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Tendu to Tango Across the Lifespan: An Argument for Prioritizing Fixed Ballet Instruction as a Contemplative Practice for the Adolescent Mind and Social Dance Instruction for Healthy Aging in the Elderly Population

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Honors Thesis

TENDU TO TANGO ACROSS THE LIFESPAN: AN ARGUMENT FOR PRIORITIZING FIXED BALLET INSTRUCTION AS A CONTEMPLATIVE PRACTICE FOR THE ADOLESCENT MIND AND SOCIAL DANCE INSTRUCTION FOR HEALTHY AGING IN THE ELDERLY POPULATION

by
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ABSTRACT

TENDU TO TANGO ACROSS THE LIFESPAN: AN ARGUMENT FOR PRIORITIZING FIXED BALLET INSTRUCTION AS A CONTEMPLATIVE PRACTICE FOR THE ADOLESCENT MIND AND SOCIAL DANCE INSTRUCTION FOR HEALTHY AGING IN THE ELDERLY POPULATION

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Why dance? This thesis investigates and provides arguments for prioritizing different dance training methods and styles across a person's lifespan for maximum neurological and mental benefit. Beyond the interpersonal, motivational, and creative skills it delivers, dance training provides significant neural benefits for the developing adolescent brain from ages 10-24 and the healthily aging brain. Additionally, there are significant implications for dance's aid in the prevention or delay of symptoms of dementia, Alzheimer's disease, and Parkinson's disease.

According to the synthesis of research provided in this thesis, fixed ballet training is an optimal form of ballet training for adolescents because of its features consistent with a contemplative practice. Contemplative practice exercises volitional control to sustain focus on a particular subject or action, an optimal activity for developing the focal

networks in the adolescent brain. Furthermore, contemplative practice induces plasticity changes in the brain, which have shown to improve sustained attention, putting students on a better path for academic success.

On the other end of the lifespan spectrum, elderly individuals, aging either healthily or rapidly, can benefit significantly from social dance, which exercises the brain's plasticity to create new, stable connections—allowing the brain to slow aging to a degree where the quality of life is improved substantially. Further, social dance promotes a learning-filled, creative, and social environment optimal for aging individuals who typically lose access to necessary social and creative interactions. Thus, these dance-focused therapeutic activities, accessible to all, must be more widely encouraged for society's youth and the elderly for the development and therapeutic benefits they provide.

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PROVIDED DEFINITIONS OF TERMS

Adolescent Years

Recently, the defined age range for adolescent development was modified in the scientific community. Adolescence encompasses growth in an individual's biology and social roles and has been redefined to ages 10-24 to more closely correspond to the growth of today's youth. The widely agreed age and currently accepted range has varied historically and across cultures.

Neurological Benefit

This defines the physical, biological, and chemical changes within the brain.

Mental Benefit

This defines the state of well-being and encompasses behavior and cognition.

Contemplative Practice

Contemplative practice refers to structured mental or physical exercises whose practice, or mindfulness, requires an individual to voluntarily exercise control over his or her mind to focus on specific ideas or tangible objects. Contemplative practices include but are not limited to: meditation, yoga, tai chi, ritual, reflective writing, and dance. Systematic practice refers to the repeated exercise of contemplative practice.

Functional Connectivity

This term refers to the activation of differing regions of the brain with the same functional characteristics. For optimal brain function to occur, functional connectivity must be strong, allowing necessary regions of the brain to work together.

Fixed Ballet Training

A method of ballet training involving set combinations performed regularly. Fixed ballet training focuses on drilling the same combinations over time and within defined levels, rather than relearning or recreating combinations each class or every few classes.

Dynamic Ballet Training

A method of ballet training involving learning new combinations regularly. Dynamic ballet training focuses on memorizing new combinations each class or every few classes and is often accompanied by new music.

I. INTRODUCTION

For thousands of years, humans have intuitively understood that there are underlying psychological and physical benefits of dance, as evidenced by the presence of cultural, healing, religious, or social dances present in every culture. Many prominent physiological benefits of general dance have been proven through scientific research, including neuroscience. Drawing on such scientific evidence, this thesis intends to argue for the prioritization of fixed ballet training and social dance for adolescent and elderly groups respectively.

What makes dance distinctive compared to other physical or cognitive activities? Richard Powers, a full-time instructor in Stanford University's Dance Division, argues that dance "integrates several brain functions at once — kinesthetic, rational, musical, and emotional — further increasing your neural connectivity."[1] Powers importantly notes the multi-faceted learning method of dance. Dance requires the integration of musical, physical, emotional, social, and observational skills. As a result, strict focus and deliberate concentration between the brain and the body is a necessity; a focus that can be powerful for an individual. This paper is not necessarily an argument for dance compared to other activities, but rather argues for prioritizing training in specific types of dance compared to other types of dance at various ages for maximum neurological and mental benefit.

Dance has a remarkably prominent influence on the brain's plasticity and intra-neural connections as they relate to healthy neurological development, as well as clinical disorders. Dance can be used in strengthening the key areas of the adolescent brain

[1] Richard Powers, "Use It or Lose It: Dancing Makes You Smarter, Longer," Stanford Dance, last modified July 30, 2010, accessed August 3, 2019, http://socialdance.stanford.edu/syllabi/smarter.htm.

involved in cognitive focus, as well as in a healthy aging brain and treatment plans of individuals who suffer from more extreme forms of aging such as dementia, Alzheimer's and Parkinson's.

