups with treatment intervention as the main between-groups factor.

Clinically meaningful change refers to the extent to which changes in scores on the self-report psychometric assessment instruments resulted in potential changes in a psychological condition. Clinically meaningful change depends on the psychometric properties of the instrument, and its sensitivity and specificity to detect change over time. For a change in score to be clinically meaningful in empirical work, the change must first be statistically significant, meaning that change in the score can be attributed to reliable differences in the scores rather than measurement error or random fluctuations in the psychological condition. Another element of clinically significant changes is when the change in score results in a shift in the diagnostic category from a
more severe psychological diagnostic category towards a more normal range in the score. These shifts in score should also be inspected within the context of demographic characteristics of the study sample. For some instruments, gender and age effects have been shown to influence scores, so appropriate adjustments must be made. For the interpretation of BDI-II scores, cut score guidelines have been set as follows to detect levels of depression severity: 0-13 minimal; 14-19 mild; 20-28 moderate; and 29-63 severe (Beck et al., 1996). These cut scores are designed to reflect the severity of a psychological condition based on expert psychological diagnosis using standardized metrics. Because the sample population in the present study was in the normative range for non-clinical subjects, without a psychological or medical diagnosis, the changes in the group scores based on repeated measures ANOVA (RM-ANOVA) comparisons reflect changes that are due to non-random fluctuations that can be attributed to the influence of the administered interventions. Additionally, with a narrow variability range in the present, healthy sample population, it would be expected that statistically significant improvements between pre- to post-intervention scores would be inherently more difficult to achieve and thus reflect the effectiveness of both gardening and art interventions. It is suggested that changes in the scores for the self-report psychometric assessment pre- to post-intervention represent a sensitive, objective measure of treatment-derived incremental improvement in psychological health status of already healthy women that may not be revealed by any other metric.

**Psychometrics**

The first hypothesis-driven objective was to determine the difference in therapeutic outcomes between the group-based gardening and art interventions as revealed by a battery of self-report psychometric instruments. The hypothesis was non-
directional, stating there would be a difference in mental and general health status between the gardening and art groups following the respective interventions, but this difference was not defined as positive or negative with respect to group assignment. When comparing pre-intervention scores to post-intervention scores between the gardening and art groups, no statistically significant time by group interactions were observed between the groups for any of the six psychometric assessments and their subscales (see p-values for F statistics based on RM-ANOVA results in Table 4-3). However, there was almost universal improvement of mean scores (15 out of 16) in the gardening and art group scores across the six self-report assessments. These results did not allow investigators to reject the null hypothesis in this case, indicating there were no statistically significant group differences in mental or general health status between the two experimental conditions pre- to post-intervention. While no group difference appears to be evident, this may be explained by both groups showing improvement in a comparable way in psychological status with respect to mood shifts, stress levels, and depression symptoms. Additionally, while both groups revealed statistically significant improvements in scores for the POMS 2 TMD, PSS, and BDI-II, only the gardening group displayed statistically significant improvements with respect to STAI Trait Anxiety scores from pre- to post-intervention. Neither the gardening nor art intervention resulted in significant changes in scores related to state anxiety, general physical health, or general mental health as indicated by the lack of statistical separations between pre- and post-intervention measurements of the STAI-State, SF-36 Physical Health Component, and SF-36 Mental Health Component, respectively. Although rejection of the null hypothesis was not possible due to lack of statistical separation between overall
group mean scores at post-intervention assessment, the results did demonstrate different trends in the psychometric assessment outcomes relative to group assignment to either the gardening or art group.

Other studies conducting plant-based or art-based programs have used the same psychometric assessment instruments to report similar improvements in the therapeutic outcomes found in the present study. Perhaps the study that is most similar to the present design and methodological approach is an unpublished study from Penman and colleagues (2015). The study by Penman and associates was conducted at the same facilities and with similar gardening sessions as the present study. The results from this earlier pilot study indicated that the POMS 2 TMD, PSS, BDI-II, STAI and SF-36 score changes pre- to post intervention were similar and of comparable magnitude (Penman, 2015) as the score changes in the present study. Additionally, the earlier pilot study provided evidence to support distinct differences between the gardening treatment and a non-active, concurrent control condition as the no treatment control. In the present study, POMS 2 TMD scores dropped 66% after the gardening intervention and 67% following the art intervention. Wichrowski and colleagues (2005) found similar results after just one gardening session with a post-operative cardiac patient population, reporting a near 92% reduction in POMS TMD. Similarly, based on meta-analysis of ten studies related to exercise in nature, Barton and Pretty (2010) reported moderate treatment effects ($d=0.54$) related to improvements in POMS TMD which is similar in magnitude to those for the POMS TMD in the present study ($d=0.74$). In studies related to interactions with plants, researchers also reported improvements in the various subscales of the POMS (Wichrowski et al., 2005; Lee et al., 2011; Park et
al., 2010), which bolster our findings of improvements on the anger, confusion, fatigue, and tension subscales for the POMS 2. Other studies have reported consistent improvements in mood-related factors based on POMS scores after an art program for breast cancer survivors (Puig et al., 2006), a general population (Kimport and Robbins, 2012), and for outpatients with a substance abuse disorder (Laurer and van der Vennet, 2015). These earlier art studies support the findings in the present study. In the present study PSS scores decreased by 37% in both the gardening and art intervention groups. These PSS results are supported by findings from two gardening intervention studies that found improvements in PSS scores to a lesser degree with an 18% reduction in PSS scores for a stressed population (Willert et al., 2014) and an 8% reduction in PSS scores for a depressed sample (Gonzalez et al., 2011). In the present study, BDI-II scores dropped 66% after the gardening intervention and 43% after the art intervention. Additional confirmatory results from Gonzalez and colleagues (2011) indicate that after just four weeks of gardening, BDI scores were significantly reduced by nearly 17% for a pooled sample of 46 clinically depressed individuals. The BDI score improvements of the present study with a healthy sample population appear to be of substantially greater magnitude than the improvements in BDI scores in the depressed population. Also, supporting the BDI findings in the present study, Sahlin and colleagues (2015) found that a 16-week intervention of gardening, nature walks, and painting decreased BDI-II scores by nearly 33%. Conversely, studies involving art interventions have shown mixed results for BDI-II score changes. One study found scores did not change following a few days of art sessions for individuals with PTSD (Henderson et al., 2007), while another study found a nearly eight-point statistically
significant reduction in BDI score \((d=0.15)\) following an eight-week art intervention with inmates (Gussak, 2006). In the present study, STAI State scores dropped by 15% after the gardening intervention, but no change with the art intervention, while STAI-Trait scores decreased by 10% after the gardening intervention and 1% following the art intervention. Similar reductions in state anxiety were found in two studies instituting a gardening program with a 5% reduction in STAI-State scores \((d=0.21)\) after 30 minutes of gardening (Weng and Chiang, 2014) and a 12% reduction in STAI-State scores after twelve weeks of gardening (Lee et al., 2004). Neither study reported statistically significant changes pre- to post-intervention. Additionally, Lee and colleagues (2004) found a 10% reduction in STAI-Trait scores after a gardening program; however, these results were not found to be statistically significant. In the art literature, several studies used the STAI; however, some reported statistically significant improvements after an art intervention (Laurer and van der Vennet, 2015; Kimport and Robbins, 2012), while others reported no statistically significant changes after an art intervention (Henderson et al., 2007; Mische Lawson et al., 2012; 2016). In the present study, SF-36 Mental Health and Physical Health Component scores improved by 7% and 2%, respectively, following the gardening and 4% and 0%, respectively, after the art intervention. No studies were found that implemented a gardening or art intervention and measured health outcomes with the SF-36; however, results from Monti and colleagues (2006) indicated no changes for the SF-36 Physical Health Component and statistically significant improvements in SF-36 Mental Health Component after an 8-week art and yoga intervention.
The Bonferroni correction was used for multiple mean comparisons for a more conservative comparison between the pre-, mid-, and post-intervention means in the RM-ANOVA. Analyzing the RM-ANOVA results for the POMS 2, PSS, and BDI-II from assessments at pre-intervention to mid-intervention and mid-intervention to post-intervention revealed some distinct trends detailing the improvements for the gardening group and less so for the art group. Specifically, the improvements in mood status, perceived stress, and depression symptomatology appeared to be accumulated over the second half of the intervention for the gardening group (see Figure 4-1; Figure 4-2; and Figure 4-3). These improvements in self-reported mood, stress and depression status in the second half of the intervention, suggest that the therapeutic outcomes may have resulted from some component of the final two weeks of the intervention. Perhaps there is a certain number of doses of gardening that are required before the psychological benefits become evident. The mood- and depression-related improvements for the art group were more gradual over the course of the intervention, and steep improvements were not observed in the first or second half of the intervention. In contrast, the stress-related improvements in the art group appear to have accrued in the first half of the intervention with sharp decreases in PSS scores from pre-intervention to mid-intervention assessment and no changes in mean score from mid-intervention to post-intervention.

One possible explanation for these dosage effect trends is that group dynamics i.e. group cohesion and social support grow stronger over time, and as study subjects become more comfortable with each other, they begin to accrue greater improvements related to the psychological assessments. The growing familiarity and comfort with co-
participants is reflected in the anecdotal comments and accounts for the sessions.

There is research which shows that increased group cohesion can influence psychological factors. Group cohesion may be influenced not only by the activities that are experienced, but also by the session leader, as the art intervention was led by two artists and the gardening intervention was led by a third individual, a horticulturalist. The extent to which group cohesion influenced the results of this study was not measured. Therefore, a definitive statement above group cohesion cannot be made.

Interestingly, this explanation was not supported by the lack of changes in the Friendliness subscale of the POMS 2 (see Table 4-5), and the lack of meaningful change in Satisfaction with Participation in Discretionary Social Activities (see Table 4-2). Therefore, perhaps another factor mediated the gardening group’s improvements in the last two weeks of the intervention. Another explanation for the changes could be the level of comfort or self-efficacy with the horticultural activities, materials, and methods enjoyed by the gardening cohort. Because there were four themes in the gardening program, namely, seeding, cutting propagation, transplanting and simulated harvest, perhaps the level of mastery with the activity themes and associated autonomy may have explain the steeper improvements in the psychological profile. It is also possible that specific activities in the last four gardening sessions were preferred over the four activities in the beginning of the gardening intervention. There is also the possibility that seeing the plants grow and develop over time, and having the opportunity to harvest from the crops allowed for the development of a special emotional attachment to the plants thus resulting in additional psychological benefits.
The second hypothesis-driven objective was to determine if the gardening and art intervention would positively influence perceptions of satisfaction with discretionary social activities. The Satisfaction with Participation in Discretionary Social Activities (SPDSA) PROMIS instrument was implemented to provide evidence in support of this objective; however, no statistically significant mean separations were found pre- to post-intervention within either intervention. However, there were changes in group mean scores for both treatment groups pre- to post-intervention in the direction of greater satisfaction, and the RM-ANOVA revealed there was a by Time interaction overall. This instrument is a relatively newly developed measure of social function; therefore, relatively few investigators have implemented this tool in intervention studies for comparison of results. Additionally, this instrument may need further testing and calibration in clinical validation studies to further develop its psychometric properties (Cella et al., 2010). With the present SPDSA results, it is possible that social satisfaction with discretionary activities may or may not mediate or contribute to the intervention therapeutic outcomes. In addition to this measure of the social dimension of the intervention, study staff recorded post-session notes of both non-verbal interactions during the sessions as well as unsolicited comments from the study subjects (see Table 5-1). In support of the SPDSA results, anecdotal accounts from each session suggested a progression toward a more social and supportive group environment in the gardening group, while fewer cooperative interactions were observed during the art intervention sessions.

Managing healthcare costs is of paramount importance in today’s society, both nationally and internationally. A unique aspect of the SF-36 instrument is its model for
calculating predicted medical expenditures for the four weeks following the assessment. This predictive model is based on the scales embedded within the SF-36 and demographic factors such as sex and age; however the exact formula is not reported in the SF-36v2 3rd Edition Manual. Several studies have used the SF-36 to predict medical expenditure and burden of disease costs (Maruish, 2011). In the present study, the predicted four-week medical expenditure for the gardening intervention decreased with statistical separations (p=0.034) from pre-intervention predicted expenditures (Mean=$143.81; SE=10.68) to post-intervention predicted expenditures (Mean=$131.18; SE=7.99). While the art intervention did not yield statistically significant changes in predicted medical expenditure (p=0.266), the intervention resulted in an estimated decrease from pre-intervention predicted medical expenditures (M=$128.25; SE=10.34) to post-intervention medical expenditures (M=$122.02; SE=7.74). These estimates may suggest potentially important health-related economic benefits from engaging in regular group-based gardening or art leisure activities in an era of perpetually rising healthcare costs.

**Blood Pressure and Heart Rate**

The third and final hypothesis-driven objective of this study was to determine whether systolic and diastolic blood pressure, and heart rate improved during each gardening and art treatment session and following the overall completed interventions. Based on the results of the linear mixed models, the gardening group had greater reductions in diastolic blood pressure than the art group, while group differences were not found for systolic BP or heart rate. More specifically, although positive trends in BP and HR were observed in the gardening group, no improvements were found to be statistically significant at p<0.05 in the gardening group. These blood pressure findings
are contrary to other people-plant studies which found nature interactions or even viewing nature improved BP and HR (Pretty, 2005; Park et al., 2010; Park and Mattson, 2008). While statistically significant increases in diastolic BP and decreases in HR were found in the present study for the art group, these findings are not supported by another study which found no changes in HR or BP following an art intervention (Mische Lawson et al., 2016). However, these blood pressure results are supported by parallel decreases in perceived stress, since blood pressure has been shown to be a physiological indicator of stress and a predictor of psychological stress (Tennant, 1996).

**Limitations**

This study had certain limitations which may have influenced the measured outcomes. The sample population was likely not a random, representative selection of women in Gainesville or the Florida community; thus, the results cannot be generalized to a broader population in the city, State, or the U.S as a whole. Furthermore, women who volunteered to participate in this study may have been a select group who had more time, a greater willingness, or more interest in gardening or arts to participate in the research than the average women living in Gainesville. Additionally, the sample did not include men which also limits the generalizability of the reported results. The sample population was also quite small, which may have limited our potential to detect group difference between the two interventions and between within group pre-intervention and post-intervention scores. Although many variables were controlled throughout this experiment, the session leaders for the two interventions were different by necessity between the gardening and art sessions, which may have potentially influenced therapeutic outcomes of the interventions, respectively. It was also unknown what the study subjects experienced outside the context of the twice weekly intervention
sessions. Therefore, competing uncontrolled factors may have influenced physical, psychological, or social factors of the health-related outcomes. Furthermore, this study did not measure the relative cognitive or physical components of the sessions; therefore, differences related to learning or physical activity during the sessions may have influenced these results. Lastly, the present study had no inactive control group to compare with the results of the active intervention groups; therefore, only relative effects can be estimated from these results rather than absolute effects. More specifically, this study did not have a control group that had no treatment of any kind, such as a wait-list control or a usual care control that went on with daily routines.

**Future Work**

The important quantitative findings of this study unequivocally warrant the continued study of both gardening and art interventions as genuine therapeutic modalities to promote good health and well-being of women that are already quite healthy. Other studies seeking to conduct experiments with a gardening intervention may consider using multiple levels of control groups, incorporating experimental conditions of a concurrent, inactive control group i.e. subjects go about daily routines or wait-listed and active control groups i.e. allied therapeutic modalities. Another consideration involves the relative therapeutic effects of passively being in an environment with plants and nature such as walking in a garden. Future studies may test levels of engagement with nature by comparing, observing, and being in a natural area with gardening and horticultural tasks which involve different levels of attention and effort, accounting for the relative quantity (dosage) and quality (diversity of experience) of each intervention. This study implemented group sessions; however, to determine the effects of the group on therapeutic outcomes, one-on-one sessions or a group
cohesion metric could be incorporated to compare differences between group gardening and gardening alone.

**Conclusions**

Engaging in gardening and art resulted in apparent therapeutic benefits for healthy women. No group differences were found between the gardening and art interventions; however, both interventions were found to improve various elements of the psychological profile after only four weeks of twice weekly, one-hour sessions. In contrast, blood pressure and heart rate were found to be quite variable in the present study; therefore, a larger sample size may be necessary to detect clear treatment differences from pre- to post-intervention. Healthy women should consider gardening or art as a leisure activity that may further strengthen their good health status and improve overall quality of life.
Table 5-1. List of unsolicited study subject comments during the associated session numbers.