In two distinct discussions, I will present the synthesized scientific evidence that supports these arguments, including MRI and fMRI studies and findings, as well as first-hand observations of individuals who use these methods of dance training in the respective populations I have identified. These individuals have seen their methods implemented from the ground up with beginners and are therefore witnesses to the age-specific benefits they provide.

First, I will discuss the adolescent brain's development and the critical evidence surrounding the importance of contemplative or meditative practice for adolescents. I will subsequently argue for fixed ballet training's compatibility and consistency with systematic practice, specifically focused attention meditation and its importance for adolescents instead of dynamic ballet training. Further, I will present an integrated series of interviews from those who are uniquely trained in fixed ballet training in their adolescent years, with the intent to show the experienced cognitive benefits as perceived by these successful individuals.

Second, I will present research on the importance of dance in healthy aging and its increased importance for those who suffer more extreme aging, such as dementia, Alzheimer's, and Parkinson's. Dance's ability to increase neural connections within the brain and rewire around damaged neural connections provides afflicted elderly individuals improved chances of quality life. Further, I will present an integrated interview with a Senior Executive Director from a senior living facility in Utah, with the

intent to develop a plan that considers potential barriers to implementing a social dance program at elderly facilities.

My thesis draws on the research of neuroscientists, contemplative scientists, sports scientists, physiologists, and dance scientists. This thesis, primarily in its initial stages, also draws minorly on my own embodied, intellectual, and social knowledge of ballet and social dance as it relates to therapeutic and beneficial impacts on neurological health. My foundation in ballet technique, including fixed ballet training, has developed over 18 years as I have studied dance across the world in Italy, Paris, New York, Arizona, Utah, and Chicago. This background helped initiate the exploratory elements of my thesis, which lead to the further discovery of the cognitive benefits both youth and elderly stand to gain from prioritizing consistent specific methods of dance training and styles.

II. BALLET FOR THE ADOLESCENT YEARS (10-24)

Though ballet is becoming more widely used as a therapy and treatment for neurological disorders and degenerative diseases, its impacts on the healthy and developing brain are still being researched. As a result, few studies have been conducted focused explicitly on adolescents and ballet as a contemplative practice. Therefore, the following section synthesizes information from various studies and concludes that fixed ballet training during adolescence is a valuable tool in developing a healthy brain.

Adolescent Neurological Development

Understanding the brain's development through adolescent years is crucial to understanding what practices encourage optimal development. During childhood, a healthy developing brain reaches its total size. However, neuroimaging has revealed that key changes in region-specific structures continue during adolescence, leading to unique patterns in adolescent behavior and responses in the brain. During adolescence, white matter, the brain tissue containing myelin-covered axons, continues to increase in volume.[2][3] Simultaneously, the adolescent brain engages in synaptic pruning, eliminating "energy expensive" synapses and neurons that are not regularly activated.[4]

Jill Sakai, a science writer from the University of Wisconsin-Wisconsin, notes that an infant has almost 100 billion neurons at birth. By adulthood, this number decreases by 15%. Sakai explains, "as we learn and grow, our experiences strengthen the

[2] Axons are the structural part of a nerve cell that conducts impulses to other cells allowing them to communicate.

[3] Myelin is the fatty layer surrounding axons which increases efficiency and speed in cell signaling throughout the brain. Myelination is the increase of these fatty layers throughout the brain.

[4] Synapses are the small spaces in between neurons that allow a signal to travel from one neuron to another.

circuits that prove most relevant while others weaken and fade." Sakai references Jeff Lichtman, a neuroscientist from Harvard University, "One extreme view of this would be that you start out wired up for every possible contingency...Over time, a large percentage of those wires are permanently disconnected...What you're left with is a narrower nervous system...But it's tuned exactly to the world you found yourself in."[5] In other words, the brain starts off exhibiting the abilities of a wild card, eventually wired to be what it needs to be through synaptic pruning.

As the brain interacts with its surroundings, including new people, environments, and situations, it structurally changes and adapts its pathways in response to experience. New experiences activate different parts of the brain, perhaps regions with less activity, encouraging myelination new connections. In other words, the brain specifically wires itself more efficiently to meet the needs of specific human experience. Throughout the neuroscience community, the simple phrases coined by Shatz, "neurons that fire together wire together," and "out of sync, lose your link," provide an elementary framework to understand how vital activating certain parts of the brain are in neural pathway development. The brain's ability to change and adapt is known as neuroplasticity and is vital in learning and development.

In fact, while the brain can undergo these plastic changes throughout the lifetime, even in elderly years, studies have shown that adolescence is a crucial timeframe for development. In an article by Jagmeet S. Kanwal, You Jin Jung, and Ming Zhang of the

[5]Jill Sakai, "Core Concept: How synaptic pruning shapes neural wiring during development and, possibly, in disease," *Proceedings of the National Academy of Sciences of the United States of America* 117, no. 28 (July 14, 2020): 16096, accessed April 14, 2021, https://www.pnas.org/content/117/28/16096#:~:text=%E2%80%9COne%20extreme%20view%20of%20this,are%20permanently%20disconnected%2C%20says%20Lichtman.

Department of Neurology at Georgetown University, they noted that adolescence is a key time for maximal plasticity because neural circuits are more modifiable at different stages of life.