<table>
<thead>
<tr>
<th>Session Number</th>
<th>Art Group</th>
<th>Gardening Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>Introduced themselves, but not much commentary.</td>
<td>Introduced themselves, but not much commentary.</td>
</tr>
<tr>
<td>1</td>
<td>Minimal commentary.</td>
<td>“I’ve been doing [seeding] wrong all of these years and listening to you really put this into perspective.”</td>
</tr>
<tr>
<td>2</td>
<td>Minimal commentary.</td>
<td>“The plants smell really good.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I’m so happy that my seeds germinated.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I feel less stressed.”</td>
</tr>
<tr>
<td>3</td>
<td>“I was sad when I came, but now I am happy.”</td>
<td>“This is so magical.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“This feels like art.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This makes me happy.</td>
</tr>
<tr>
<td>4</td>
<td>“This is not my cup of tea.” (referring to session activity)</td>
<td>“I’m having so much fun.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“This would be a great gift.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I’m so excited we’re doing cuttings today.”</td>
</tr>
<tr>
<td>5</td>
<td>“This is so much fun. I can definitely do this at home.”</td>
<td>“I feel more confident in my ability to germinate seeds.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I’m so excited to see how this turns out!”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“These sessions get me outside which motivates me to go to the gym after the sessions.”</td>
</tr>
<tr>
<td>6</td>
<td>Complimented each other’s designs.</td>
<td>“This is a lot of fun!” “I’m really enjoying watching you incorporate ingredients [to the herb pesto].”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I think this is the coolest thing we’ve done.”</td>
</tr>
<tr>
<td>7</td>
<td>“I don’t want this to end; time went by so fast!”</td>
<td>“This is so exciting.” (referring to seeing first roots on rooted cuttings)</td>
</tr>
<tr>
<td></td>
<td>“I want to work on this more.”</td>
<td>“I don’t want this to end.”</td>
</tr>
<tr>
<td></td>
<td>“I’m going to miss this.”</td>
<td>“This feels instinctual.”</td>
</tr>
<tr>
<td></td>
<td>“I’m so excited.”</td>
<td>“I love the ornamental plants they’re so photogenic.”</td>
</tr>
<tr>
<td></td>
<td>“I haven’t done anything like this since I was in college, I love it!”</td>
<td>“This is the first joy I felt all year and it made me realize I need to keep doing this.”</td>
</tr>
</tbody>
</table>
Table 5-1. Continued

<table>
<thead>
<tr>
<th>Session Number</th>
<th>Art Group</th>
<th>Gardening Group</th>
</tr>
</thead>
</table>
| 8              | “This is my time to be away.” | “I love microgreens!”
|                |           | “This radish tastes just like in China, it feels like home.” |
|                |           | “Have some of these, because I cut a lot.” (sharing microgreens between subjects) |
| Post           | Expessed sadness about the sessions ending and wanted to find a similar activity. | The reason I came to the study was to learn something about gardening. I even made a friend! |
|                | Expessed feeling nostalgic. | “Let’s exchange emails to stay in touch.” |
|                |           | “I was bummed about missing the last session.” |
|                |           | “I’m having way too much fun right now.” (touching microgreens) |
|                |           | “I was intimidated before, but now I know a lot!” |
|                |           | “[The plants] are like my children.” |
|                |           | “There are definitely times I came to the sessions stressed, but left great after working with the plants.” |
|                |           | “I loved the sessions; I’m going to garden more.” |
APPENDIX A
STUDY PHONE SCRIPT

PHONE SCRIPT FOR RECRUITING PARTICIPANTS GARDENING & ART STUDY

IRB Study Number:

Italicized words, bolded words or words in parentheses are not read aloud.
Individuals indicating interest by contacting the program and leaving contact information may be called by a member of the research study staff team.

HELLO 1 (if directly answering incoming call)
Hello, this is ____________ at the University of Florida.

Is this call regarding the gardening and art study?
YES (continue to ASK1)
NO (continue to END2)

HELLO 2 (if no one answers phone call-back-leaving a message)
Hello, my name is ____________ from the University of Florida and I am returning a call from (state potential volunteer’s first name). I am sorry I could not reach you, and would like you to call me back at ________ or email me at _____________. I will be in the office, (list available days and times for a phone call). If you do not wish to be contacted again by our study staff, please leave a message indicating that and we will not reach out to you again; otherwise, I look forward to speaking with you soon.

HELLO 3 (if someone answers phone call-back)
Hello, my name is ____________ and I am returning a call from ____________ (state potential volunteer’s first name). Is this ____________ (re-state potential volunteer’s first name)?

YES (continue to INTRO1)
NO (person unavailable at this time continue to INFO)
NO (wrong number/person physically/mentally unable to come to the phone continue to END1)

INFO
Can you please let me know a good time to call ________________ (state potential volunteer’s first name) back?
(Arrange time, confirm phone number and set up call back)

INTRO 1
I am calling from the University of Florida. I am contacting you today because you recently expressed interest in our gardening and art study at the University of Florida.
Continue to REMEMBER
Interviewer note: if participant not available, find out when a good time to call back will be.

REMEMBER
Do you remember calling about this study in order to learn more about it?
YES (continue to INTRO3)
NO (continue to INTRO2)

INTRO2
If you don’t remember, I am happy to tell you about the study. Do you have a moment to discuss this with me?
YES (continue to ASK1)
NO (continue to INFO)

INTRO3
Great! Do you have a moment to discuss the study?
YES (continue to ASK1)
NO (continue to INFO)

ASK1
First, how did you hear about this study? (Record answer) Thank you for your response.

Before we get started let me describe the general requirements. To be in the study:

a) You have to be between the ages of 26 and 49 and premenopausal.
b) You must be in good health and have an average height to weight ratio (BMI less than 32)
c) You cannot be pregnant prior to being enrolled in the study
d) You cannot regularly engage in gardening or making art or crafts
e) You cannot regularly use addictive or recreational drugs or abuse alcohol
f) You must be available Mondays and Wednesdays OR Tuesdays and Thursdays at 5:15pm.

Do you think you meet these eligibility criteria?

NO- Not interested/qualified (continue to END1)
YES- Great! (Proceed to INTRO4)

Are you interested in learning more about the study?

NO- Not interested/qualified (continue to END1)
YES- Great! (Proceed to INTRO4)
Allow me to tell you more about the study. Please know that participation in this study is entirely voluntary. If you are still interested in the study after I finish describing it fully, we will ask you to make an appointment to come in for a screening session. If you are willing and still eligible to participate after this in-person screening, you may be selected for the study and randomly assigned to participate in either gardening or art activities. These free activities are designed for women ages 26-49. There is no cost to participate in this program. The purpose of this program is to see if working with plants or art will have distinct outcomes on the lives of women. If you agree to participate in this study, we will ask you to come to Wilmot Gardens on the University of Florida campus twice each week for about 1 hour sessions for a total of 11 visits over approximately 5 to 6 weeks. Group sessions will take place on Mondays and Wednesdays or Tuesdays and Thursdays at 5:15pm. Each participant will receive a free handbook to guide you through the program and a published book covering selected topic areas specific to the program. Participants will be able to take all products made during the art or gardening sessions home. If you choose to participate, you will receive a gift card to compensate for your travel expenses. Does this sound like a program that you might like to participate in?

YES (continue to MEET)
NO (continue to END1)

END1
We appreciate you calling, and thank you for your time, we will not contact you again for this program. Have a great day, bye.

END2
Okay, then how may I assist you?

[Continue with conversation and direct them however I can; then wish them a good day.]

MEET
Great! I could schedule you for the screening session now if you would like.

[If they are ready to schedule a screening, do so and give them directions to the screening location and directions for parking — tell them we will have a parking pass for them. Also, ask if they would like to receive a reminder call the day before the meeting and ask them to call and leave a message if they are unable to make it to the scheduled meeting for whatever reason. Give them the phone number again.]
(continue to END4)

END4
Thank you so much for your time. I look forward to meeting you soon.
APPENDIX B
INFORMED CONSENT FORM

Study ID:IRE201701647  Date Approved: 9/19/2017  Expiration Date: 8/2/2018

INFORMED CONSENT FORM
to Participate in Research, and

AUTHORIZATION
to Collect, Use, and Disclose Protected Health Information (PHI)

Name of person seeking your consent: __________________________________________

Place of employment & position: ______________________________________________

Please read this form which describes the study in some detail. A member of the research team will describe this study to you and answer all of your questions. Your participation is entirely voluntary. If you choose to participate you can change your mind at any time and withdraw from the study. You will not be penalized in any way or lose any benefits to which you would otherwise be entitled if you choose not to participate in this study or to withdraw. If you have questions about your rights as a research subject, please call the University of Florida Institutional Review Board (IRB) office at (352) 273-9600.

1. Name of Participant ("Study Subject")
   (Please Print)________________________________________________________________

2. What is the Title of this research study?
   "Assessing Human Health Benefits of Gardening"

3. Who do you call if you have questions about this research study?
   Principal Investigator: Dr. Charles Guy at (352) 273-4528
   Study Coordinator: Mr. Raymond Odeh at (352) 273-4525

4. Who is paying for this research study?
   The sponsors of this study are the Environmental Horticulture Department at the University of Florida, and the Horticultural Research Institute.
5. Why is this research study being done?

The purpose of this research study is to determine the effects of engaging in gardening or art activities on the psychosocial and physiological outcomes of healthy women.

You are being invited to be considered for this research study because you meet the initial eligibility requirements, and you have expressed interest in participating in this study.

A description of this research study will be available on http://www.ClinicalTrials.gov, as required by U.S. Law. This website will not include information that can identify you. At most, the website will include a summary of the results. You can search this website at any time.

6. What will be done as part of your normal clinical care (even if you did not participate in this research study)?

This is not a clinical study. No portion of this study will be done as a part of your normal clinical care, and refusing to be in this study will not affect any clinical care that you may be presently receiving.

7. How long will you be in this research study?

This study will include 11 visits over a period of up to 5 weeks. Visit 1, eligibility screening, will last approximately one hour. Visit 2 and 11 will each last about 1.5 hours. Visits 3-10 will last about 1 hour. Total time requirement to complete the study is estimated to be no more than 12-13 hours over five weeks.

8. What will be done only because you are in this research study?

**Screening:** Prior to signing this consent form, a member of the research team will tell you about the study. If you agree to be screened for eligibility for this study you will be asked to sign this **Informed Consent Form** and then complete a screening questionnaire to determine your eligibility for the research study (see In-Person Eligibility Screening Questionnaire Gardening & Art Study). Screening will take place at the time you sign this Informed Consent Form or at a prearranged appointment either on the UF campus, in the private office of the Principal Investigator or study staff member or at a mutually agreed upon suitable alternative location where privacy and confidentiality can be ensured.

If you choose, you may take the consent form with you and discuss your participation with friends or family prior to signing the consent. If you choose to do so, we will contact you within the next 2-3 days to determine your interest and arrange a screening session.

The screening questionnaire will ask you to report about information that could be sensitive in nature. Specifically, the questionnaire will ask you to report on substance
use, general health and prescriptions. You may choose to skip any question that makes you feel uncomfortable.

You will be informed about your eligibility status. If you meet the eligibility requirements for the study, you may be continued in the study and randomly assigned to either an art program or a gardening program. If you do not meet eligibility requirements your collected information will be destroyed.

If you continue to meet eligibility requirements, you will be asked to fill out a 15-question demographic questionnaire (see Participant Demographic Questionnaire) that will help the investigators understand potential factors that may influence the experimental outcomes.

You will also be asked to refrain from engaging in gardening or art activities at home or anywhere else other than in this study’s gardening or art sessions for the duration of your time in the study. You may be discontinued from the study if you engage in gardening or art outside of the study gardening or art sessions.

The screening process described above should require approximately one hour.

During the course of the study, you will be asked to complete several self-report assessment questionnaires designed to measure psychosocial characteristics. The assessment instruments are:

- SF-36;
- Beck Depression Inventory (BDI) 2nd Edition;
- Perceived Stress Scale (PSS);
- Profile of Mood States (POMS);
- State Trait Anxiety Inventory (STAI);
- Satisfaction with Participation in Discretionary Social Activities (SPDSA) PROMIS short form v1.0 instrument

The SF-36, BDI, PSS, POMS, STAI, and SPDSA assessments will be given during visits 2 and 11. In addition, the BDI will also be given at two additional times at visits 6 and 10, and the POMS and PSS will be given at visits 4, 6, 8, and 10.

Anytime you complete a health and psychometric assessment instrument and the study staff sees that your responses indicate depressive or anxiety symptomatology, the study staff will recommend that you seek professional help. In the event your self-report responses on the BDI-II or the STAI instruments suggest potential for self-harm or suicidal behavior, the study staff will immediately arrange for you to be evaluated by a qualified mental health professional, and assist as needed to help you access emergency care at a recognized mental health treatment facility.

During the course of the study, you will also be asked to allow study staff to collect systolic and diastolic blood pressure and heart rate using a wrist cuff blood pressure
monitor. With your approval, blood pressure and heart rate readings will be collected two to three times at the beginning and two to three times at the end of visits 2 through 11.

**Visit 1:** Study staff will present this informed consent, and if you provide your consent, you will be asked to fill out one short eligibility screening questionnaire and one demographic questionnaire (questions include topics of marital status, ethnic background, income, work, and health-related habits). Study staff will review this information for eligibility and contact you with your eligibility status and study assignment.

**Visit 2:** Orientation to the Wilmot Gardens greenhouse facility will occur in this visit. You will arrive at Wilmot Gardens at a prearranged time and date to receive a tour of the greenhouse if you are assigned to the gardening program or the Wilmot Gardens conference center if you have been assigned to the art program. You will meet study staff and be informed of all safety measures and procedures of working in the greenhouse or conference center.

- You will also be asked to fill out a set of six questionnaires at this visit. These six questionnaires, listed above in Question 8, will ask you about your health.

This visit will last no longer than 1.5 hours.

**Visits 3-10:** These visits for the gardening or art sessions will take place over a period of four weeks. You will be asked to attend the sessions every Monday and Wednesday or Tuesday and Thursday for 4 weeks. If you miss more than two of the gardening or art sessions, your participation in the study will be discontinued.

During these sessions, you will learn about basic gardening or art skills through hands-on activities. You will be allowed to take plants or art home throughout the program as they become ready.

**Visit 11:** This visit will serve as a wrap up session. You will also be asked to again complete the same set of questionnaires listed above in Question 8 that you completed during visit 2.

At the conclusion of this session, you will be allowed to take home the plant or art projects you have worked on.

This visit will last no longer than 1.5 hours.

9. **How many people are expected to take part in this research study?**

We anticipate screening and enrolling up to 104 individuals, and having up to 40 individuals (up to 20 in the art group and 20 in the gardening group) complete this study.
10. What are the possible discomforts and risks from taking part in this research study?

Minor discomfort may be associated with the screening evaluation and questions. Sometimes people may feel uncomfortable revealing private information that is necessary to conduct the research. Any information shared by you will be kept confidential.

Researchers will take appropriate steps to protect any information they collect about you; however, there is a slight risk that information about you could be revealed inappropriately or accidentally. Depending on the nature of the information, such a release could upset or embarrass you, or possibly affect your insurability or employability. Questions 17-21 in this form discuss what information about you will be collected, used, protected, and shared with your identity removed.

This study may include risks that are unknown at this time. No obvious risks are known related to participating in the gardening or art activities of this study. The risks of participating in the gardening or art activities of this research study will be no greater than when engaging in light gardening or art activities at your home. During some of the gardening sessions, you may use a pair of small garden hand clippers, isopropyl alcohol to clean the clippers and gardening supplies such as soil mix, rooting powder and slow release fertilizer. During the art activities you will use cutting tools, adhesive gels, and dyes.

Participation in more than one research study or project may further increase the risks to you. If you are already enrolled in another research study, please inform one of the research team members listed in question 3 of this form or the person reviewing this consent with you before enrolling in this or any other research study or project.

If you wish to discuss the information above or any discomforts you may experience, please ask questions now or call one of the research team members listed in question 3 in this form.

11a. What are the potential benefits to you for taking part in this research study?

There may be direct benefits to you for participating in this research study. As part of your participation in this study, you will have an opportunity to learn about either gardening or arts and crafts.

11b. How could others possibly benefit from this study?

The information gained from this study will help us understand the effects of engaging in gardening or art activities on healthy women ages 26-49.

11c. How could the researchers benefit from this study?

In general, presenting research results helps the career of a scientist. Therefore, the Principal Investigator listed in question 3 of this form may benefit if the results of this
study are presented at scientific meetings or in scientific journals. This study will constitute part of the requirements for a Master’s degree thesis.

12. **What other choices do you have if you do not want to be in this study?**

   Participation in this study is entirely voluntary and you can refuse to be in the study.

13a. **Can you withdraw from this study?**

   You are free to withdraw your consent and to stop participating in this study at any time. If you do withdraw your consent, you will not be penalized in any way and you will not lose any benefits to which you are entitled.

   If you decide to withdraw your consent to participate in this study for any reason, please contact one of the research team members listed in question 3 of this form. They will tell you how to stop your participation safely.

   If you have any questions regarding your rights as a research subject, please call the Institutional Review Board (IRB) office at the University of Florida at (352) 273-9600.

13b. **If you withdraw, can information about you still be used and/or collected?**

   Information collected prior to your withdrawal from the study can be used for the purpose of the research study. No additional information will be collected, however.

13c. **Can the Principal Investigator withdraw you from this study?**

   You may be withdrawn from the study without your consent for the following reasons:

   - The research team decides that you are subject to harm by continuing participation.
   - The study is cancelled for administrative reasons.
   - You miss more than two gardening or art sessions.
   - You experience a significant life event that may markedly influence and alter the outcome of the experimental results such as a head injury or personal loss.

14. **If you choose to take part in this research study, will it cost you anything?**

   The Sponsor will pay for all services required as part of your participation in this study as described above in the question “What Will Be Done Only Because You Are In This Research Study”. If you receive a bill for these services, please contact Principal Investigator, Dr. Charles Guy at (352) 273-4528 or study coordinator staff, Mr. Raymond Odeh at (352) 273-4525.

   Any medical services provided to you that are not directly required by this study will be billed to you or your insurance company in the usual manner.
15. Will you be paid for taking part in this study?