> The time period during which a system is maximally plastic is called a critical time window, which terminates with the crystallization of a generally irreversible behavioral outcome. In humans, many critical time windows that open and close during brain development are closely associated with the teenage years, also referred to as "adolescence."[6]

This indicates that the adolescent brain is in a vital window for engaging in activities that can support this plastic development.[7] For this reason, activities should be carefully formulated to provide the brain with the optimal scenario to succeed.

Just as with the exercise-induced breakdown of muscles, the brain needs access to essential nutrients and hormones to maintain and build its internal structure for efficiency in response to demanded plastic changes. Activities that engage specific brain areas induce blood flow to those areas, flooding the areas with necessary nutrients that subsequently aid restructuring and plasticity. As rapid turnover is needed to restructure the brain beneficially, active engagement of key areas is needed to induce blood flow that supports beneficial plasticity.

Conversely, when specific brain regions are utilized less and receive less vascular support, they are subject to synaptic pruning and deprioritizing their functions. One

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[6]Jagmeet S. Kanwal, You Jin Jung, and Ming Zhang, "Brain Plasticity during Adolescence: Effects of Stress, Sleep, Sex and Sounds on Decision Making," *Anatomy & Physiology: Current Research* 6, no. 1 (December 14, 2015): 1, accessed April 8, 2021, https://www.longdom.org/open-access/brain-plasticity-during-adolescence-effects-of-stress-sleep-sex-andsounds-on-decision-making-2161-0940-1000e135.pdf.

[7] In this context, the term "plastic" refers to the capacity for alteration and malleability.

specific region of the brain, the prefrontal cortex (PFC), is vital in working memory, executive function, and regulating focus and attention. The combination of low activation, low volume, or excessive synaptic pruning, otherwise known as "hypofrontality," of the PFC, coupled with poor functional connectivity to the other regions of the brain, is associated with many adverse psychological disorders, including ADHD, chronic depression, bipolar disorder, OCD, PTSD, schizophrenia, and addiction.[8] Many of these disorders negatively affect adolescents, impacting their relationships and academic performance, leading to further issues like poor self-esteem and major depression. In fact, according to the World Health Organization, childhood behavioral disorders, such as ADHD and OCD, are the "second leading cause of disease burden in adolescents aged 10-14 years and the eleventh leading cause among older adolescents aged 15-19 years."[9]

Individuals with ADHD struggle with cognitive control, especially in overriding responses that provide immediate reinforcement—both positive and negative—and ignoring other stimuli. Studies have shown that major depression commonly occurs in conjunction with ADHD. Doctor Atilla Turgay of Scarborough Hospital made the observation that frequently, individuals with ADHD also suffer from "'demoralization,' or a low/sad mood and chronic unhappiness. The inability to live up to their potential creates a sense of loss, and many experience 'the inner pain.'"[10] Frustration with the

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[8]Willoughby Britton and Arielle Sydnor, "Neurobiological Models of Meditation Practices: Implications for Applications with Youth," in *Teaching Mindfulness Skills to Kids and Teens*, ed. Christopher Willard and Amy Saltzman (New York: Guilford Press, 2015), 404.

[9]"Adolescent Mental Health," World Health Organization, last modified September 28, 2020, https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health.

[10] Atilla Turgay and Rubaba Ansari, "Major Depression with ADHD," *Psychiatry (Edgmont)*, April 2006, 22, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2990565/.

inability to achieve cognitive control results in, what many would agree with, diminished quality of life and experience. Cognitive control can waiver for even the healthy brain, leading to avoidable difficulties in school, relationships, and behavior. All of the conditions above present as clinically diagnosable disorders. However, adolescents who do not have severe enough symptoms to be identified as ADHD or ADD may still struggle from weakness in the PFC or important neural connections and have difficulty voluntarily focusing.

There are a wide variety of psychiatric conditions and difficulties strongly influenced by the decreased functionality of the brain's prefrontal region. It follows, therefore, that strengthening this region of the brain to minimize adverse effects would be of great benefit. The period of adolescence is a small window to strengthen and develop the neural pathways in the focal regions of the brain, which could help alleviate problematic clinical issues. Therefore, it stands that adolescents should engage in activities that specifically activate and thus encourage connection development in and between these individual neural units to foster healthy development and lasting mental benefits.

Contemplative Practice

Contemplative science is a rapidly developing, interdisciplinary branch of science dedicated to the mind's metacognitive self-regulatory capacity (MSRC). Contemplative science studies the mind's ability to be critically aware of its awareness. Contemplative practice and its effects can be difficult to quantify but analyzing the basic foundations of brain functionality and how it responds to contemplative practice has allowed scientists to identify its benefits.

Focused attention (FA) meditation is a key activity in contemplative science and engages in enhancing cognitive awareness while maintaining attentional control on one element. In a study by Wendy Hasenkamp and Lawrence W. Barsalou of Emory University, highly practiced meditative individuals were asked to focus on their breathing, a form of FA meditation.[11] They then underwent an fMRI scan which is a scan used to detect blood flow changes in the brain. This test is based on the understanding that blood flow and brain activation occur in conjunction, but not necessarily simultaneously, as increased oxygenated blood flow quickly follows brain activation. Carefully observing this blood flow allows researchers to identify what specific activities stimulate which parts of the brain. Participants were asked to push a handheld button when they became aware that their attention shifted from their breath. Hasenkamp and Barsalou hypothesized that this would provide information as to when awareness of mind wandering occurred. Moments of AWARE, SHIFT, and FOCUS were identified, and the fMRI scan detected activity in the brain during the AWARE phase. These high-meditative experience participants were then compared to participants with lower meditative experience.

Focus requires simultaneous activation of multiple parts of the brain, including the frontoparietal network and the prefrontal cortex. Individuals with stronger voluntary focus and attention skills have greater functional integration between these pieces, thus allowing them to focus at a greater capacity voluntarily. The fMRI scan revealed stark

[11] Wendy Hasenkamp and Lawrence W. Barsalou, "Effects of Meditation Experience on Functional Connectivity of Distributed Brain Networks," *Frontiers in Human Neuroscience* 3 (March 2012): 1-14, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3290768/.

key differences in the functional connectivity in the brains of those with more meditative experience.

This experiment supports the theory that participants with greater meditative experience have increased functional connectivity among regions involved with attention, including the dorsolateral prefrontal cortex, an important part of the frontoparietal network because frequent activation supports plastic changes of increased connectivity. Hasenkamp and Barsalou note in their study that the FOCUS phase of the experiment most likely accounts for a significant percentage of the overall time the subjects spent in their meditative state. Because of this, researchers believe that with repetition, the neural networks involved in supporting voluntary focus could undergo lasting, beneficial plastic changes. This study indicates that repeated activation of the "focus" regions of the brain and others will most likely strengthen functional connectivity, allowing one to improve his or her brain's default ability to stay alert and focused voluntarily.

The study showed higher functional connectivity in areas of the brain involved in cognitive tasks such as internal awareness, sustained focus, and voluntary behavior due to repeated activation involved in the subjects' meditation practice. For those with more meditative experience, the repetition of focused attention meditation activated critical areas involved in focus and cognition, causing increased, oxygenated blood flow, and supporting structural changes for stronger focus efficiency in future practices.

Other studies on meditation's benefits look at subjects over time, analyzing the benefits of FA meditation on tasks that use the same attention and cognitive skills. In a longitudinal study on the long-term effects of intensive FA meditation by Antoine Lutz et al., subjects demonstrated enhanced stability in attention. Those who showed the most

significant increases in stability also showed the greatest decrease in behavioral variability. In other words, they showed enhanced consistency in focus-requiring tasks. This most likely indicates changes due to actual rewiring within the brain.[12] The intensive FA meditation put the subjects' brains on a set track to activate the focus center, limiting variable activations. The conclusions from this longitudinal study make it clear that attentional skills are subject to training. Due to the brain's plasticity, cognitive attention can be learned and trained through meditative practices.

Another collaborative study by researchers from the University of Arkansas, the University of California, and the University of Miami, focuses on the effects of concentration meditation practice on interference control, or the resisting distracting stimuli.[13] Concentration meditation, like FA meditation, focuses an individual's attention on one thing. In the study, participants were randomly assigned to either a 3-month meditation training retreat or to the waitlist controls who later had their own 3-month training. The waitlist group was tested as a control group at the same time as the first retreat group. Participants were shown a set of five letters on an LCD monitor: (XXXXX) (XXZXX) (ZZZZZ) (ZZXZZ). Participants were shown the letters for 1/10 of a second and asked to press a mouse button to indicate whether the middle letter was an X or a Z. The idea of this task was to test the participants' interference control, measuring if they could focus on the middle letter while ignoring the other letters, meant to be distracting stimuli.

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[12]Antoine Lutz et al., "Mental Training Enhances Attentional Stability: Neural and Behavioral Evidence," *The Journal of Neuroscience* 29, no. 42 (October 21, 2009): 13418-27, https://www.jneurosci.org/content/jneuro/29/42/13418.full.pdf.

[13] Grant S. Shields, et al., "Brain, Behavior, and Immunity," ELSEVIER, 1-12, https://doi.org/10.1016/j.bbi.2020.06.034.

Results found that the initial retreat group showed significantly higher levels of controlled attention, as well as total automatic attentional activation than the waitlist-control group. Later, when the waitlist control group had their own 3-month training retreat, they also improved significantly. These results caused researchers to believe that "the strengthening of controlled attention appears to be a reliable effect of meditation training," because improvements were observed reliably in each group.

As revealed in multiple studies, cognitive function does not lie in a singular portion of the brain, given that it requires the joint activation of key structures through functional connectivity. No cognitive skill, especially involving voluntary attention, can be strengthened by activating just the prefrontal cortex. These studies show that contemplative practice, specifically FA meditation in its ability to induce plastic changes to improve functional connectivity, is a promising training tool to strengthen the areas of the brain dedicated to focusing.

Contemplative Practice – Benefits Catered for Adolescents

During adolescence, the brain undergoes a cycle of continued myelination and synaptic pruning, resulting in further differentiation in the brain's distinct regions. Increasing connectivity between these regions is vital to cognitive control, or voluntary behavior, and is possible through plasticity. As cited in an article in *The Journal of Neuroscience*, "Cognitive control is required to regulate interactions between brain regions to produce effective, purposeful behavior."[14] Cognitive control allows an individual to coordinate his or her thoughts and actions toward goals and intentions.

[14]The Journal of Neuroscience, February 1, 2006, 1429, https://www.jneurosci.org/content/jneuro/26/5/1429.full.pdf.