You will not be paid for your time in this study, but your travel and parking costs will be reimbursed. You will be allowed to take home plants or art that you have worked with during the gardening or art sessions, and any educational materials given out explaining and providing instructions for the individual gardening or art activities. You will be provided a free gardening or art handbook with information about gardening or art that you can keep.

To offset travel expenses associated with participation in the study, you will be provided with a small monetary benefit in the form of gift cards totaling no more than $60. To offset your travel expenses as you incur them, you will receive a $20 gift card upon completion of the orientation session (visit 2). You will then also receive a $20 gift card during visits 6 and 10.

16. What if you are injured because of the study?

If you are injured as a direct result of your participation in this study, the professional services that you receive from any University of Florida Health Science Center health care provider will be provided without charge. These healthcare providers include physicians, physician assistants, nurse practitioners, dentists or psychologists. Any other expenses, including Shands hospital expenses, will be billed to you or your insurance provider.

You will be responsible for any deductible, co-insurance, or co-payments. Some insurance companies may not cover costs associated with research studies or research-related injuries. Please contact your insurance company for additional information.

The Principal Investigator will determine whether your injury is related to your participation in this study.

No additional compensation is offered. The Principal Investigator and others involved in this study may be University of Florida employees. As employees of the University, they are protected under state law, which limits financial recovery for negligence.

Please contact one of the research team members listed in question 3 of this form if you experience an injury or have questions about any discomforts that you experience while participating in this study.

17. How will your health information be collected, used and shared?

If you agree to participate in this study, Dr. Charles Guy will create, collect, and use private information about you and your health. This information is called protected health information or PHI. In order to do this, the Principal Investigator needs your authorization.

The following section describes what PHI will be collected, used and shared, how it will be collected, used, and shared, who will collect, use or share it, who will have
access to it, how it will be secured, and what your rights are to revoke this authorization.

Your protected health information may be collected, used, and shared with others to determine if you can participate in the study, and then as part of your participation in the study. This information can be gathered from you and from procedures such as blood pressure and heart rate cuffs or from other procedures or tests. This information will be created by receiving study treatments or participating in study procedures, or from your study visits and telephone calls. More specifically, the following information may be collected, used, and shared with others:

- Medical and other history gathered through your self-report to determine eligibility criteria for the study;
- Your contact information including name, email address, phone number and address for scheduling purposes;
- Demographic information about you;

This information will be stored in locked filing cabinets or on computer servers with secure passwords, or in encrypted electronic storage devices.

Some of the information collected could be included in a “limited data set” to be used for other research purposes. If so, the limited data set will only include information that does not directly identify you. For example, the limited data set cannot include your name, address, telephone number, photographs, or other codes that link you to the information in the limited data set. If limited data sets are created and used, agreements between the parties creating and receiving the limited data set are required in order to protect your identity and confidentiality and privacy.

18. For what study-related purposes will your protected health information be collected, used, and shared with others?

Your PHI may be collected, used, and shared with others to make sure you can participate in the research, through your participation in the research, and to evaluate the results of the research study. More specifically, your PHI may be collected, used, and shared with others for the following study-related purpose(s):

- To determine if your participation in the gardening or art program has affected your psychosocial or physiological outcomes.

Once this information is collected, it becomes part of the research record for this study.
19. Who will be allowed to collect, use, and share your protected health information?

Only certain people have the legal right to collect, use and share your research records, and they will protect the privacy and security of these records to the extent the law allows. These people include:

- The study Principal Investigator, Study Coordinator (listed in question 3 of this form) and authorized research staff associated with this project.
- Other professionals at the University of Florida or Shands Hospital that provide study-related research related procedures.
- The University of Florida Institutional Review Board (IRB; an IRB is a group of people who are responsible for looking after the rights and welfare of people taking part in research).

20. Once collected or used, who may your protected health information be shared with?

Your PHI may be shared with:

- The study sponsor(s) (listed in Question 4 of this form).

Otherwise, your research records will not be released without your permission unless required by law or a court order. It is possible that once this information is shared with authorized persons, it could be shared by the persons or agencies who receive it and it would no longer be protected by the federal medical privacy law.

21. If you agree to take part in this research study, how long will your protected health information be used and shared with others?

Your PHI will be collected until the end of the active experimental data collection stage of the study ending in late Fall. Your de-identified PHI information may be used and shared with other researchers in the study as part of the scientific process of analysis of experimental data, and publication of the study results and findings. It is anticipated that the process to final publication could take two years or more.

You are not required to sign this consent and authorization or allow researchers to collect, use and share your PHI. Your refusal to sign will not affect your normal clinical treatment, enrollment, or eligibility for any benefits outside this research study. However, you cannot participate in this research unless you allow the collection, use and sharing of your protected health information by signing this consent and authorization.

You have the right to review and copy your protected health information. However, we can make this available only after the study is finished.
You can revoke your authorization at any time before, during, or after your participation in this study. If you revoke it, no new information will be collected about you. However, information that was already collected may still be used and shared with others if the researchers have relied on it to complete the research. You can revoke your authorization by giving a written request with your signature on it to the Principal Investigator.
SIGNATURES

As an investigator or the investigator’s representative, I have explained to the participant the purpose, the procedures, the possible benefits, and the risks of this research study; the alternative to being in the study; and how the participant’s protected health information will be collected, used, and shared with others:

Signature of Person Obtaining Consent and Authorization  Date

You have been informed about this study’s purpose, procedures, possible benefits, and risks; the alternatives to being in the study; and how your protected health information will be collected, used and shared with others. You have received a copy of this Form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask questions at any time.

You voluntarily agree to participate in this study. You hereby authorize the collection, use and sharing of your protected health information as described in sections 17-21 above. By signing this form, you are not waiving any of your legal rights.

Signature of Person Consenting and Authorizing  Date
APPENDIX C
IN-PERSON ELIGIBILITY SCREENING QUESTIONNAIRE

Participant ID Code [FOR STUDY STAFF USE ONLY]: ____________________________

1. Are you currently between ages 26-49, not pregnant, a nonsmoker, and premenopausal? (If you have had a hysterectomy but are still premenopausal, you are able to select “yes” below)
   Yes      No

2. Have you been diagnosed with any diseases, disorders or disabilities that presently, negatively affect your daily life?
   Yes      No

3. Do you currently participate in any gardening at home or elsewhere? (“Gardening” includes activities such as planting, pruning, propagating, weeding, fertilizing, watering, harvesting, etc.)
   Yes      No

4. How many indoor or outdoor plants do you personally care for? (This includes potted plants, growing vegetables, and specimen plants in the landscape like roses.)

5. Do you have any known allergies to pollen, plants or any plant foods? If yes, please list below.
   Yes      No

6. Do you currently engage in art or crafts activities at home or elsewhere? (“Arts and crafts” includes activities such as painting, drawing, illustration, woodworking, printmaking, making collages, etc.)
   Yes      No
   If yes, please list the types of art activities and frequency of your participation in such activities.

7. How often do you use recreational drugs?
   Never    Rarely    Occasionally    Often    All the time
8. When you drink alcohol, about how many drinks do you consume in an average week?

0     1     2     3     4     5     > 5

9. About how many packs of cigarettes do you presently smoke in an average week?

0     1     2     3     4     5     > 5

10. Please list below all prescription and over the counter medications that you are currently taking.


11. Do you take any over-the-counter medications on a regular basis for chronic pain?
    Yes        No

12. Indicate your current BMI. See BMI chart for reference if needed. _________________________

13. Are you currently involved in a research study or clinical trial with projected therapeutic outcomes?
    Yes        No

14. Have you participated in a gardening study conducted at Wilmot Gardens?
    Yes        No

Thank you for your responses, we will contact you if you are selected for participation in the study.
APPENDIX D
DEMOGRAPHIC INFORMATION FORM

Participant ID Code [FOR STUDY STAFF USE ONLY]: __________________________

Demographic information collected from the Gardening and Art Study participants will only be used for
research purposes to define the study group.

Age: ______________

Race and Ethnicity (May circle more than one)

a. American Indian or Alaska Native
b. Asian
c. Black/African-American
d. Native Hawaiian or other Pacific Islander
e. White/Caucasian
f. Other: ________________________________

Are you of Hispanic, Latino, or Spanish origin? Yes___ No___

What kind of work or occupation do you normally do (indicate if student)? ______________

How many years of school have you COMPLETED? ______________________

High School or GED=12 years
Include technical training
Add 1 year for every 30 college hours completed

What is your marital status? ________________________________

What is your annual family income? ________________________________

How many children do you have living in your home currently? ____________

Do you currently serve as a caregiver for another adult in your home? Yes___ No___
What is your gardening experience level? (Circle one)
   a. None    b. Some    c. Extensive

What is your experience level working with art and crafts? (Circle one)
   a. None    b. Some    c. Extensive

Which of the following best describes the level of activity or exercise you participate in on a regular basis? (Circle one)
   a. None    b. Low intensity    c. Moderate intensity    d. High intensity

During an average week, how many times do you exercise? (0 times-7 times) __________________

General Health:

Please rate your general physical health: (Circle one)
   1  2  3  4  5  6  7  8  9  10
     Poor     Fair     Excellent

Please rate your general mental health: (Circle one)
   1  2  3  4  5  6  7  8  9  10
     Poor     Fair     Excellent

Which of the following days are you available after 5 p.m.? (Circle all that apply)

Mondays  Tuesdays  Wednesdays  Thursdays  or  Mondays & Wednesdays  or  Tuesdays & Thursdays
# APPENDIX E
## POST SESSION STAFF OBSERVATION FORM

### WILMOT GARDENS THERAPEUTIC GREENHOUSE OR CONFERENCE CENTER

**Date:** ______________   **Session Number/Main Theme:** ___________________________________

**Attendance Number:** ______________   **Session Start Time:** _____   **Session End Time:** _____

**Environmental Conditions:**

<table>
<thead>
<tr>
<th>GH ONLY Temperature/Humidity Start: _____</th>
<th>GH ONLY Temperature/Humidity End: _____</th>
</tr>
</thead>
</table>

**General Weather Conditions (circle):** Sunny, Partly Cloudy, Cloudy, Rainy, Stormy, Hot, Mild, Cool, Cold

**Group Dynamics:**

<table>
<thead>
<tr>
<th>Group Observation (circle answer)</th>
<th>General Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall Group interest in Session Activity</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Group Displays of Engagement</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Followed Instructions Well</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Asked Questions</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Dialog Between Leader and Study Subjects</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Interacted with Other Study Subjects</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Cooperatvity with Others</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Shared Experiences and Ideas</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Overall Level of Enjoyment</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Expressed Having Fun</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Expressed Not Having Fun</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Group Remained on Task</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Group Completed Exercise on Time</strong> (Low) 1 2 3 4 5 (High)</td>
<td></td>
</tr>
<tr>
<td><strong>Other Observations:</strong> List</td>
<td></td>
</tr>
</tbody>
</table>

**Name of Person(s) Completing the Form:** ____________________________

---

142
Gardening and Art Study
Gardening Session Manual

Wilmot Gardens Greenhouse
University of Florida

Study Coordinator Raymond Odeh, BS
Principal Investigator Charles Guy, PhD
Table of Contents

Table of Contents .................................................................................................................. 7
Welcome to the Study .............................................................................................................. 8
Contact Information ............................................................................................................. 8
Gardening Sessions Information ........................................................................................... 9
Timeline Sequence for Eight Gardening Sessions ................................................................. 9
Gardening Activity Handouts and Instructions ......................................................................... 10
  Gardening Session 1: Propagation by Seed ......................................................................... 10
  Gardening Session 2: Propagation by Cutting ..................................................................... 13
  Gardening Session 3: Transplanting Succulents ................................................................. 17
  Gardening Session 4: Propagation by Cutting & Division ..................................................... 20
  Gardening Session 5: Simulated Harvest of Herbs ............................................................... 25
  Gardening Session 6: Propagation by Seed for Microgreens .............................................. 28
  Gardening Session 7: Transplanting Herbs and Lettuce ...................................................... 31
  Gardening Session 8: Simulated Harvest of Florida Vegetables & Microgreens ............... 34
Appendix of Plant Latin Names Per Session ......................................................................... 36
Glossary of Key Terms .......................................................................................................... 38
Welcome to the Study

First, allow our research team to welcome you to the Gardening and Arts Study. We value your time and participation in this research, and if at any time you have questions or concerns regarding your participation in the study, feel free to contact Study Coordinator Raymond Odeh or Principal Investigator Charles Guy. Our contact information is below.

Now, let us provide you with some guidelines regarding your participation in this study:

- Please refrain from engaging in gardening or art activities including visiting botanical gardens and art museums outside of the study sessions.
- Please refrain from using the Internet to find and access information about gardening or arts activities during the time following the orientation and until after the final wrap-up session.
- Please do not walk through the grounds at Wilmot Gardens outside of study sessions.
- You may use the *Florida Gardener's Handbook* during the study as a resource and reference to find an answer to a question you may have, but avoid doing extensive reading during the time from the orientation and until after the wrap-up session.
- Please do not take any photographs or make any recordings that may reveal the identity of any study subject as this will result in a protocol deviation that must be reported to the IRB.
- Please inform the Study Coordinator, Raymond Odeh or the Principal Investigator, Charles Guy, if you experience any major life event that changes your daily life during the course of the study.
- If you miss more than 2 of the 8 gardening sessions, you may be withdrawn from the study, it is not possible to offer a make-up session under the approved procedures of the study.

This manual is intended to help you navigate each session and provides you with additional resources if you choose to continue engaging in gardening or arts activities after your active participation in the study is completed. Complementing this manual, we have provided you with a reference book, *Florida Gardener's Handbook* to serve as a supplement to the information provided in this manual.

Contact Information

Study Coordinator | Raymond Odeh (352)273-4525 rodeh@ufl.edu

*Mrs. Odeh, graduate student, working on a Master of Science in Horticulture with a degree from the University of Florida specialized in Landscape and Nursery Horticulture can answer questions regarding session details and research protocol.*

Principal Investigator | Charles Guy (352) 273-4528 elguy@ufl.edu

*Dr. Guy, Assistant Chair and Professor of Plant Physiology and Biochemistry in the Department of Environmental Horticulture with research interests in people-plant interactions and the biochemical and molecular responses of plants to unfavorable temperature conditions can answer any questions about this study.*
Gardening Sessions Information

Mondays/Wednesdays or Tuesdays/Thursdays at 5:30 PM to 6:30 PM
The Greenhouse at Wilmot Gardens
Corner of Gale Lemerand Drive and Mowry Road, just North of Archer Road
Please park in available parking in one of the three locations circled below:

Timeline Sequence for Eight Gardening Sessions

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Session Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min</td>
<td>Arrival and Sign-in/Pick up Name Tag</td>
</tr>
<tr>
<td>0-10 min</td>
<td>Individuals Review Previous Activities (i.e. plant growth)/Instructors Greet Individuals and Assemble Group/Heart Rate and Blood Pressure Measurements Recorded</td>
</tr>
<tr>
<td>10-20 min</td>
<td>Educational Module/Introduction to Activity/Demonstration of Activity as Warranted (booklet, instruction sheet, resource material handouts)</td>
</tr>
<tr>
<td>20-50 min</td>
<td>Gardening Activity, Questions</td>
</tr>
<tr>
<td>50-70 min</td>
<td>Clean-up/Heart Rate and Blood Pressure Measurement Recorded/ POMS and PSS Assessments (Even-numbered Sessions)/ BDI (Sessions 4 and 8)/ Departure</td>
</tr>
</tbody>
</table>
Gardening Activity Handouts and Instructions

Gardening Session 1: Activity, Goals, Materials, Supplies and Instructions for Exercise

| Session 1 | PROPAGATION: Planting Seeds of Herbs and Scented Plants e.g. basil, chives, dill, oregano, rosemary, and thyme (seedlings can be used later for Session 7) |

Plant Propagation by Seed

As everyone knows, seeds are an important way that plants reproduce themselves for the next generation. Seeds come in a wide variety of shapes and forms, in different colors and sizes and with different surface textures. Equally variable are the conditions that different types of seeds require to start the process of germination and continue with the growth and development of a seedling. Some seeds can germinate right away when placed in a favorable soil medium with adequate moisture and temperature, while others are blocked from immediate germination by an internal mechanism known as dormancy. The function of seed dormancy is an evolutionary informed strategy to favor germination when environmental conditions are likely to be most optimum for seedling survival and reproductive success.

This exercise will introduce you to the seeds of several herbs and scented plants that can be a starting point to make a home herb garden. You will be able to observe the germination process and the growth and development of the young seedlings, and see some of the variation that exists in the seed biology of different types of plants.

Educational Purpose: This exercise will highlight a group of plants widely used in culinary practices and prized for their sensory stimulating attributes. Instruction will explain the role and significance of seeds in plant propagation, sexual reproduction, and the development of a plant from a seed. Session activities will also highlight variation in plant seed morphology, size, shape and tactile characteristics, sowing methods, and rates of germination for different species. Participants will learn how to sow seeds and what materials are needed to begin growing herbs and scented plants for use at home.

Social Interactions: Participants will interact with session leaders and other participants. In this session, participants will be asked to share their first name with the group. The mechanism for interactions will include questions and comments between and among leaders and participants. Participants can be asked to share their favorite herbs, scented plants, and recipes with the group. Participants can be asked to pass seeds to other participants who would like to plant those varieties. Participants can demonstrate and/or observe planting techniques of other members of the group.

Goals/Benefits: Facilitate participant-plant interactions, increase knowledge; stimulate cognitive abilities and skills; restore directed attention; enhance motor skills (hand-eye coordination); meet new people; experience individual and group interactions; and enjoy activity.
Materials and Supplies:
✓ Soil Mix SunGro an all-purpose growing mix made with Canadian sphagnum peat moss, perlite, vermiculite, dolomitic limestone, and a wetting agent. It is suitable for a wide variety of crops especially for those requiring good drainage and aeration;
✓ 72 Cell Seed Pack Insert, 10” x 20” Seed Flat Tray, Plastic Dome for 10” x 20” Tray;
✓ Seeds Ready for Planting: basil, borage, chives, dill, oregano, rosemary and thyme or other herb plant seeds as may be available;
✓ Plastic Plant, Flower and Nursery Garden Label Marker Sticks 60x100mm;
✓ Black Sharpie Permanent Marker
✓ Tap water for soil mix wetting and hydration

Considerations for Germinating Herb or Scented Plant Seeds:
✓ Buy only fresh quality seed from a reliable source.
✓ Germinating herb seeds requires good light, quality growing medium, proper amount of moisture, the right temperature, good air circulation, and adequate gardening attention and care.
✓ Some herbs are more difficult to start from seeds than others are. For this reason, many types of herbs are not grown from seeds, but from vegetative cuttings. We will learn about making cuttings of herbs and scented plants in Session 2.
✓ Germination container: Almost anything that will hold soil and allow excess water to drain away can be used for germinating herb seeds.

Instructions for Growing Herbs and Scented Plants from Seed:
1. We will use standard garden supply trays and cell-pack inserts for our seeding exercise. (Note: Our containers will be unused, but should you in the future reuse containers, consider removing plant disease organisms by first rinsing the container in a mixture of 10% chlorine bleach and water, let set for at least 10 minutes, followed by rinsing with water to remove the bleach. Allow the containers to dry before using.)
2. Break apart any soil clumps to ensure soil is of fine texture, then fill the cell-pack container to the top with the soil mix. (Note: Do not compact the soil in the container.)
3. Wet down the soil in the container and let it sit for a few minutes to hydrate the soil.
4. While you are waiting, take some label sticks and write down the names of the seeds you are planting. On your label sticks, include the common name of the plant, the date you planted the seed, and your name; this will allow you to track the progress of your seeds.
5. Planting seeds at the proper depth is very important for best germination. The amount of growing medium you place on top of your seeds is partially determined by their size. A good general rule for planting seeds is to cover them with enough soil for 1-3 times their size. (Note: For best results, follow the directions on the seed packet or consult a reliable gardening book for proper planting requirements.)
6. Place 2-3 seeds in each cell and cover with appropriate amount of soil mix.
7. To keep the seeds from drying out, bottom water your seeds by placing the containers in a flat tray of water with about \( \frac{3}{4} \)" of water. Leave containers in the tray of water until the soil at the top is moist.

8. Cover your containers with a clear plastic dome or you can use plastic wrap to create high humidity to help conserve moisture during germination. To avoid too much humidity remove the dome every other day for 30 minutes to evaporate excessive moisture and allow for some fresh air. Remove the plastic dome completely once the seedlings begin growing and have developed a few leaves.

(Note: Horticultural professionals often use mist houses, fog houses or humidity chambers to maintain high relative humidity or moisture around the seeds. We may place your seed trays in the Fifield Hall Plant Science Greenhouse Complex mist house).

9. Herb seeds need as much as 14 to 16 hours of light per day in order to germinate and develop properly.

10. Monitor the germination process during your return for each session in the program.

*We will cover transplanting your seedlings in Session 7.

**Resources:**

Gardening Session 2: Activity, Goals, Materials, Supplies and Instructions for Exercise

**Session 2**

**PROPAGATION:** Cuttings of Herbs and Scented Plants e.g. tarragon, Cuban oregano, lavender, mint, rosemary, scented geraniums, thyme, pineapple, basil, ginger, Artemisia, and sweet potato (rooted plantlets may be used for container plantings in Session 7)

**Plant Propagation by Cuttings**

Unlike people, many plants have the ability to regenerate vital body parts after amputation, because of a phenomenon called pluripotency. Pluripotent cells can form or become any of the cell types that make up the body; embryonic stem cells are considered pluripotent. Plants have stem cells? Plants grow at specific sites known as meristems where cell division can occur and give rise to new cells and new plant parts. Meristems contain the plant version of stem cells that can make cells of the same type or other types of cells. Apical (meaning apex or tip) meristems give rise to primary shoot and root elongation and growth. Lateral meristems are responsible for horizontal growth, for example the branches on the main stem or trunk and lateral roots which would be similar to side branches on the main stem. For many plants, the presence of apical meristems for growth will often suppress the growth of lateral meristems. When the apical meristem is removed, the suppression of lateral meristems can be relieved resulting in growth processes in the lateral meristems.

Wounding can also stimulate the activation and growth of new meristems, a process involving a callus phase (a growing mass of unorganized parenchyma cells,) which can give rise to meristematic cells with the appropriate environmental signals i.e. light, relative humidity and temperature, sometimes referred to as wound periderm. Callus can play an important role in regeneration of a lost body part of a plant. This ability forms the important basis for the common practice of plant propagation using cuttings from an intact plant. A cutting can be a shoot a node, a leaf with a petiole, a leaf without a petiole, a leaflet or part of a leaf.

Activation growth and development of meristems are hormonally controlled within the plant. In our exercise, we will stimulate the growth of meristems that lead to the formation of roots at the base of the cuttings. We will use an artificial plant hormone mixed in a talc power to coat the cut end of the cuttings to promote the growth of new roots. Some plants species do not need supplemental hormones for the meristems to start growing new roots; however, some species will not root from cuttings without the use of plant hormones, such as the commonly used hormone auxin.

In today’s exercise, we will demonstrate making cuttings from a number of herb and scented plants. The cuttings will be used to generate new intact plants, thus turning one plant into several. This is a good way one can increase the numbers of a given plant with desirable traits. For example, cuttings are widely used in commercial horticulture to generate thousands or even tens of millions of identical plants starting from a single plant.

**Educational Purpose:** This exercise will again highlight a group of plants widely used in culinary practices and prized for their sensory stimulating attributes. Instruction will explain and demonstrate how many herbaceous plants can be cloned or asexually propagated implementing cutting propagation with vegetative parts of the plant such as stems, branches or leaves and
division of ramets (a group of genetically identical individuals that have grown in a given location, all originating vegetatively, not sexually, from a single ancestor). Session activities will also highlight how these asexual forms of propagation provide advantages or disadvantages over seed-based, sexual propagation methods. Participants will learn how to make vegetative cuttings and divide ramets to create new individual plants, and what materials are needed to begin growing asexually propagated herbs and scented plants for use at home. Participants will also be prompted to touch and smell the plants and comment on the sensory aspects of the plants.

Social Interactions: Participants will interact with session leaders and other participants as appropriate. The mechanism for interactions will include questions and comments between leaders and participants. Participants can be asked to share their favorite herbs, scented plants, and recipes with the group. Participants can also be asked about some of their favorite scents in either their homes or in the landscape, and compare current preferences to their childhood preferences. Participants can demonstrate and/or observe planting techniques of other members of the group.

Goals/Benefits: Facilitate participant-plant interactions, increase knowledge; stimulate cognitive abilities and skills; enhance motor skills (hand-eye coordination); trigger sensory stimulation; promote social interactions; stimulate memory and reminiscing; and meet new people; experience individual and group interactions; and enjoy activity.

Materials and Supplies:

✓ Soil Mix. SunGro is an all-purpose growing mix made with Canadian sphagnum peat moss, perlite, vermiculite, dolomitic limestone, and a wetting agent. It is suitable for a wide variety of crops especially for those requiring good drainage and aeration;
✓ Stock plants to take cuttings from: Artemisia, lavender, mint, rosemary, scented geraniums, Cuban oregano, and thyme or others as available;
✓ 72-Cell Seed Pack Insert; 10” x 20” Seed Flat Tray; Clear Plastic Covers
✓ Soil mixing tray
✓ Hand-held Clippers with Sharp Cutting Surfaces
✓ Rooting Hormone Powder
✓ Medline Souffle 0.75 Oz Disposable Paper Cups
✓ Plastic Plant, Flower and Nursery Garden Label Marker Sticks 60x100 mm:
✓ Black Sharpie Permanent Marker
✓ Isopropyl Alcohol
✓ Cotton Swabs or Paper Towels
✓ Water

Considerations for Propagating Herbs or Scented Plants from Cuttings:

✓ Use clean stock or parent plant that is disease free.
✓ Herb cuttings require good light, quality growing medium, proper amount of moisture, the right temperature, good air circulation, and good gardening attention and care.
✓ Cuttings should be kept moist and not dry out during the initial stages when forming roots.
Almost anything that will hold soil and allow excess water to drain away can be used for rooting cuttings.

**Instructions for Propagating Herbs and Scented Plants from Cuttings:**

1. We will use standard garden supply trays and cell-pack inserts for our cutting exercise. (Note: Our containers will be unused, but should you in the future reuse containers, consider removing plant disease organisms by first rinsing the container in a mixture of 10% chlorine bleach and water, let set for at least 10 minutes, followed by rinsing with water to remove the bleach. Allow the containers to dry before using.)
2. Gather some soil and place it in a mixing container. Separate any clumps of soil and add water to the soil until moistened but not over saturated. (Note: To avoid over saturation of soil, add just enough water so that soil will form a ball in your hand without falling apart.)
3. Fill the cell-pack container to the top with the soil mix.
4. Now take your clippers in hand, wipe the cutting surfaces with a cotton swab that is saturated with isopropyl alcohol to disinfect the surface. Let air dry until alcohol has evaporated.
5. Identify a good place on the stock plant to take a cutting. Your cutting should be about 3-4 inches long and contain several nodes on the cutting.
6. After taking the cutting, strip the bottom half of the cutting of all of its leaves. Only a few leaves should be left at the top of the plant. If leaves are large, consider cutting all leaves in half; this reduces evapotranspiration and results in greater rooting success.
7. Place the tip of the cutting in water and then in your rooting hormone. Tap off excess hormone powder; only a small amount of rooting hormone is needed. (Note: Whenever working with rooting hormone, place powder into a separate container to prevent contamination of the stock container of rooting hormone)
8. Place one cutting into each cell in the cell-pack tray. Continue this until all the cells are full or you reach the desired amount of cuttings.
9. Take label sticks and write down the names of the plants you are planting. On your label sticks include the common name of the plant, the date you planted the cutting, and your name; this will allow you to track the progress of your cuttings. Insert these into the proper place in the tray.
10. To keep the cuttings from drying out, water the cuttings regularly or place under a misting system to keep the area around the cutting moist; this increases relative humidity.
11. In later sessions, you can check to see if your cuttings are producing roots by gently pulling on the cutting. If it pulls free easily, it has not produced roots. If it resists your pull, it has begun to form roots. Plants will start to form roots in the following weeks.

**Resources:**

Gardening Session 3: Activity, Goals, Materials, Supplies and Instructions for Exercise

| Session 3 | TRANSPANTING: Container Garden Succulent Collection Planting e.g. Aloe spp., Echeveria spp., Jade Plant, Kalanchoe spp., Panda Toes, and Sedum spp. |

**Succulent Plants**

Succulent refers to a broad category of mostly xerophytic plants, including cacti, that have thick fleshy leaves or stems that serve as water storage organs in arid conditions. Succulents are found worldwide, and include a number of familiar plants such as the medicine plant (Aloe barbadensis), the jade plant (Crassula arborescens), Kalanchoes and Sedums (Sedum sp.) that are commonly found in succulent or perennial gardens.

Many succulents are well adapted to living indoors in homes where the relative humidity is often much lower than outside in Florida. They require much less amounts of water and fertilizer than other types of plants. Most commonly grown succulents prefer warm temperatures and are not able to tolerate freezing. Succulents typically need abundant sunlight or light to remain healthy. At home, succulents should be located in bright, sunny spaces often in a window that faces east, south or west. Low natural light can be supplemented by artificial lighting. Cool white fluorescent bulbs or a combination of daylight and natural white fluorescent light can give good results. Position lights about 6-12 inches above the plants, and keep them on for 14-16 hours each day or as necessary.

Succulents are often grouped together in container or dish gardens. This can be an extremely attractive method of display, as long as several precautions are taken. Choose plants that are compatible in rate of growth so that one or two plants do not outgrow the rest. Plants should have similar water requirements. Generally speaking, most cacti need less water than do other succulents. Since shallow dishes seldom have drain holes, it is essential that the plants are not overwatered.

Most succulents and cacti grow in open, well-drained sandy soils. These conditions should be duplicated for your indoor container garden whenever possible. A mix of one part potting soil and one part coarse sand (builders sand) is usually porous enough for the health of succulents. A good test is to moisten the mixture and squeeze it in your hand. On release, the soil should fall apart. Both pot and growing medium should be sterile. Ideally, these plants should be grown in pots with drainage holes, because excess water trapped in the soil will result in rot and decay in a very short time.

**Educational Purpose:** This exercise will highlight a group of plants widely used in ornamental horticulture and valued for their fascinating morphological diversity and vegetative attributes. Instruction will explain and demonstrate how transplanting of young and rooted plants can be used to create an aesthetically pleasing arrangement for display and enjoyment. Key principles that maximize transplant success and some design elements will be presented.

**Social Interactions:** Participants will interact with session leaders and other participants as appropriate. The mechanism for interactions will include questions and comments between
leaders and participants. Participants can be asked to share their favorite succulent plants with the group. Participants can be asked to pick their favorite plant out of the group and give reasons for why they may enjoy it. Participants can be asked to comment on why these plants have a different morphology than other plants, and they will be taught about xerophytic plants.

**Goals/Benefits:** Facilitate participant-plant interactions; increase knowledge; stimulate cognitive abilities and skills; enhance motor skills (hand-eye coordination); promote social interactions; trigger sensory stimulation; become familiar with other group members; experience individual and group interactions; and enjoy activity.

**Materials and Supplies:**

- Succulent Mix (composed of 50% sand): coarse builder’s sand and Soil Mix. SunGro an all-purpose growing mix made with Canadian sphagnum peat moss, perlite, vermiculite, dolomitic limestone, and a wetting agent. Colored sand small rocks can be used for topdressing the medium to add aesthetic and decorative value.
- Large container for transplanting young plants
- Transplants of succulents: aloe, Echeveria, jade plant, Kalanchoe, panda toes, sedum
- Colored coarse sand (optional)
- Small rocks for placing on the top of the soil around the plants
- Plastic Plant, Flower and Nursery Garden Label Marker Sticks 60x100mm:
- Black Sharpie Permanent Marker
- Water

**Considerations for Transplanting Succulents:**

- Containers with good drainage should be used
- Growing media should allow for drainage through the profile of the container
- Succulents planted in the same container should be matched in their water requirements
- Consider the growth habits of each succulent species for a compatible container garden

**Instructions for Transplanting Succulents into a Container Garden:**

1. We will use containers that will be appropriate for holding succulent plants and have good drainage on the bottom of the container. (Note: Some containers have drain holes that have not been removed yet. Ensure that the plastic holes are popped out before use.)
2. Start by taking some of the succulent potting mix and placing it into a soil-mixing container. Add water to the soil until moistened but not over saturated.
3. Place the soil mix into your container.
4. Choose plants for your container and think where you will want to place them in the container. A good guide for designing container gardens is to use the “thrill, fill, spill” method. So perhaps choose plants that will fit these criteria.
5. Make holes in the media where you will plant your succulent transplants. Ensure that the roots have enough room when placed into their holes. Do not crush the root ball into a space where it does not fit. After placing a plant into a transplant hole, gently fill in the soil where there is remaining space.
(Note: Some succulents have leaves and stems that easily break off, so this can be a delicate process. If leaves or stems break off, consider leaving them in the container to root as cuttings.)

6. Repeat for all the plants until you have placed in all the plants that you desire.
7. Make sure that your plants have room to grow in the container. Do not overcrowd the container.
8. Place rocks around the top of the soil in order to add to the aesthetic appeal of the container.
9. You may want to write a label with some of the plants names on it. You will also want to label the container with your name.
10. After a few weeks, the plants will be established in the container and start to fill in all the empty spaces.
11. Make sure that you do not overwater these plants. These plants are desert plants and typically do not need much water or fertilizer. Ensure you let the soil medium dry out between watering, and place containers in a space with plenty of sun.
12. After a while, the plants may need to be transplanted to another container if this one seems to be getting overly crowded.