Skills such as sustained attention, information processing, working memory, and interference control are all supported when functional connectivity is strong, and as a result, cognitive control is also. For students from ages 10-24, success in these skill areas is vital for academic achievement, social integration, and positive behavioral development because decision-making and voluntary behavior play a vital role in an individual's success during these developmental years.

To succeed academically, students must actively pay attention and frequently study. This requires voluntary focus and alertness. For children and teenagers to develop healthy, lasting social relationships, they must engage in active decision-making, which promotes harmony, rather than acting on impulses, which results in discord. To develop positive behavior, adolescents must think critically and determine the best response to conflicts that arise. All of these actions require cognitive skill and control. Such skill development is crucial for elementary and college students alike and should thus be encouraged through specific supplemental means.

When the function and development of the brain are put into perspective and context with the rapidly changing world, it becomes clear that voluntary attention, an important cognitive skill for success in school, relationships, work, and happiness, is increasingly declining in the adolescent population. With the ever-increasing ability to find any information with a few keyboard clicks on a laptop or the phone readily in pocket comes severe disadvantages and changes.

According to recent surveys by Common Sense Media, a non-profit organization that promotes safe technology use for children by educating families, 53% of adolescents in the U.S. own a smartphone by age 11, and almost 84% of teenagers have their own

phones.[15] Microsoft conducted a longitudinal study on the attention span of teens and young adults and found that from 2000 to 2016, the average attention span decreased from 12 seconds to merely 8.[16] In its report, the technology giant admitted that technology is harming sustained attention. But how? When the brain encounters something stimulating, dopamine, a "feel good" neurotransmitter, is released, essentially rewarding the individual. Likewise, when something is not as stimulating to the brain, this neurotransmitter is not released in the same quantity. With no discernable reward, the individual moves on in a matter of seconds.

The average public-school lesson runs from 50 to 90 minutes, while undergraduate college lectures can range from 50 to 180 minutes. With incompatible attention spans, students can struggle to focus, impeding their ability to complete schoolwork timely and study well, which can greatly impact family, social life and well-being.

One solution is improving functional connectivity, which is directly related to cognitive control. As the research indicates, functional connectivity and cognitive control are directly related, with an increase in functional connectivity resulting in a linked positive change in cognitive control. When the brain has strong interconnectedness supporting cognitive control, it can override prepotent or instinctive responses, ignore unimportant environmental stimuli, and multi-task. Given the unquestionable benefits of contemplative practice for the development of the adolescent brain, adolescents must

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[15]Victoria Rideout and Michael B. Robb, "The Common Sense Census: Media Use by Tweens and Teens," Common Sense Media, last modified 2019, https://www.commonsensemedia.org/sites/default/files/uploads/research/2019-census-8-to-18-full-report-updated.pdf.

[16]"Attention Spans," Microsoft, last modified 2015, https://dl.motamem.org/microsoft-attention-spans-research-report.pdf.

engage in activities to strengthen cognitive control. As discussed below, a synthesis of my research supports the conclusion that fixed ballet training is a valuable tool to strengthen functional connectivity, and therefore cognitive control in adolescents.

Why Fixed Ballet Training?

Considering the many benefits of meditation, readers may question why ballet or fixed ballet training may benefit beyond meditation alone. While meditation is substantially beneficial for increasing functional connectivity and developing the neurological pathway necessary to sustain focus, another essential part of adolescent brain development must be considered: myelination. Myelination increases the efficiency of brain signal communication. An average unmyelinated axon signal runs at a velocity of about 0.5 to 10 m/s, but in a myelinated axon, signals can be conducted up to 150 m/s.[17] When the signals that govern cognitive processes become quick and efficient, cognitive skills are also subject to magnified improvement. While meditation can strengthen connections to achieve focused attention, efficient brain signal is important to support this improvement further. Therefore, an activity that both strengthens and myelinates cognitive pathways is superior.

Exercise is a key factor in supporting myelination because it increases myelin protein expression.[18] Studies found that regular exercise is associated with a larger volume of white matter, or myelination, within the brain. Therefore, meditation, coupled

[17] Increased Conduction Velocity as a Result of Myelination," in *Neuroscience*, 2nd ed. (Sunderland: Sinauer Associates, 2001).
[18]"Analyzing the Role of Diet and Exercise in Myelin Production," Mayo Clinic, last modified October 11, 2016, https://www.mayoclinic.org/medical-professionals/physical-medicine-rehabilitation/news/analyzing-the-role-of-diet-and-exercise-in-myelin-production/mac-20429394.

with ballet, a form of exercise, more fully supports the holistic activity recommendation for adolescents in supporting the entirety of healthy development.

Additionally, while the term adolescent does indeed encompass older and more mature individuals, it also encompasses an age range as young at 10. Because adolescent ages span from approximately 5th grade to near graduate school, approaches must consider the population's average attentiveness and energy expenditure as a whole. Children struggle to sit still and regulate their energy and mind. While exercise is effective in helping kids get this energy out, it is not meditative and excites many areas of the brain rather than just the attentive pathway. It does not, therefore, provide benefits for cognitive control. Fixed ballet training, on the other hand, as a form of meditation, can provide a multimodal approach to neurological and mental benefit.