Resources:

**Gardening Session 4: Activity, Goals, Materials, Supplies and Instructions for Exercise**

| Session 4 | PROPAGATION: Cuttings/Division of Herbaceous Ornamentals (African violet, begonia, coleus cultivars, hosta, hoya, impatiens, pilea, prayer plant, and spider plant) |

**Plant Propagation by Cuttings and Division**

Session 2 demonstrated the value and importance of propagating desirable plants by cuttings. This session will again highlight and reinforce the use of making cuttings in plant propagation, but here the focus will be on ornamentals. For most of the plants in this exercise, we will make cuttings (stems or shoots) very similar to those made in Session 2. However, in this session cuttings using leaves and parts of leaves will also be demonstrated with African violet, begonia, and hoya. This session will also illustrate a second form of propagation that is known as division using the hosta, prayer plant, and spider plant as examples. Some plants have growth habits that allow them to spontaneously multiply and give rise to clonal copies. Frequently new plantlets are spawned at the base of the stem of the parent plant, but in other cases, underground stems known as rhizomes (pilea) or above ground stems known as stolons (spider plant) can give rise to rooted plantlets that have their own roots and shoots while still being connected to the parent plant. When a parent plant produces clonal plantlets, the plantlets can be detached from the parent and transplanted to a new location or container. Generating new plants by division is the most successful form of propagation, because an intact plantlet is ready to begin independent growth without having to form replacement parts. The example of a parent plant producing clonal plants is the well-known spider plant. The spider plant will form many long aerial stolons that will each form a clonal plantlet at the end. Spider plants are often grown in hanging baskets allowing the long stolons to hang down with the clonal plantlets slowly growing at the ends. This is one of many survival strategies that plants use to asexually propagate themselves.

**Educational Purpose:** This exercise will highlight a group of plants widely used in ornamental horticulture and valued for their foliage, floral and vegetative attributes. Instruction will explain and demonstrate how many herbaceous ornamental plants can be cloned or asexually propagated implementing cutting propagation with vegetative parts of the plant such as stems, branches or leaves and division methods. This session will also cover how these forms of propagation provide advantages or disadvantages over seed-based, sexual propagation methods. Participants will make vegetative cuttings, divide plants, and learn the materials necessary to begin growing asexually propagated herbaceous ornamental plants at home.

**Social Interactions:** Participants will interact with session leaders and other participants as appropriate. The mechanism for interactions will include questions and comments between leaders and participants. Participants will be asked to work in small groups to propagate the different types of plants. Participants can be asked to share their favorite ornamental flowers and plants with the group. Participants can also be asked to comment on why certain plants become popular horticultural crops while others do not.
**Goals/Benefits:** Facilitate participant-plant interactions, increase knowledge; stimulate cognitive abilities and skills (recognition, learning and concept formation); enhance motor skills (hand-eye coordination); promote social interactions; improve neuromusculoskeletal elements such as range of motion, muscle tone, strength, and postural control; enjoy activity. Participants will experience common group goals, shared accomplishments, and cooperative interactions.

**Materials and Supplies:**
- Soil Mix. SunGro an all-purpose growing mix made with Canadian sphagnum peat moss, perlite, vermiculite, dolomitic limestone, and a wetting agent. It is suitable for a wide variety of crops especially for those requiring good drainage and aeration;
- 4'' and 6'' and 1 gallon plastic pots (chosen based on size of cutting/division)
- Stock plants: African violet (leaf cutting), begonia (stem, leaf or wedge cutting), coleus (stem cutting), hoya (leaf cutting), hosta, prayer plant, and spider plant (division)
- Clippers
- Knife
- Rooting powder
- Small cups
- Isopropyl alcohol
- Cotton swabs
- Plastic Plant, Flower and Nursery Garden Label Marker Sticks 60x100 mm;
- Black Sharpie Permanent Marker
- Water

**Considerations for Propagation of Herbaceous Ornamentals:**
- Containers with good drainage should be used
- Some leaf and stem cuttings can be taken a few days prior to planting and be placed in water. Some plant species will start to develop roots while in water.
- Some plants can be propagated multiple ways. It can be fun to test out different ways and see which method works best for you.
- Leaf cuttings often take longer to develop roots than a stem cutting, so remember to be patient for this plant to take root and start producing a new plant.
- Wedge cuttings often take the longest to develop roots out of all the rooting methods described here. So remember to be patient for this plant to take root and start producing a new plant.
- Some plants produce new meristems at their base and quickly form a clump. When a clump becomes too large for a pot or if you simply would like to divide and share your plant, you can simply split the clump into separate pieces.

**Instructions for Propagation of Herbaceous Ornamentals:**
1. We will use standard garden pots for our exercise.
   (Note: Our containers will be unused, but should you in the future reuse containers, consider removing plant disease organisms by first rinsing the container in a mixture of 10% chlorine bleach and water, let set for at least 10 minutes, followed by rinsing with water to remove the bleach. Allow the containers to dry before using.)
2. Gather some soil and place it in a mixing container. Separate any clumps of soil and add water to the soil until moistened, but not over saturated. (Note: To avoid over saturation of soil, add just enough water so that soil will form a ball in your hand without falling apart.)
3. Fill the pots you plan on using with the moistened soil.

**Leaf Cutting**

1. Take your clippers and identify a healthy leaf to be cut off for propagation. Gently clip off this leaf at the petiole.
2. Place the tip of the petiole in water and then in your root hormone. Tap off excess hormone powder; only a small amount of rooting hormone is needed. (Note: Whenever working with rooting hormone, place powder into a separate container to prevent contamination of the stock container of rooting hormone)
3. Place the leaf into a pot filled with soil. Make sure that the leaf has been pushed down into the soil and will not fall over when watered.
4. Take label sticks and write down the names of the plants you are planting. On your label sticks include the common name of the plant, the date you planted the cutting, and your name; this will allow you to track the progress of your cuttings. Insert these into the proper place in the pot.
5. To keep the cuttings from drying out, water the cuttings regularly or place under a misting system to keep the area around the cutting moist; this increases relative humidity.
6. In later sessions, you can check to see if your cuttings are producing roots by gently pulling on the cutting. If it pulls free easily, it has not produced roots. If it resists your pull, it has begun to form roots. Plants will start to form roots in the following weeks.

**Stem Cutting**

1. Take your clippers and identify a healthy place on the stock plant to take a stem cutting. Your cutting should contain three or more nodes on the stem. Having 4 to 5 is generally favorable.
2. After taking the cutting, strip the bottom of the cutting of all of its leaves. Only a few leaves should be left at the top of the plant. If the leaves are large, you can trim them to a smaller size using your clippers.
3. Place the tip of the cutting in water and then in your root hormone. Tap off excess hormone powder; only a small amount of rooting hormone is needed. (Note: Whenever working with rooting hormone, place powder into a separate container to prevent contamination of the stock container of rooting hormone)
4. Place the cutting into a pot filled with soil. Make sure that the stem has been pushed down into the soil and will not fall over when watered. (Note: Some cuttings root from the cut end, while others root from the node closest to the cut end; therefore, a good practice is to bury at least one basal node of the cutting)
5. Take label sticks and write down the names of the plants you are planting. On your label sticks include the common name of the plant, the date you planted the cutting, and your name; this will allow you to track the progress of your cuttings. Insert these into the proper place in the pot.
8. To keep the cuttings from drying out, water the cuttings regularly or place under a misting system to keep the area around the cutting moist; this increases relative humidity.

9. In later sessions, you can check to see if your cuttings are producing roots by gently pulling on the cutting. If it pulls free easily, it has not produced roots. If it resists your pull, it has begun to form roots. Plants will start to form roots in the following weeks.

**Wedge Cutting**

1. Take your clippers and remove a large leaf from the stock plant. You will then want to remove a “wedge” from this leaf that has a vein running through it. Roots will start to develop from this vein. There is a diagram at the bottom of this handout to show you what your wedge cutting should look like.

2. Place the bottom of the wedge cutting in water and then in your root hormone. Tap off excess hormone powder; only a small amount of root hormone is needed. (Note: Whenever working with root hormone, place powder into a separate container to prevent contamination of the stock container of root hormone)

3. Push the wedge into the soil so that it is standing upright. You may need to tamp soil around the base of the leaf to ensure that it will be sturdy and not fall over.

4. Take label sticks and write down the names of the plants you are planting. On your label sticks include the common name of the plant, the date you planted the cutting, and your name; this will allow you to track the progress of your cuttings. Insert these into the proper place in the pot.

5. To keep the cuttings from drying out, water the cuttings regularly or place under a misting system to keep the area around the cutting moist; this increases relative humidity.

6. In later sessions, you can check to see if your cuttings are producing roots by gently pulling on the cutting. If it pulls free easily, it has not produced roots. If it resists your pull, it has begun to form roots. Plants will start to form roots in the following weeks.

**Division**

1. Decide how many divisions you would like to make of this plant. This will depend on the size of the plant and how many new plants you would like to have.

2. Start by removing the parent plant from the pot. Identify some gaps between the leaves where pulling apart or cutting apart may be easiest.

3. Gently pull apart a portion of the clump using your hands. If it does not break apart easily, you may need to use a knife or clippers to cut through the material.

4. It is OK to cut through roots and plant parts. Often times the plant will simply regrow new roots to replace those.

5. Place the new clump into a new pot with soil.

6. Take label sticks and write down the names of the plants you are planting. On your label sticks include the common name of the plant, the date you planted the plant, and your name; this will allow you to track the progress of your plant. Insert these into the proper place in the pot.

7. To keep the divided plants from drying out, water them regularly or place under a misting system to keep the area around the plants moist; this increases relative humidity.
8. In later sessions, you can check to see if your divided plants have established in the soil by looking for signs of new leaves or new roots from the bottom of the pot.

http://www.bradsbegoniaworld.com/prop.htm

Resources:

Herbs and Plants Used in Culinary Practice

Plants make an amazing array of chemical compounds, more so than almost any other type of organism. The extra ability of plants to make different chemical compounds beyond what is needed for basic cellular and organism function relates both to the unique biology of plants and the diversity of plants from a wide variety of environments. Unlike animals, plants are not able to move around to find food, to find mates or to escape an enemy or unfavorable environmental condition. One way they can accomplish these needs is through chemical biology. In the simplest form, many plants produce nectar to attract and reward insect pollinators coming to their flowers to spread pollen across long distances to other receptive flowers. Like the pollinators, humans can be attracted to plants because of their uniquely varied chemical constituents that we find pleasant smelling, visually attractive, tasty or in one way or another psychoactive.

Herbs belong to a loose grouping of plants that are grown for their special flavor and aromatic characteristics that can enhance our environment or modify the aroma and flavor of our foods. Botanically speaking, an herb is a seed-bearing plant that does not have a woody stem, and dies after flowering. Herb is from the Latin word *herba* which means grass or green crops. From a culinary perspective, the shoots, leaves, flowers, seeds and roots of many herbs can be used for flavoring. The flavoring is often due to a large array of volatile organic compounds and/or essential oils that the plant tissues contain. Depending on the herb and the intended use, the plant material can be used fresh or after drying and curing. In this exercise, the group will sample fresh forms of popular herbs; and taste some examples of herbs widely used in foods and beverages.

**Educational Purpose:** This exercise will further highlight a group of plants widely used in culinary practices and prized for their sensory stimulating attributes. Participants will learn about herbs, herb flavors and the plants that provide a wide range of flavorings and seasonings for culinary practice. Individuals will experience the visual, olfactory, taste and tactile qualities and characteristics of this grouping of plants. Instructors will describe how to dry herbs and how to create seasonings. Participants will experience making and sampling pesto served on a baguette.

**Social Interactions:** Participants will interact with session leaders and other participants as appropriate. The mechanism for interactions will include questions and comments between leaders and participants. Participants can be asked to share with the group their favorite herbs and scented plants, recipes, and other ways of using herbs and spices. Participants can also be asked if there is a particular herb they use often in cooking that would be a good option for them to grow at home to save money. Small groups of participants will prepare a custom-made pesto with different combinations of fresh herbs to share with other session members.

**Goals/Benefits:** Facilitate participant-plant interactions, increase knowledge; stimulate cognitive abilities and skills; enhance motor skills (hand-eye coordination); trigger sensory stimulation;
promote social interactions and enjoy activity. Experience group cooperativity and creativity in making a custom pesto.

Materials and Supplies:

✓ Fresh herbs: basil, chives, dill, mint, oregano, parsley, rosemary, sage, and thyme
✓ Dried herbs: basil, cilantro/coriander, dill, mint, oregano, parsley, rosemary, sage, and thyme (as available)
✓ Electric Kettle (for hot tea): cups, stris, sugar, and agave nectar
✓ Food processor
✓ Parmesan cheese
✓ Lemons or lemon juice
✓ Kosher salt
✓ Extra virgin olive oil

Considerations for Harvesting and Preparing Herbs:

✓ To encourage branching in perennial herbs, remove the growing tips or apical meristems
✓ It is OK to cut perennial herbs to about half of their size
✓ Remove flowers for longer vegetative yields
✓ Review the pesticide application history before consuming herbs

General Activities

1. Fresh herbs will be passed around and people will be asked to smell, taste, and comment on each herb.
2. Fresh herbs will be compared to dry herbs in smell and flavor.

Instructions on drying fresh herbs

1. Clip herb when they are at their freshest and most flavorful. For leaf herbs, this is when the plant is producing buds, but before it has flowered.
2. Tie together your bundle of herbs. Hang in a cool, well-ventilated place. Indoor drying is more favorable than outdoor drying because flavor is better preserved.
   (Note: This works well for less tender herbs such as rosemary, sage, thyme, and parsley)
3. For tender herbs (basil, oregano, tarragon, lemon balm, and mint), place the herb in small bundles in a paper bag. To prevent molding, tear holes in the bag to allow for air-circulation. Close the top of the bag with a rubber band and hang upside down. The leaves will fall off into the bottom of the bag
4. Tender herbs can also be dried using the oven. Pull leaves off the stem. Lay the leaves flat on a sheet in the oven. Turn on the oven light and leave overnight. The oven-light often produces enough heat to dry the leaves.

Resources:

Plant Propagation by Seeds and Microgreens

Reviewing from Session 1, seeds are an important way that plants reproduce themselves for the next generation. Seeds come in a wide variety of shapes and forms, in different colors and sizes, and with different surface textures. Equally variable are the conditions that different types of seeds require to start the process of germination, grow, and develop into a seedling. Some seeds can germinate right away when placed in a favorable soil medium with adequate moisture and temperature, while others are blocked from germination by an internal mechanism known as dormancy. None of the seeds used in this exercise will be inhibited from germinating because of dormancy.

This exercise will introduce you to the seeds of vegetable plants that can be a starting point to make a single container or potted plant, start a vegetable garden, or grow your own microgreens. You will be able to observe the germination process and the growth and development of the young seedlings, and see some of the variation that exists in the various types of plants.

Microgreens are a relatively recent and trendy concept in vegetable production that has stimulated interest in the popular press. One example is an article at WebMD entitled: “Tiny Microgreens Packed with Nutrients,” [http://www.webmd.com/diet/news/20120831/tiny-microgreens-packed-nutrients](http://www.webmd.com/diet/news/20120831/tiny-microgreens-packed-nutrients). Many recipes can now be found incorporating the use of microgreens. Microgreens are young immature vegetable seedlings that are harvested at the first true leaf stage, and they are used for color and to add texture and flavor to salads and other dishes. Microgreens can be differentiated from baby greens by the fact that microgreens are younger and usually smaller than baby greens. The distinction is not characterized by a specific botanical growth stage. The flavor and aroma of microgreens are going to differ from those of their mature vegetable forms that we know. This illustrates how plant chemical composition can change as plants develop, mature, and even senesce.

With the microgreens, we might also be able to observe how planting density influences the development of young seedlings. You may find it surprising that plants can send and receive chemical signals from one another, but they do this all the time! Plants can also sense when they have neighbors and how close its neighbors might be. We will be planting the seeds for microgreens very densely and we should be able to observe how crowding influences the growth of the young seedlings. In Session 8, we plan to harvest the microgreens and sample them individually and in a salad.

**Educational Purpose:** This exercise will highlight a group of very important vegetable food crops valued for their nutritional attributes. Instruction will further explain the role and significance of seeds in plant reproduction, propagation, and the development of a plant from a seed. This activity will illustrate variation in plant seed morphology, size, shape and tactile characteristics.
demonstrate sowing methods, and observe the rate of germination of different species. Participants will learn how to sow seeds and what materials are needed to begin growing vegetables for use at home. This exercise in conjunction with Session 10 will also demonstrate the rapid production of fresh microgreens for home use.

**Social Interactions:** Participants will interact with session leaders and other participants as appropriate. The mechanism for interactions will include questions and comments between leaders and participants. Participants can be asked to share their favorite microgreens, vegetable plants and recipes with the group. Participants can give and receive advice on how to sow the different types of seeds, and share life experiences and memories of growing and consuming vegetables and salads.

**Goals/Benefits:** Facilitate participant-plant interactions, increase knowledge; stimulate cognitive abilities and skills; enhance motor skills (hand-eye coordination); promote social interactions; and enjoy activity.

**Materials and Supplies:**

- Soil Mix. SunGro an all-purpose growing mix made with Canadian sphagnum peat moss, perlite, vermiculite, dolomitic limestone, and a wetting agent. It is suitable for a wide variety of crops especially for those requiring good drainage and aeration;
- Greens growing tray: 10” x 20”. Seed Flat Tray with holes. Plastic Dome for 10” x 20” Tray
- 4” plastic pots
- Seeds for microgreens and vegetables
- Soil mixing tray
- Plastic Plant, Flower and Nursery Garden Label Marker Sticks 60x100 mm;
- Black Sharpie Permanent Marker
- Water

**Considerations for Growing Vegetables and Microgreens from Seed:**

- Appropriate seeding density should be achieved. For smaller seeded varieties, aim for 10-12 seeds per sq. in. For larger seeded varieties, aim for 6-8 seeds per sq. in.
- If not seeding enough, you may not produce a desirable yield
- If seeding too much, you increase risk of disease

**Instructions for Growing Vegetables and Microgreens from Seed:**

1. We will use containers that will be appropriate for holding microgreens and vegetable sprouts with good drainage from the bottom of the container.
2. In the soil-mixing tray, place some soil and break apart any soil clumps to ensure soil mix is of fine texture.
3. Fill your microgreen tray with dry soil until it reaches 1” below the top of the tray. (Note: Do not compact the soil in the container.)
4. Wet down the soil in the tray and let it sit for a few minutes to hydrate the soil.
5. While you are waiting, take some label sticks and write down the names of the plants you are planting. On your label sticks, include the common name of the plant, the date you planted the seed, and your name; this will allow you to track the progress of your seeds.