Fixed Ballet Training vs. Dynamic Ballet Training

Medications are expensive, can produce unwanted side effects, and sometimes do not solve the problem they are prescribed to address. Different types of therapy counseling can be beneficial but primarily work to cope with the emotional and mental effects caused by the brain's structural problems or inefficiencies. In essence, many current "solutions" are merely superficial. These "solutions" address symptoms but frequently do not address the underlying condition or promote healthy development from the inside out. Movement therapy practices, however, can promote lasting changes within the brain. Ballet, a physically active practice that promotes physical and mental health, is an easily accessible practice where the only equipment needed is one's body and open space. As I have labelled and defined them, fixed ballet training and dynamic ballet

training are two pedagogical methods of dance training, each with its own purpose and each reaping its own benefits.

In a typical ballet class, students are constantly asked to learn new combinations to new timing and music, splitting their attention between many different factors. As a result, the environment can be hectic and is not usually conducive to a focus-encouraging setting. This can result in frustration, injury, boredom, and distraction in adolescents. For the purposes of my analysis and synthesis, I have labeled this method of training dynamic ballet training.

Contrastingly, I define another form, fixed ballet training, as a repetitive set of combinations practiced the same way, to the same music each day, according to the individual's level of training. The student focuses all attention on the mind-body connection to develop and achieve the correct technique. Ballet is based in movement and, on the surface, may not appear to correlate with meditation. However, after analysis, I would argue that fixed ballet training is an FA meditation method because it focuses on one thing: mind-body connection inhabited within the technique. While meditation is commonly believed to be a stationary mindful practice, historical criteria for the most basic form of meditation, founded in Buddhist tradition, rely on four distinct features.[19]

1. Each practice must induce a predictable and distinctive state that can be observed by cognitive or physical features or events.
2. The state should have a predictable effect that can enhance positive traits and dissolve negative traits if repeatedly practiced.

[19]Antoine Lutz, John D. Dunne, and Richard J. Davidson, "Meditation and the Neuroscience of Consciousness," in *The Cambridge Handbook of Consciousness*, by Philip David Zelazo, Morris Moscovitch, and Evan Thompson (Cambridge [England]: Cambridge University Press, 2007).

3. The practices should be gradual in that improvement is possible over time, improvement that is "marked especially by two phenomenally reportable features: the acquisition of certain traits (cognitive, emotional, or physical) and/or the occurrence of certain events (cognitive, emotional, or physical)."
4. The practice must be learned from a teacher who is an expert in the practice to guide and assist.

As described in the "Provided Definitions of Terms," fixed ballet training firmly adheres to each of these distinct features of meditation. First, in fixed ballet training, combinations are distinctly set, predictable to the dancer, with no areas of uncertainty. Counts and timing are set and put the dancer in a maintainable rhythm. Second, fixed ballet training is developed upon the commonly understood process of habit breaking and habit making. Studies show that it takes 18 to 254 days to make or break a habit if practiced repeatedly.[20] Therefore, good or bad habits in physical technique or mental consistency need repetition, the framework of fixed ballet training. Third, fixed ballet training is founded upon the idea that when the set combinations are repeatedly practiced, visual improvement of technique and internal mind-body connection is expected because attention does not have to be split between technique and memorizing a new combination. Fourth, fixed ballet training is taught by highly trained ballet professionals who understand the perfect technique and have spent years crafting the combinations to achieve a specific state where improvement and functional repetition is possible.

Conversely, dynamic ballet training is quite the opposite. The combinations are not set and often contain areas of uncertainty. With the mind spread thin between staying

[20]Phillippa Lally et al., "How Are Habits Formed: Modelling Habit Formation in the Real World," *European Journal of Social Psychology*, https://onlinelibrary.wiley.com/doi/full/10.1002/ejsp.674.

on time with the music, maintaining spatial awareness, trying to memorize the combination, and other factors, it is difficult to focus on making and breaking good and bad habits in technique. There is an element of chaos involved in the average dynamic ballet class that is not conducive to the healthy development adolescent mind. It is a training style far off from the calm, focused meditative form of fixed ballet training.

For adolescents with a need for brain connectivity and cognitive development, I argue that one of these methods is optimal: fixed ballet training. Contemplative practice, specifically FA meditation as aforementioned, has been proven to activate and thus create beneficial, plastic changes in the brain's connectivity, thus solving problems and preventing others from the inside out.

At its foundation, fixed ballet training distinctively follows the features required in basic Buddhist meditation. As for FA meditation, it also follows definitionally. Compared to dynamic ballet training, which requires split focus on learning, memorizing, and performing a new combination, which by practice is the opposite of meditation, fixed ballet training maintains focused attention on a single object: the body. Fixed ballet training follows the definitional form of focused attention meditation, and it follows, therefore, that the plastic changes and conclusions observed and quantified in the FA meditation study would apply to fixed ballet training.

II. THE BENEFITS PERCEIVED - INTERVIEWS

Fixed ballet training as a form of meditation for cognitive focus benefits is a new concept synthesized from FA meditation research and meditation concepts. As a result, it has not been specifically researched. However, it has been practiced and experienced by dancers for several decades at Faubourg Theatre in Hanover Park, Illinois.

In my early adolescent years, from 2010 to 2014, I trained at Faubourg, a studio that had deeply integrated this unique method of training. In 2010, after one private lesson with the director, Watmora Casey, I was sent home with a DVD and asked to come back to the studio with all of the routines memorized. Each level had its own, carefully developed, set barre and center repeated almost daily for years until each careful movement was perfected and the dancer was ready to move to the next level. To this day, Faubourg dancers know each intricate move to each routine and how each movement correlates to the music. This training method was starkly different than the dynamic ballet training I grew up with, and even though the combinations remained the same day to day, I found that my focus was unwavering. As my body progressed through the routine class, I no longer had a split focus toward being on time with new music, memorizing and executing new combinations, and my technique. Instead, I keyed in on a meditative rhythm of executing a known combination and choosing to focus on the technique or quality of my movement. Almost ten years later, my research indicates that day after day, and hour after hour, I had been training my brain to enter into a focused state and stay there for extended periods of time.

Several generations of dancers have been exposed to this method of fixed ballet training and shaped by its benefits. Despite humble facilities and circumstances, the

young adolescents at this studio exhibited extremely sharp focus in class and beyond the studio. Their awareness, confidence, discipline, motivation, and focus were unmatched, particularly for their age. Why? Much of this can be attributed to the focus gained from fixed ballet training. Through observation, there was a remarkable change in these said characteristics from when the dancers began training and after they had learned the repetitive technique exercises over time.

Though this synthesized theory has not yet been specifically studied through scientific research, it has been informally tested by generations of dancers over several decades. To gauge whether this theory should be tested at a scientific level, I interviewed the director of Faubourg School of Ballet, as well as several successful dancers and academics who trained using this method to collect qualitative data and testimonials of the perceived benefits experienced by those who engaged in this type of training for several years.

Watmora Casey Interview

Watmora Casey is the founder of Faubourg Theatre and recipient of the Outstanding Teacher Award in the 2011 Youth America Grand Prix Finals, the largest international student ballet competition. This award is an elite honor given to only one instructor worldwide at the Finals. Casey drew on his training from serving in the military. He explained that in training, soldiers were created from the repetition of basic concepts and ideas. On the battlefield, where there are many variable elements, he said that focusing on the basics kept soldiers alive. Casey applied this idea within the set curriculum for each ballet technique level at Faubourg, what I refer to as fixed training.

Casey discussed the importance of basic movement, saying, “advanced movement is made possible through basics practiced to perfection.” In essence, each combination teaches fundamentals, which can then be applied to any complex movement a dancer might experience in their career. However, as he noted, this allows dancers to directly focus on the basic technique required to engage in any ballet movement correctly. In his interview, Casey explained the specific ideas he gives his dancers on which to focus their minds during the course of a combination. Verbal prompts such as: “Are you constantly in the posture mode? Is your turnout constantly in use? Are you feeling your body execute the movement?” actively focus the dancers and engage them in a form of FA meditation, which then increases cognitive focus through the activation of this specific neural network.

Throughout the years, Casey has trained many successful dancers who have succeeded artistically and academically. I asked him what he had noticed about the academic performance of students who engaged in a fixed ballet training setting during their adolescence. He proudly said, “In the academic world, every one of those kids that come to this class starts repetition of basics. Every teacher sees the change, the principals see the change, the parents see the change. They gain focus.” Students who engage in this extracurricular activity in this way gain phenomenal benefits in sustained attention that they then apply to academic work, a change noticed by many. In fact, through a program called Literacy Through the Arts, Faubourg Theatre actively works with the local school district to make after-school and summer-time ballet instruction available to students and less fortunate children in the community. This program aims to give physical and mental tools to dancers and students alike to help unlock their potential by teaching them

discipline and accountability, as well as academic, social, and emotional awareness through the arts. This successful arts program places its roots in the idea that the meditative benefits of fixed ballet training can be accessed and applied academically, personally, and socially, resulting in individual, community, and societal benefits.

Brigid Walker Interview

Brigid Walker, a 2020 graduate from the Royal Ballet School in London, England, recently began an apprenticeship with The National Ballet of Canada in Toronto, Canada. Walker has trained in ballet for a total of 15 years. In 2011, Walker began her training with Casey, studying at Faubourg for two years. As Walker looked back on her time with fixed ballet training, she keyed in on several significant elements of fixed ballet training that she benefitted from. First, she explained that, compared to dynamic ballet training, fixed ballet training is unique in that it serves as a frame of reference for improvement. She noted how observable improvements from fixed ballet training can easily be identified because from class to class, the set barre serves as a litmus test for what went well and what could be performed better. This observable improvement is key in traditional meditation as it ensures that the repetition is not mindless but rather active.

Second, Walker explored fixed ballet training's benefits in combating external distractions by accessing the pathways it develops. "The combination is a familiar pathway. Your brain will focus on that more than all the distractions in the room. Your brain is used to recognizing the distractions and blocking them out." She reflected that prior to this method of training, it might be natural to think, "'Oh, who is waving at the

window?' the whole combination, rather than taking the fixed mindset of 'I'll see who is waving after." In her experience, just along the lines of interference control, fixed ballet training helped her acknowledge distractions and set them aside, which is a key skill developed through FA meditation. "In a Faubourg class, you're so locked in, but it's in such a healthy way." Walker found that fixed ballet training gradually made it easier to withhold from engaging in distractions that would otherwise throw her sustained attention.