**Planting Microgreens**

6. Divide your tray into different sections where you will spread your different types of seeds and place label sticks in each section.

7. Start to spread your seeds on the top of the soil and try to spread evenly (this is easier said than done). These plants can grow very close together, aim for about 10 seeds per sq. in.

8. Sprinkle a small layer of soil on the top of the seeds, about ¼” thick.

9. Gently water the seeds.

10. Plants should begin to germinate in a week. Once the first true leaves are opened, the microgreens can be harvested. Time elapsed from seeding to harvest varies between 7-21 days, depending on the seed.

**Resources:**

- "Florida Gardener’s Handbook" by MacCubbin, Tasker, Bowden and Lamp’l. Cool Spring Press, Minneapolis, MN. (2012) 88, 92, 94-95


Gardening Session 7: Activity, Goals, Materials, Supplies and Instructions for Exercise

Session 7

**TRANSPLANTING:** Container Herb and Lettuce Salad Bowl Planting (seeds and cuttings from Sessions 1 and 2 can be used)

Transplanting

Long before transplantation became possible in medicine, botanists and horticulturists were transplanting plants that they fancied. The word “transplant” comes from Latin *trans* which means across and *plantare* which means to plant. It has always been part of our nature to take plants that we like or need wherever we go. Sometimes that means taking a fruit, seed, cutting or an entire plant. Our expanding understanding of plant biology and our large machines have made it possible in recent times to successfully transplant fully-grown large trees. Perhaps you have seen trucks on the highways carrying large palm trees or other trees to be transplanted. In fact, most of the large palms on campus were transplanted from somewhere off campus. Many of the plants in Wilmot Gardens are transplants.

This exercise will demonstrate how to transplant young, small plants to make a containerized herb and lettuce bowl that can provide greenery and a fresh source of herbs and lettuce for culinary purposes in the home. Some of the herb seeds germinated from Session 1 and herb cuttings rooted from Session 2 should be ready for transplanting into our containers. Some keys to successful transplanting include: 1. preparing the soil at the site where the transplant will be planted; 2. carefully removing the plant from its original site ensuring that damage to the root system is minimized; 3. planting to the proper depth (not too deep or too shallow); and 4. watering and caring for the plant post-transplant. Like people, being transplanted can also be stressful to a plant. Plants can and often do experience transplant shock, but with proper attention and care it can be minimized and the success rate for plant survival and healthy growth can be maximized.

The beauty of an herb and lettuce or salad bowl is that it does not require a lot of supplies or an outside plot of land, instead requiring little space and in a few weeks, you can raise a small edible garden. Provided you have a suitable source of light, your salad bowl can be grown indoors. Apartment patios, back porches screened in enclosures with good sun exposure (at least for a few hours a day direct light) can be a perfect place for your container garden.

A salad bowl can provide fresh leafy vegetables and herbs with the first crop ready for harvest in a few weeks, and the regrowth can perhaps be harvested multiple times. Most leafy vegetables can be harvested down almost to the ground level and will still re-grow. The plants can be planted much closer together than would be typical, because harvesting does not require waiting for mature, full-size plants.

**Educational Purpose:** This exercise will further highlight a group of plants widely used in sensory stimulation and culinary practices. Instruction will explain and demonstrate how transplanting of young and rooted plants can be used to create a small sensory garden that can be aesthetically pleasing, serve as a source of sensory stimulation, and provide flavoring and nutrition for culinary
uses. Key principles that maximize transplant success will be reinforced, and some elements of design will be presented.

**Social Interactions:** Participants will interact with session leaders and other participants as appropriate. The mechanism for interactions will include questions and comments between leaders and participants. Participants can be asked to share their favorite herbs, scented plants and recipes with the group.

**Goals/Benefits:** Facilitate participant-plant interactions, increase knowledge; stimulate cognitive abilities and skills; enhance motor skills (hand-eye coordination); promote social interactions; increase sense of pride and self-expression; and enjoy activity.

**Materials and Supplies**

- ✓ Soil Mix, SunGro an all-purpose growing mix made with Canadian sphagnum peat moss, perlite, vermiculite, dolomitic limestone, and a wetting agent. It is suitable for a wide variety of crops especially for those requiring good drainage and aeration
- ✓ Slow Release Fertilizer (Scott’s Osmocote 14+14+14 or equivalent)
- ✓ Herb and lettuce transplants: basil, chives, dill, mint, oregano, and thyme
- ✓ Larger container for transplanting into young plants
- ✓ Plastic Plant, Flower and Nursery Garden Label Marker Sticks 60x100 mm
- ✓ Black Sharpie Permanent Marker
- ✓ Water

**Considerations for Transplanting Herbs/Lettuce into a Container Garden:**

- ✓ Many leafy vegetables can be harvested down almost to the ground level and will still re-grow.
- ✓ Plants in a salad bowl can be planted much closer together than would be typical, because harvesting does not require waiting for mature, full-size plants
- ✓ When transplanting large plants with greater overall leaf surface area, consider reducing leaf area and number by cutting leaves in half or removing older leaves completely
- ✓ Herbs and lettuce require quite a bit of water and full to partial sun in order to grow large.
- ✓ Watering herbs less once the plants are established and ready to use in cooking is a good idea as it stresses the plants, causing them to produce more of the compounds that are responsible for flavor and smell.
- ✓ Whenever you would like to eat a salad, simply harvest the greens from the container. Use a pair of scissors to cut the greens about 1” above the base. Leaving this 1” will let the plants continue to grow so you can get a few more harvests out of the greens.

**Instructions for Transplanting Herbs/Lettuce into a Container Garden:**

1. We will use containers that will be appropriate for holding herbs and lettuce with good drainage from the bottom of the container.
2. Gather some soil and place it in a mixing container. Separate any clumps of soil and add water to the soil until moistened but not over saturated.
(Note: To avoid over saturation of soil, add just enough water so that soil will form a ball in your hand without falling apart.)

3. Place the soil mix into your container.

4. Choose plants for your container and think where you will want to place them in the container. A good guide for designing container gardens is to use the “thrill, fill, spill” method. So perhaps choose plants that will fit these criteria.

5. Make holes in the media where you will plant your transplants. Make sure that the roots have enough room when placed into their holes. Do not crush the root ball into a space where it does not fit. Place a small amount of slow release fertilizer (¼ of the scoop) in the planting hole and cover with a layer of soil.

6. Place a plant into a transplant hole; gently fill in the soil where there is remaining space.

7. Repeat for all the plants until you have placed in all the plants that you desire.

8. Make sure that your plants have room to grow in the container. Do not overcrowd the container.

9. You may want to write a label with some of the plant names on it. You will also want to label the container with your name.

10. After a few weeks, the plants will be established in the container and start to fill in all the empty spaces.

11. After several months, the herb plants may need to be transplanted to another container if this one seems to be getting crowded. Many of the herbs are annual plants and will not survive a freeze. So either protect your container by covering it in the cold or simply replant with cool season herbs in the winter.

12. After a few harvests, the lettuce greens may start to decline or look bad. This means that they are done producing and can be composted or thrown away. They may also bolt if you leave them growing for too long. When the plant bolts, the leaves will become bitter, so leaves should be harvested before then.

**Resources:**

Gardening Session 8: Activity, Goals, Materials, Supplies and Instructions for Exercise

| Session 8 | EDUCATION/TASTING/SENSORY: Florida Vegetables and Flavors (bell pepper, broccoli, carrot, celery, collards, cucumber, lettuce, and onion); Microgreen salad tasting (arugula, garden cress, kale, radish, spinach, and Swiss chard). |

Florida Vegetables

Florida is a major vegetable producing state. According to the USDA (Vegetables, NASS, USDA, 2015), in 2015 Florida ranked second in the nation in vegetable production in terms of acreage harvested and gross sales. The farm value of vegetables grown in Florida was estimated to be more than 1.0 billion dollars. Florida farms commercially grow more than 40 different vegetable crops, with harvests largely occurring in fall, winter and spring. In Florida, tomatoes account for about $3 out of every $10 dollars in production value. The top ten vegetable crops according to market value in Florida are in order: tomato, strawberry, bell pepper, sweet corn, potatoes, watermelon, snap beans, cucumber, cabbage, and squash.

| Table 1.1. Vegetable production acreage and value in Florida. |
|-----------------|-----------------|-----------------|------------------|
| Crop            | Planted acres   | Value (million US$) | U.S. rank |
| Tomato          | 33,000          | 453.1             | 1               |
| Strawberry      | 11,000          | 296.6             | 2               |
| Bell pepper     | 12,400          | 220.5             | 2               |
| Sweet corn      | 41,200          | 155.0             | 2               |
| Potato          | 29,300          | 117.0             | 11              |
| Snap bean       | 29,500          | 762.1             | 1               |
| Watermelon      | 21,500          | 882.1             | 1               |
| Squash          | 6,000           | 27.5              |                |
| Cabbage         | 8,900           | 338.7             | 2               |
| Cucumber        | 11,000          | 47.8              | 1               |
| Source: Vegetables-2015 summary, NASS, USDA. |

Perhaps one finds it surprising that strawberry and watermelon are included as a vegetable by the USDA. Many would consider strawberry to be a fruit, but then why is it listed as a vegetable? Well the word vegetable is not a botanical or scientific word, and there lies the source of confusion as to what is and what is not a vegetable. The meaning of the term vegetable is rather arbitrary and subjective whereas the term fruit is a botanical and scientific word with a specific meaning “the mature ovary of a plant.” What is an ovary of a plant? An ovary is the enlarged basal portion of the pistil where the embryo and seeds form and includes the fleshy tissues that surround the embryo or seed. Apples, pears, oranges and blackberries are fruits. A fruit is produced only from a flower, yet while a tomato is botanically speaking a fruit, it is also non-scientifically considered a vegetable. One definition of vegetable would be the edible portion of an herbaceous plant including leaves (lettuce), stems (celery), roots (carrot), tubers (potato), bulbs (onion) and flowers and floral stalks (broccoli) or fruits. Other definitions of vegetable might include any of the following: an accompaniment to meat or fish; any plant whose fruit, seeds, roots, tubers, bulbs, stems, leaves, or flower parts are used as food; parts of a plant that are savory but not necessarily sweet.
Educational Purpose: This exercise will additionally highlight a group of very important vegetable food crops valued for their nutritional attributes. Participants will learn about different vegetable types and some of the important features that contribute to flavor and nutritional value. They will experience the visual, olfactory, taste and tactile qualities and characteristics of this grouping of plants. Salads for tasting will be prepared from the microgreens that were planted in Session 6.

Social Interactions: Participants will interact with session leaders and other participants as appropriate. The mechanism for interactions will include questions and comments between leaders and participants. Participants can be asked to share with the group their favorite vegetables and recipes. Participants can also be asked to share preferences in texture of foods.

Goals/Benefits: Facilitate participant-plant interactions. Increase knowledge; stimulate cognitive abilities and skills; trigger sensory stimulation; promote social interactions, and enjoy activities.

Materials and Supplies:
- Scissors
- Bowls
- Utensils
- Salad dressings

General Activities:
- For fun, based on the introduction and definition(s) of vegetable, make a list of five vegetables that you can think of other than those already mentioned that are actually fruits, but also considered vegetables.
- Make a table listing of common vegetables according to the part of the plant that is used as a vegetable.
- Pass around various vegetables grown in Florida and explore their sensory aspects such as smell, taste, texture, and appearance
- Harvest the microgreens grown in Session 6 and taste them with some salad dressing
- Discuss some favorite recipes or ways of cooking these vegetables

Resources:
Appendix of Plant Latin Names per Session

Session 1 - PROPAGATION: Planting Seeds of Herbs and Aromatic Plants
Basil, Ocimum basilicum L.
Chives, Allium schoenoprasum L.
Cilantro/Coriander, Coriandrum sativum L.
Dill, Anethum graveolens L.
Oregano, Origanum vulgare L.
Rosemary, Rosmarinus officinalis L.
Thyme, Thymus vulgaris L.

Session 2 - PROPAGATION: Cuttings of Herbs and Aromatic Plants
Lavender, Lavender spp. L.
Mint, Mentha spp. L.
Rosemary, Rosmarinus officinalis L.
Scented Geranium, Pelargonium spp. (L.) L’Her.
Tarragon, Artemisia dracunculus L.
Thyme, Thymus vulgaris L.

Session 3 - TRANSPLANTING: Container Garden Succulent Collection Planting
Aloe, Aloe spp. L.
Echeveria, Echeveria spp. DC.
Jade Plant, Crassula ovata (Miller) Druce
Kalanchoe, Kalanchoe spp. Adans.
Panda Toes, Kalanchoe tomentosa Baker
Stonecrop, Sedum spp. L.

Session 4 - PROPAGATION: Cutting/Division of Herbaceous Ornamentals
African Violet, Saintpaulia spp. H. Wendl.
Begonia, Begonia spp. L.
Coleus, Solenostemon scutellarioides (L.) R. Br.
Hosta, Hosta spp. Tratt
Hoya, Hoya spp. R. Br.
Impatiens, Impatiens L.
Pilea, Pilea peperomioides
Prayer Plant, Maranta spp. L.
Spider Plant, Chlorophytum comosum (Thunb.) Jacques

Session 5 - EDUCATION/TASTING/SENSORY: Herbs and Herb Flavors
Basil, Ocimum basilicum L.
Chives, Allium schoenoprasum L.
Cilantro/Coriander, Coriandrum sativum L.
Dill, Anethum graveolens L.
Mint, Mentha spp. L.
Oregano, Origanum vulgare L.
Parsley, Petroselinum crispum (Mill) Fuss
Rosemary, Rosmarinus officinalis L.
Sage, Salvia officinalis L.
Thyme, Thymus vulgaris L.
Session 6 - PROPAGATION: Planting Seeds of Fast Germinating Vegetables
Arugula, *Eruca sativa* Mill.
Garden Cress, *Lepidium sativum* L.
Kale, *Brassica oleracea* Acephala Group
Lettuce, *Lactuca sativa* L.
Radish, *Raphanus sativus* L.
Spinach, *Spinacea oleracea* L.
Swiss Chard, *Beta vulgaris* subsp. cicla L.
Tomato, *Solanum lycopersicum* L.

Session 7 - TRANSPLANTING: Container Herb/Lettuce Salad Bowl Planting
Basil, *Ocimum basilicum* L.
Chives, *Allium schoenoprasum* L.
Dill, *Anethum graveolens* L.
Mint, *Mentha* spp. L.
Oregano, *Origanum vulgare* L.
Thyme, *Thymus vulgaris* L.
Arugula, *Eruca sativa* Mill.
Garden Cress, *Lepidium sativum* L.
Kale, *Brassica oleracea* Acephala Group
Lettuce, *Lactuca sativa* L.
Radish, *Raphanus sativus* L.
Spinach, *Spinacea oleracea* L.
Swiss Chard, *Beta vulgaris* subsp. cicla L.

Session 8 - EDUCATION/TASTING/SENSORY: Florida Vegetables and Flavors
Arugula, *Eruca sativa* Mill.
Bell Pepper, *Capsicum annum* L.
Broccoli, *Brassica oleracea* Italaica Group L.
Carrot, *Daucus carota* subsp. *Sativus* (Hoffm.) Thell.
Collards, *Brassica oleracea* Acephala Group L.
Cucumber, *Cucumis sativus* L.
Garden Cress, *Lepidium sativum* L.
Kale, *Brassica oleracea* Acephala Group L.
Lettuce, *Lactuca sativa* L.
Onion, *Allium cepa* L.
Radish, *Raphanus sativus* L.
Spinach, *Spinacea oleracea* L.
Swiss Chard, *Beta vulgaris* subsp. cicla L.
Tomato, *Solanum lycopersicum* L.
Glossary of Key Terms

Asexual propagation: producing genetically uniform copies of plants via stem, root or leaf cuttings

Auxin: a plant hormone produced in the shoot meristems that promotes cell elongation, and often used in asexual propagation to promote rooting

Bolt: when a plant starts to produce flower stems; lettuce, basil and spinach are examples of plants inclined to bolt

Callus: a mass of unorganized and prolific parenchyma cells produced as a result of wounding. Callus commonly occurs at the cut end of a cutting during the rooting process.

Chemical biology: the discipline involving chemistry, biology and physics of biological systems

Cuttings: portions of stems, roots, or leaves that are detached from a plant and used to clonally multiply new plants

Division: a type of asexual propagation where the plant is sectioned into portions containing shoot and root parts

Dormancy: a condition when seeds are blocked from germination by an internal or external mechanism, even in favorable environmental conditions. Seed embryo or seed coat factors can cause different types of dormancy.

Embryo: the part of the seed developed from the sexual union of male and female gametes during fertilization

Evapotranspiration: the combined process of evaporation of water vapor from soil and plant surfaces into the atmosphere and transpiration or water movement from roots through the plant canopy and out from the leaves

Fruit: the mature ovary and seed-bearing structure of a plant by which flowering plants disseminate seeds

Germination: the process of seed development beginning with water uptake and leading to radicle protrusion from the seed coating

Herbaceous plant: a soft plant that lacks lignified or woody structures

Meristems: plant tissue composed of meristematic cells capable of dividing; found in the shoot and root tips and secondary growing points (vascular cambium, cork cambium, leaf marginal meristems)

Apical Meristem: meristem found at the highest shoot tip or lowest root tip

Lateral Meristem: meristem found below the highest shoot tip or above the lowest root tip

Microgreens: the shoots of salad vegetables harvested after the first true leaves have emerged
Node: a part of the stem where one or more leaves are held and buds emerge with vegetative or floral organs

Ovary: the enlarged basal portion and fleshy tissues of the pistil where the embryo and seed form

Petiole: the stalk that holds the leaf to the stem

Pluripotency: the concept that a single cell is able to divide and differentiate to produce all of the cells and tissues needed produce a new plant

Ramets: the vegetative offspring of a stock plant

Relative humidity: the amount of water vapor in the air relative to the amount of water vapor needed to reach saturation at the same temperature

Rhizome: a specialized, fleshy, stem structure growing horizontally at, or near, the surface of the ground

Seed: the next generation of a plant produced via sexual reproduction. The main parts include an embryo, food storage, and a protective coating.

Senesce: the process of aging in plants resulting from normal development or stress

Sexual reproduction: male pollen comes into contact with female egg cell in the ovule known as pollination and fertilization, then after recombination of genetics the ovule grows into seeds

Stolon: a specialized stem that grows laterally, either above or below ground, from the crown of the plant to produce either another plant or a tuber.

Transplant shock: a period of plant stress after transplanting typically expressed by plant wilting and caused by unfavorable weather conditions and a disproportionate root to shoot ratio

Transplant: a plant that is moved from one location to another

Vegetable: the edible portion of an herbaceous plant including leaves, stems, roots, tubers, bulbs and flowers/floral stalks (broccoli) or fruits

Xerophytic plants: plant that are adapted to dry climatic conditions
Gardening and Art Study
Art Session Handouts

Wilmot Gardens Conference Center
University of Florida

Study Staff: Kris Sullivan, BS; Dylan Klempner, BS & MFA; Jill Sonke, MA
Study Coordinator: Raymond Odeh, BS
Principal Investigator: Charles Guy, PhD
Table of Contents

Table of Contents ................................................................................................................................................. 2
Welcome to the Study ............................................................................................................................................. 3
Contact Information............................................................................................................................................. 3
Art Sessions Information .................................................................................................................................. 4
Timeline Sequence for Eight Art Sessions ......................................................................................................... 4
Art Activity Handouts and Instructions .................................................................................................................. 4
  Art Session 1: PAPERMAKING: Creating Handmade Paper from Recycled Materials .............................. 5
  Art Session 2: IMAGE TRANSFER: Transferring images into artwork ......................................................... 7
  Art Session 3: VISUAL STORYTELLING: Sequential Arts ........................................................................... 9
  Art Session 4: LINOCUT PRINTMAKING, PART 1: Carving the Matrix ..................................................... 12
  Art Session 5: LINOCUT PRINTMAKING, PART 2: Printing the Matrix .................................................... 14
  Art Session 6: PAPER BATIK: Creating patterns with resist ......................................................................... 16
  Art Session 7: MIXED MEDIA COLLAGE: Writing/Visual Art Activity .................................................. 18
  Art Session 8: SENSATION DRAWING: Sensorial Perceptions ............................................................... 20
Glossary of Key Terms ....................................................................................................................................... 22
Welcome to the Study

First, allow our research team to welcome you to the Gardening and Arts Study. We value your time and participation in this research, and if at any time you have questions or concerns regarding your participation in the study, feel free to contact Study Coordinator Raymond Odeh or Principal Investigator Charles Guy. Our contact information is below.

Now, let us provide you with some guidelines regarding your participation in this study:

- Please refrain from engaging in gardening or art activities including visiting botanical gardens and art museums outside of the study sessions.
- Please refrain from using the Internet to find and access information about gardening or arts activities during the time following the orientation and until after the final wrap-up session.
- Please do not walk through the grounds at Wilmot Gardens outside of study sessions.
- You may use the *The Artist’s Handbook* during the study as a resource and reference to find an answer to a question you may have, but avoid doing extensive reading during the time from the orientation and until after the wrap-up session.
- Please do not take any photographs or make any recordings that may reveal the identity of any study subject as this will result in a protocol deviation that must be reported to the IRB.
- Please inform the Study Coordinator, Raymond Odeh or the Principal Investigator, Charles Guy, if you experience any major life event that changes your daily life during the course of the study.
- If you miss more than 2 of the 8 arts sessions, you may be withdrawn from the study. It is not possible to offer a make-up session under the approved procedures of the study.

This manual is intended to help you navigate each session and provides you with additional resources if you choose to continue engaging in gardening or arts activities after your active participation in this study is completed. Complementing this manual, we have provided you with a reference book, *The Artist’s Handbook* to serve as a supplement to the information provided in this manual.

Contact Information

Study Coordinator| Raymond Odeh (352)273-4525 rodeh@ufl.edu

*Mr. Odeh, graduate student, working on a Master of Science in Horticulture with a degree from the University of Florida specialized in Landscape and Nursery Horticulture can answer questions regarding session details and research protocol.*

Principal Investigator| Charles Guy (352) 273-4528 cglyu@ufl.edu

*Dr. Guy, Assistant Chair and Professor of Plant Physiology and Biochemistry in the Department of Environmental Horticulture with research interests in people-plant interactions and the biochemical and molecular responses of plants to unfavorable temperature conditions can answer any questions about this study.*
Art Sessions Information

Mondays/Wednesdays or Tuesdays/Thursdays at 5:30 PM to 6:30 PM

Conference Center at Wilmot Gardens

Corner of Gale Lemereand Drive and Mowry Road, just North of Archer Road

Please park in available parking in one of the three locations circled below:

---

Timeline Sequence for Eight Art Sessions

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Session Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min</td>
<td>Arrival and Sign-in/Pick up Name Tag</td>
</tr>
<tr>
<td>0-10 min</td>
<td>Individuals Review Previous Activities (i.e. plant growth)/Instructors Greet</td>
</tr>
<tr>
<td></td>
<td>Individuals and Assemble Group/Heart Rate and Blood Pressure Measurements Recorded</td>
</tr>
<tr>
<td>10-20 min</td>
<td>Educational Module/Introduction to Activity/Demonstration of Activity as Warranted</td>
</tr>
<tr>
<td></td>
<td>(booklet, instruction sheet, resource material handouts)</td>
</tr>
<tr>
<td>20-50 min</td>
<td>Art Activity. Questions</td>
</tr>
<tr>
<td>50-70 min</td>
<td>Clean-up/Heart Rate and Blood Pressure Measurement Recorded/</td>
</tr>
<tr>
<td></td>
<td>POMS and PSS Assessments (Even-numbered Sessions)/</td>
</tr>
<tr>
<td></td>
<td>BDI (Sessions 4 and 8)/ Departure</td>
</tr>
</tbody>
</table>
Art Activity Handouts and Instructions

Art Session 1: Activity, Goals, Materials, Supplies and Instructions for Exercise

| Session 1 | PAPERMAKING: Creating Handmade Paper from Recycled Materials |

**Hand Papermaking**

Paper fibers are cellulose and are made from plant materials. To make new paper from old paper, you will simply reverse the papermaking process. Dry paper is put into water to weaken the hydrogen bonds, electrostatic interactions and induced dipoles between cellulose fibrils. When agitated in the blender, the fibers let go of one another and become single fibers in water called pulp. When the pulp is scooped into hand mold and water is removed allowing it to dry, the bonds and interactions reform and finishes a complete cycle.

This exercise will introduce basic papermaking techniques and materials.

**Educational Purpose:** This exercise will explore basic handmade papermaking techniques and highlight one of the oldest recycling practices. Paper dates back to 105 AD in China and was made by hand until industrial manufacturing was introduced in 1803. Hand papermaking continues to be a specialized craft today, and is widely used as a medium for artistic expression. Participants will learn how to create a paper pulp from recycled papers and cotton linter using a household blender. They will experiment with color options and provided additives before pulling sheets of handmade paper using a dip hand mold. Papers will be transferred to couch sheets and left to dry until a subsequent workshop. Participants will also be shown a basic pour method utilizing a tin can mold to increase accessibility of papermaking at home without specialized materials.

**Social Interactions:** Participants will interact with session leaders and other participants. In this first session, participants will be asked to share their first name only with the group. Mechanism for interactions will include questions and comments between and among leaders and participants. Participants will be sharing pulp vats and additives with one another.

**Goals/Benefits:** Facilitate participant-art medium interactions, increase knowledge; stimulate cognitive abilities and skills; increase concentration; enhance motor skills (hand-eye coordination); meet new people; experience individual and group interactions; and enjoy activity.

**Materials and Supplies:**

✓ Water
✓ Scrap Papers
✓ Plastic storage tub or vat
✓ Drain pan
✓ Kitchen blender (recommended to dedicate an inexpensive blender to papermaking)
✓ Mold & Deckle
✓ sponge
✓ press bar
✓ Couch sheet or other absorbent material

Considerations for Making Paper with Recycled Materials:

✓ Drawing, printmaking, and watercolor papers are the best scrap papers to use because they are generally made from cloth rag and not chemically treated tree fiber; however, any and all paper can be recycled.
✓ You will not want to use your kitchen blender to make pulp. It is best to purchase an inexpensive blender and dedicate it to papermaking.

Instructions for Making Recycled Paper with a Dip Hand Mold:

1. Cut or rip up your paper into about 1 inch squares. Ideally, you should soak your paper for a few hours or overnight for easy blending.
2. Throw in a good handful or two of the cut up scrap papers. Fill up a kitchen blender with water and blend until it is a pulp. Fill up the tub 1/3 to 1/2 way with your blended pulp. Add more water to the bin. The more pulp in your slurry, the thicker your paper will be.
3. Stir your vat of pulp. Hold the mold screen side up, and place the deckle evenly on top. Holding them together at a 45-degree angle, dip the mold and deckle to the bottom of the vat and scoop up, holding the mold and deckle horizontally. As you lift it out of the slurry, give it a quick shake back and forth, and left to right to align the fibers and make a uniform sheet. Stop shaking before the sheet is fully drained. Let the water drain to a drip.
4. Set the deckle aside and carefully put the cover screen over the new sheet resting it on the screen support. Press a sponge firmly down on the cover screen. Wring the sponge and press again. Continue until you have removed most of the water.
5. Lift a corner of the cover screen carefully and peel it off slowly. Pick up the papermaking screen with the new sheet on it and turn it over onto your couch sheet.
6. Press sponge firmly all over the screen’s surface, removing additional water. Slowly lift one corner and peel off the screen from the damp sheet.
7. Place a second dry couch sheet on top of your sheet. With a sponge, press gently at first, then press firmly with as much pressure as possible. Use a press bar to press your paper even more. Remove second couch sheet.
8. Let paper dry fall and remove couch sheet.

Resources:

✓ Arnold Grummer’s YouTube Channel: www.youtube.com/arnoldgrummer
✓ Hand Papermaking, Inc: http://handpapermaking.org
Art Session 2: Activity, Goals, Materials, Supplies and Instructions for Exercise

Session 2 | IMAGE TRANSFER: Transferring images into artwork

Image Transfer

An image transfer is the act of transferring an image from one source to another. Artists frequently create with reference images, and there are numerous ways to incorporate existing imagery directly into one’s work. Utilizing a transfer technique can be an inspiration for art making, as well as having direct applications in beginning a project.

This exercise will introduce a basic image transfer technique and materials for mixed media and printmaking projects. High contrast photocopies will be transferred onto canvas and linoleum with a gel medium. Gel medium is essentially a colorless acrylic paint that can additionally be used as an adhesive or sealant. Photocopies are created with toner and utilize a heat process to set the toner. Instead of absorbing into the fibers of the paper, toner sets on top allowing it to release once coated in medium.

Educational Purpose: Participants will learn a basic image transfer process for use in art, mixed media and design. Individuals will be provided with a canvas panel substrate and use gel medium to transfer found images onto the panel. They will also select a found image to transfer onto easy cut linoleum for a printmaking workshop to follow. Found images will be a variety of printed images sourced from the Internet and books. The transfer method includes brushing gel medium onto the panel, placing the image face side down, and softly burnishing to adhere. The pieces will be left to dry for use in future printmaking and mixed media collage workshops. Paper will be removed when dry leaving images on the canvas panel and linoleum substrates.

Social Interactions: Participants will interact with session leaders and other participants. Mechanism for interactions will include questions and comments between leaders and participants.

Goals/Benefits: Facilitate participant-art medium interactions; increase knowledge; stimulate cognitive abilities and skills; increase concentration, restore directed attention; enhance motor skills (hand-eye coordination); experience group interactions; enjoy activity.

Materials and Supplies:

✓ Photocopies of found images
✓ Matte gel medium
✓ Paintbrush
✓ Canvas panel substrate
✓ Linoleum substrate
✓ Brayer
✓ Sponge
✓ Water

Considerations for Image Transfer:

✓ High contrast images work best for all image transfers, both color and black and white.
✓ Laser prints and photocopies are recommended as they utilize toner, which makes cleaner transfer.
✓ Smooth, porous surfaces receive transfers best.
✓ Direct gel medium transfers reverse the image, so be sure to mirror copy if it includes text.

**Instructions for Transferring Images:**

1. Select an image from provided photocopies.
2. Apply a generous coat of gel medium to the canvas panel with brush.
3. Place photocopy face down on the gel and smooth gently with brayer to adhere.
4. Allow the gel to dry.
5. Dampen the back of the photocopy with water. Use your fingers or a small sponge in a circular motion to remove the paper leaving the transferred image.

**Resources:**

✓ Courtney Cerruti’s image transfer class: [www.creativebug.com](http://www.creativebug.com)
Art Session 3: Activity, Goals, Materials, Supplies and Instructions for Exercise

Session 3  VISUAL STORYTELLING: Sequential Arts

Visual Storytelling
This exercise will explore techniques for making basic comics, also called Sequential Arts. Rome’s Trajan’s Column, which commemorates Emperor Trajan’s victory in the Dacian Wars and was dedicated in 110 AD, is considered one of the earliest example of modern comics. Visual images presented in a sequential narrative structure date back even earlier to Egyptian hieroglyphics and Greek friezes. In the middle ages, as Christianity grew throughout Europe, images relating Bible stories were often used for the illiterate. With the invention of the printing press, comics developed alongside the printed word. Cartoonists began depicting political and social life through storytelling and satire by the 17th and 18th centuries. Comics’ popularity continued to grow throughout the 20th century. They were printed in newspapers and as stand-alone comic books. Today, the art form continues to grow and evolve into a variety of innovative forms including graphic novels and digital comics.

Educational Purpose: Participants will learn how to create a simple three-panel comic strip. They will experiment with generating ideas for narratives that can be developed through both words and images.

Social Interactions: Participants will interact with session leaders and other participants. Mechanism for interactions will include questions and comments between leaders and participants. Participants will be sharing writing and visual art supplies with one another.

Goals/Benefits: Facilitate participant-art medium interactions, increase knowledge, stimulate cognitive abilities and skills, increase concentration, restore directed attention, develop ability to form basic narrative structures, experiment with basic drawing techniques, enhance motor skills (hand-eye coordination), experience group interactions, enjoy activity.

Materials and Supplies:
✓ Pencils
✓ Paper

Consideration for Visual Storytelling:
✓ In brainstorming, allow yourself to be guided by your own intuition without thinking about whether you are right or wrong.

Instructions for Visual Storytelling:
This activity was adapted from the online course Storytelling Flow with instructor Tom Hart, a cartoonist, best-selling author, and Director of The Sequential Artists Workshop.

1. According to cartoonist, Tom Hart, the first step to starting a comic is to generate ideas by writing lists. Write between 1-3 items for each category below. One is fine, three may be
better. Always write the first thing that comes to your mind. Write whatever comes in 30-60 seconds.

- Start with something distracting you right now
- Write your favorite Urban Phenomenon, like chain-link fences, or banks, or tall buildings or whatever
- Write your favorite rural phenomenon, like morning birds, or big skies full of clouds, or whatever you may wish to choose.
- Invent a society. This is one of the crazier things I am asking, but just try it. In 1 or 2 minutes, invent some part of a society. Maybe it's society of 12-year-old hunter-gatherers who are under threat from robots, or a city in which people sell and trade their foot lice. Just come up with something. As with everything, write the first thing that comes to mind.
- What you would be if everything were awesome for you? Would you be a fabulous unicorn, a glamorous rock star, or merely someone who flies and is adored by all? Just write it.

If any of the above frustrate you or freak you out, draw instead from this list:

- Your favorite machinery
- A big win
- A big fail
- A time you were lost in a crowd
- A beautiful thing you saw

2. Draw anything in that list of ideas. Doodle characters, doodle actions, draw anything that comes to mind, whether it's from the list or not.

3. Take your favorite doodle, whichever one speaks to you the most, and draw it again on a new sheet of paper somewhere, making sure that there is something active going on. It cannot just be a character, but needs to be a character doing something. This is important, just make sure that there is something happening, even if it's staring, or holding something up, or it could be more extreme: fighting, loving, etc. This is our Narrative image that we will use below.

4. Divide a piece of paper into 3 rectangular panels. Then divide each panel into 3 sections.

5. Draw your single image in the box in the center of each panel.

6. Under the left box of each panel, write one possible thing that might have happened right BEFORE this image.

7. Under the right box of each panel, write one possible thing that might have happened right AFTER this image.

8. Use the blank three-panel comic sheets, make three single comics using the character from #3 above. If you struggle to think of BEFORE and AFTER images, choose ideas from the list below:
• One that focuses on a surprised reaction
• One that focuses on a hiding something
• One that focuses on discovering something
• One that focuses on a decision
• One that focuses on a transfer of power
• One that focuses on a disappointment or loss

**Resources:**

- Sequential Artists Workshop online classes: [http://sequentialartistsworkshop.thinkific.com/collections](http://sequentialartistsworkshop.thinkific.com/collections)
- Sequential Artists Workshop: [http://www.tomhart.net/saw.html](http://www.tomhart.net/saw.html)
- Tom Hart’s personal website: [http://www.tomhart.net/](http://www.tomhart.net/)
Art Session 4: Activity, Goals, Materials, Supplies and Instructions for Exercise

Session 4 | LINOCUT PRINTMAKING, PART 1: Carving the Matrix

**Linocut Printmaking, Part 1**

Printmaking is the process of transferring an image from a matrix to a substrate, most often with the possibility for replication. There are many forms of printmaking and each has its own origin. It is hard to pinpoint exactly when printmaking started historically, as engravings go all the way back to prehistoric cave art. Before the invention of the printing press, early printmaking techniques were more likely considered a means of communication than an art form. In the 18th century, art prints began to be considered original works of art. Linoleum was first invented in the 1860s. It was first used as a medium for printing in the early 1900s, when Germans used it for making patterns on wallpaper.

Linoleum printing, a form of relief printing, is one of the easiest and most direct of all the printmaking methods. Linocuts can be simplistic and graphic, or as intricately detailed as you want. It is a subtractive process, meaning you cut away, or subtract, the areas you do not want to print. They can be printed onto almost any type of paper or fabric.

**Educational Purpose:** Participants will learn a basic form of relief printmaking. Linoleum printing is a subtractive method, where individuals cut away images transferred on a previous workshop. Individuals will use a specialized cutter with various blades, and explore cutting techniques to achieve detail and shading.

**Social Interactions:** Participants will interact with session leaders and other participants. Mechanism for interactions will include questions and comments between leaders and participants.

**Goals/Benefits:** Facilitate participant-art medium interactions, increase knowledge; stimulate cognitive abilities and skills; increase concentration, restore directed attention; enhance motor skills (hand-eye coordination); experience group interactions; enjoy activity.

**Materials and Supplies:**
- Prepared linoleum
- Speedball cutter with various blades
- Dry paintbrush

**Considerations for Linocut Printmaking:**
- Carving tools are very sharp, so always remember to cut slowly and away from your body.
- If you are unsure about how something will look printed, you can do a practice print and resume carving if you are unsatisfied.
- How one holds a carving tool is a matter of personal preference and will become more natural as one spends time carving. It is best to start holding the tool as you would a pencil to give you the most control.
Instructions for Linocut Printmaking:

1. Based on the image you have transferred onto the linoleum, decide whether you wish to print a positive or negative image. For positive images, you will cut away the background, and for negative images, you will cut away the image leaving the background to print.

2. Using a Speedball handle and the accompanying blades, start carving using small strokes away from your body. Rotate the linoleum or matrix to maintain a carving motion away from the body.

3. Clean off any stray pieces of linoleum with a dry paintbrush.

Resources:

Art Session 5: Activity, Goals, Materials, Supplies and Instructions for Exercise

Session 5 | LINOCUT PRINTMAKING, PART 2: Printing the Matrix

Linocut Printmaking, Part 2

Printmaking is the process of transferring an image from a matrix to a substrate, most often with the possibility for replication. There are many forms of printmaking and each has its own origin. It is hard to pinpoint exactly when printmaking started historically, as engravings go all the way back to prehistoric cave art. Before the invention of the printing press, early printmaking techniques were more likely considered a means of communication than an art form. In the 18th century, art prints began to be considered original works of art. Linoleum was first invented in the 1860s and was first used as a medium for printing in the early 1900s, when Germans used it for making patterns on wallpaper.

Linoleum printing, a form of relief printing, is one of the easiest and most direct of all the printmaking methods. Linocuts can be simplistic and graphic, or as intricately detailed as you want. It is a subtractive process, meaning you cut away, or subtract, the areas you do not want to print. They can be printed onto almost any type of paper or fabric.

**Educational Purpose:** Participants will create prints from their linoleum matrix. The process includes applying paint to a palette, and using a brayer to apply paint to the linocut. Brayers are hand rollers used to evenly distribute paint on the palette. Paper is then placed on top of the linocut and the image is burnish onto the paper by using a baren in a circular motion on the back of the paper. Barens are traditional, handheld printmaking tools used for burnishing. Participants will check their prints and potentially do more carving until desired effects are achieved. Several prints will be made of each image.

**Social Interactions:** Participants will interact with session leaders and other participants. Mechanism for interactions will include questions and comments between leaders and participants.

**Goals/Benefits:** Facilitate participant-art medium interactions, increase knowledge; stimulate cognitive abilities and skills; increase concentration, restore directed attention; enhance motor skills (hand-eye coordination); experience group interactions; enjoy activity.

**Materials and Supplies:**

- Prepared linoleum substrate
- Dry paintbrush
- Speedball cutter with various blades
- Piece of Flexiglas
- Water-based printmaking ink
- Brayer
- Several sheets of paper
- Baren

**Considerations for Linocut Printmaking:**

- If you are unsure about how something will look printed, you can do a practice print and resume carving if you are unsatisfied.
- Carving tools are very sharp, so always remember to cut slowly and away from your body.
The first print you pull won’t likely be the best, so try a few prints before making any judgments about your work.

**Instructions for Linocut Printmaking:**

1. Brush off carved linoleum matrix removing any stray carvings.

2. Choose a water-based printmaking ink color and apply to Plexiglas. Use your brayer to roll out the ink into an evenly coated rectangle.

3. Use the charged brayer to roll ink onto the linoleum matrix. It will take several passes to get the linoleum fully covered and you may need to charge the brayer again during this initial inking.

4. With clean hands, pull your first print by lining up a piece of paper on top of the linoleum. Lightly burnish the back of the paper in a circular motion with the printmaker’s baren.

5. Carefully peel back the paper from the linoleum. Evaluate your image and decide if it needs more carving. If so, wash and dry the linoleum before carving.

6. Continue to pull prints by re-inking the linoleum for each new print.

**Resources:**

Art Session 6: Activity, Goals, Materials, Supplies and Instructions for Exercise

**Session 6** | **PAPER BATIK: Creating patterns with resist**

**Paper Batik**

Batik is a textile art form in which wax is applied to cloth before paint or dye is applied. Once the paint is dry, the wax is removed, leaving an imprint where the wax resisted the paint. Early examples of batik have been found in the Far East, Middle East, Central Asia, and India from over 2000 years ago. Traditionally where batiks are commonly made, regions have their own patterns.

This exercise will introduce the concept of batik utilizing simple materials. Creating batik style art on paper is a fantastic way to explore composition with minimal investment.

**Educational Purpose:** Participants will learn principles of batik, a method of producing a colored design using a resist. Instead of using wax on fabric, participants with use a masking fluid to create a ghost design or resist on paper. Watercolor will then be applied to images by direct application with a brush.

**Social Interactions:** Participants will interact with session leaders and other participants. Mechanism for interactions will include questions and comments between leaders and participants.

**Goals/Benefits:** Facilitate participant-art medium interactions. Increase knowledge: stimulate cognitive abilities and skills; increase concentration; restore directed attention; enhance motor skills (hand-eye coordination): experience group interactions: enjoy activity.

**Materials and Supplies:**

- ✓ Watercolor paper
- ✓ Pencil
- ✓ Masking fluid
- ✓ Color shaper
- ✓ Watercolor paint
- ✓ Paintbrush
- ✓ Soft rubber eraser

**Considerations for Paper Batik:**

- ✓ If you choose to draw the pattern in pencil in advance, you will want to draw very lightly as dark pencil lines will show through once the masking fluid is removed.
- ✓ Using darker tones of watercolor paint next to the masking fluid design will create a more dramatic pattern.
- ✓ Be sure to let the watercolor paint dry completely before removing the masking fluid.

**Instructions for Paper Batik:**

1. Create a repeating pattern on the provided paper lightly with pencil and then with masking fluid. Let the fluid dry for several minutes until it has completely set.
2. Create a watercolor wash and cover paper over dried resist.

3. Once watercolor paint is full dry, lightly remove masking fluid with soft eraser or finger.

**Resources:**

Art Session 7: Activity, Goals, Materials, Supplies and Instructions for Exercise

Session 7  MIXED MEDIA COLLAGE: Writing/Visual Art Activity

Mixed Media Collage

This exercise will explore techniques for making collages. Though the term “collage” was coined by Pablo Picasso and Georges Braque in 1912, its origins date back to the invention of paper in China around 2000 BC. In 10th Century Japan, poets used glued pieces of text. Gold leaf and gemstones were applied to religious images in medieval Europe. Evidence of hobbyists using collage for memorabilia began in the 19th century. Contemporary collage in art occurred with the rise of modernism in the early 20th century. Through the technique, these artists brought a collision of fragmented meaning by incorporating newspaper and other found materials into their work.

Educational Purpose: Participants will learn how to create simple collages, which they will use for expressive and/or reflective writing.

Social Interactions: Participants will interact with session leaders and other participants. Mechanism for interactions will include questions and comments between leaders and participants. Participants will be sharing writing and visual art supplies with one another.

Goals/Benefits: Facilitate participant-art medium interactions, increase knowledge; stimulate cognitive abilities and skills; increase concentration; restore directed attention; develop ability to form basic narrative structures; experiment with basic drawing techniques; enhance motor skills (hand-eye coordination); experience group interactions; enjoy activity.

Materials and Supplies:

✓ Pencil
✓ Pens
✓ Prepared canvas panel
✓ Scrap papers
✓ Scissors
✓ Acrylic gel medium
✓ Acrylic paints
✓ Paint brush
✓ Magazines
✓ Embellishments (glitter, stamps, found objects, etc.)
✓ Writing paper

Consideration for Mixed Media Collage:

✓ Layering images can create interesting depth.
Instructions for Mixed Media Collage:

1. Begin by revisiting your image transfer on the canvas panel and consider a theme. Start cutting out images from magazines and looking through scrap papers and embellishments. Do not think too much, about which images might work best. Instead, allow the search to be an organic process.

2. When you are satisfied with the number of images and additional materials you have selected, begin assembling and gluing them onto your prepared canvas panel with gel medium. Coat the surface of the panel with gel medium. Position your images and papers into the wet gel on the panel. Coat the item with another layer of gel medium from the center outward, using the brush to press down and smooth any bubbles. Continue with addition images and objects.

3. When you are prompted (after 40 minutes) to do so, set aside your collage materials and take up your pen and writing paper. Use the remaining class time to write. Consider thoughts or ideas that may have arisen because of the collage activity.

Resources:

✓ The International Museum of Collage, Assemblage and Construction:
  http://collagemuseum.com

✓ Kolaj Magazine, which focuses on contemporary collage:
  http://kolajmagazine.com/content/

Art Session 8: Activity, Goals, Materials, Supplies and Instructions for Exercise

| Session 8 | SENSATION DRAWING: Sensorial Perceptions |

**Sensation Drawing**

**Educational Purpose:** This exercise will explore expressive drawing techniques. Participants will broaden their experiential knowledge of drawing materials by incorporating sensorial perceptions. They will experiment with line, pattern, and color to represent their felt experience.

**Social Interactions:** Participants will interact with session leaders and other participants. Mechanism for interactions will include questions and comments between leaders and participants. Participants will be sharing drawing materials with one another.

**Goals/Benefits:** Facilitate participant-art medium interactions, increase knowledge; stimulate cognitive abilities and skills; stimulate sensorial expression. Increase concentration. Restore directed attention; enhance motor skills [hand-eye coordination]; experience group interactions; enjoy activity.

**Materials and Supplies:**
- Drawing paper
- Graphite Pencils
- Pens
- Colored Pencils
- Markers

**Considerations for Sensation Drawing:**
- Focus on non-visual sensations
- For this activity you can take two approaches:
  1. Pay close attention to sensations found in your environment
  2. Imagine what it’s like to experience various sensations

**Instructions for Sensation Drawing:**

This activity was adapted from the Stanford University’s online course, *Drawing Inspiration: Developing a Creative Practice* with the artist and instructor, Trevor Tubelle.

1. Get comfortable and recognize your non-visual senses.

2. Divide up a piece of drawing paper into four equal sections and label each section with one of your non-visual senses (hearing, taste, smell, and touch).

3. Focus on or imagine one of your senses at a time, e.g., close your eyes while imagining the taste of some spicy food or sound of calming music, the feel of a soft textured sweater, etc. Or, try to be focused and acutely conscious of your body’s reactions and associations. Focus on the sensation of the hard seat beneath you or the quiet sounds of people working and speaking softly.

4. Respond to the stimuli by drawing marks that represent or express each sensory experience in a literal or metaphorical way and fill the corresponding section on the page.
5. If you have time, do this for all your non-visual senses at least three times, which means that you would divide and fill three pages with marks.

As an example, if I was imagining drinking strong coffee I would go to the area on the page labeled “taste” and draw marks that visually show how that coffee tastes on my tongue as the hot liquid goes down my throat (I imagine lots of dark, energetically clustered and smooth flowing lines). It can be an odd, and sometimes challenging, experience to translate non-visual sensory information into visual marks, but in essence, we are doing this all the time when we are drawing or writing.

**Resources:**

- Trevor Tubelle’s Website: [http://tubelle.com/](http://tubelle.com/)
- Link to Stanford University’s online course Drawing Inspiration: Developing a Creative Practice: [http://online.stanford.edu/course/drawing-inspiration-developing-creative-practice](http://online.stanford.edu/course/drawing-inspiration-developing-creative-practice)
Glossary of Key Terms

**Baren** = Traditional printmaking tool used for burnishing.

**Batik** = Technique of wax-resist dyeing cloth.

**Brayer** = Hand tool used in printing, printmaking, and collage.

**Collage** = Artwork created from an assemblage of different parts or materials.

**Deckle** = Removable top part of a hand mold, used to determine sheet's paper and size in papermaking.

**Gel Medium** = Binder that used in acrylic paints without any pigment added for color. Can be used as transfer medium, paint thickener, adhesive or sealant.

**Hand mold** = Tool for making paper by hand, consisting of a screen, screen support and deckle.

**Linocut** = Design carved in relief on a block of linoleum.

**Masking Fluid** = Solution of latex in ammonia used to block out areas of a watercolor while painting.

**Substrate** = Substance or layer that underlies something.
LIST OF REFERENCES


Detweiler, M., Sharma, T., Detweiler, J., Murphy, P., Lane, S., Carman, J., . . . Kim, K. (2012). What is the evidence to support the use of therapeutic gardens for the elderly? *Psychiatry Investigation, 9*(2), 100-110. doi:10.4306/pi.2012.9.2.100


BIOGRAPHICAL SKETCH

Raymond Gabriel Odeh is a native Floridian, born and raised in subtropical Sarasota, Florida. Raymond’s interest and ultimate passion for horticulture and horticultural therapy (HT) have developed through a series of early exposures and volunteer experiences. In his youth, Ray spent a great deal of time with his grandmother Mary who taught him how to propagate Crepe Myrtles. During high school, in preparation for qualifying for Florida’s Bright Futures Scholarship, Ray volunteered at local organizations in his hometown before discovering Marie Selby Botanical Gardens, which is truly a display of horticultural expertise. Observing the projects at Selby and learning from the skilled horticulturalists sparked his excitement about the cultivation of his very own garden. High school was stressful, and his home garden was a place of respite where he could get away from those stresses and pressures. This grew into his present passion for horticulture and horticultural therapy, and led to his matriculation into the University of Florida’s Department of Environmental Horticulture.

Completing his bachelor’s degree in plant science fueled his passion and gave him the tools to move on to a master’s degree in horticultural sciences at UF. In August 2016, Raymond commenced his Master of Science under the direction of Charles Guy, PhD. Together, Charlie and Ray with a committee of colleagues across the University of Florida developed a robust experiment to contribute quantitative and qualitative evidence to broaden support for the use of HT in such places as hospitals, prisons, assisted-living facilities, schools, etc. With enhanced evidence-based support and clear communication of the range and magnitude of therapeutic benefits achievable by
gardening, more individuals may share in the quality of life benefits associated with horticulture.

Throughout his master’s program Raymond has concurrently worked to achieve his goal of registration as a horticultural therapist, a goal which he anticipates completing by the end of his master’s program. Ultimately, Raymond strives to continue developing quality research to inform an evidence-based practice in HT, an approach in which the horticultural therapist can develop an individualized horticultural treatment plan based on the physical, cognitive, psychological, and social needs of a client. Raymond is a researcher, an educator, and a leader in the field of horticultural therapy and people-plant interactions, and plans to continue on this path toward his career goals.