Finally, Walker emphasized how key fixed ballet training is as a form of multimodal cognitive strengthening. Walker noted how recently, more books and articles are being published about developing and strengthening the mind in certain ways. Meditation is always one of the forefront methods discussed, but laughing, Walker told me that simple meditation is not the method for many adolescents. "I had a lot of energy as a kid. Sitting for eight hours a day is not the way. You learn better when you're moving. You learn better when you have those endorphins going." Walker then focused on the multimodal benefit of fixed ballet training: "[With fixed ballet training] you're doing both at once, you're training your brain, which you need, and you're training your body, which you need as well, to support the brain. It's focusing on something you can do, rather than just sitting, and that makes it tangible." For adolescents, as she observed, pure meditation is difficult for kids and teenagers who just want to move and do not know how meditation is supposed to feel. With fixed ballet training, however, is easier to identify how and why you are doing something.

Caroline Baldwin Interview

Caroline Baldwin is a principal dancer with the Royal Danish Ballet in Copenhagen, Denmark, the highest rank a ballerina can achieve within a professional ballet company. This coveted achievement takes decades of training and dedicated focus to reach. Baldwin started dancing at age 11 and moved schools to begin training with Casey around the age of 14. She trained under Casey's method of fixed ballet training for about three years until she received a job offer from the Royal Danish Ballet.

When asked about her experience with fixed ballet training compared to dynamic training, she noted its meditative nature in allowing the dancer to focus on the technique in the moment rather than on upcoming steps. As an experienced meditator of four years, Baldwin discussed how focusing on her breath did not come easily. However, with time and practice, it became easier as she began to go into an autopilot mode of focused breath and meditation. She directly compared her progression in meditating to fixed ballet training, explaining: "This is how I feel fixed ballet training works; in the beginning it's hard to remember the steps, and your brain is focusing so much on what comes next but after a while...these repetitive movements then become more comfortable in your body…" She contrasted this approach with dynamic training, noting that "you never get to that point where your subconscious takes over because your brain is always working hard to learn and memorize the exercises."

With the COVID Pandemic in 2020, many dancers found themselves barred from the studio, forced to try to maintain their technique at home until lockdown lifted. While taking barre in her kitchen was an unprecedented occurrence, Baldwin found herself reverting to the fixed ballet combinations learned at Faubourg, time and time again. "I think this is because I don't have to think about steps and can subconsciously focus on

my technique I need to maintain." Even on her own, when given a choice between taking a new class or executing a pre-learned class, Baldwin knew that fixed ballet training's meditative quality gave her the opportunity to focus directly on the task at hand.

Curious about how fixed ballet training affected her life inside and outside the studio, I asked Baldwin how she felt fixed ballet training helped her. Interestingly, she explained that training in fixed ballet gave her, and other dancers she knew, a sense of responsibility that contributed to their ability to hyper-focus. She told me how it was up to her to remember what came next, so the class was essentially in her and the other dancers' control, and their responsibility was to keep it going. "What Casey did was give us responsibility. This responsibility was to stay focused. This almost 'forced focus,' I think, was very beneficial [in adolescence] where focus can be a bit all over the place sometimes." Baldwin recalled how Casey sometimes left the studio, peeking in at times to see who had maintained their focus and attention. "I think that type of responsibility aided in why we all developed a sense of unified focus. I think this responsibility of one's own attention was carried through to my schoolwork and everything else I did at the time."

Baldwin strongly supported the idea of recommending fixed ballet training for adolescents, noting that some dynamic ballet training was necessary to maintain the skill of learning a combination in short notice, a skill necessary for auditions. Baldwin explained that fixed ballet training gave her a unique ability to focus on the moment by training her to activate her "inner drive of focus and retained attention to accomplish a task whether that be a rehearsal, a class, [or] a show," even when she felt tired or

overworked. Baldwin discussed her background in fixed ballet training with a strong sense of gratitude for its meditative and focus benefits.

Katarina Stephan Interview

Katarina Stephan, a successful TED-Ed speaker and Neuroscience & Behavior graduate at Columbia University, is currently working on getting her MS in Biomedical Engineering with a concentration in Robotics and Control of Biological Systems in preparation for medical school. At Harvard University during her undergraduate years, Stephan researched bionic eye technology and hopes to explore more solutions for blindness in medical school. Despite having vision in only one eye, Stephan trained in the fixed ballet method with Casey for four years, attaining an elite level. Stephan was quick to emphasize how vital fixed ballet training was for her meditatively.

When Stephan was 17, she lost her mom to cancer. “The fixed training helped me stay focused, not just in the ballet studio, but outside of it...Ballet transformed into a literal sanctuary for me during the hardest year of my life. I lost my home, spent my college savings to try to save her life and couldn’t stand going to school. Casey’s studio and specifically his fixed training allowed me to accomplish something in my day that was predictable and showed a measurable amount of success.” While a dynamic ballet class is ever-changing in its combinations and lacks consistency, Stephan emphasized the measurable progress that can be seen in fixed ballet training, a progress that made her feel that she had succeeded in something even on the most difficult days.

Stephan also emphasized how crucial fixed ballet training was in her academic life. She compared fixed ballet training to mathematics. She explained that mathematics is repetition, just on paper, requiring the same principles. Stephan has attributed most of

her success on academic exams to her ability to prepare, focus, and apply herself, all of which she believes came in significant part from her time with Casey. “Academically, I really didn’t succeed until high school and college, but in high school it was specifically when I was training with Casey.” Stephan emphasized the dedication and discipline that comes from fixed ballet training, recommending it for adolescents to specifically develop those skills through fixed attention meditation.

IV. CONCLUSION

Adolescence, a specified period of development for ages 10-24, is marked by the rapid development of the brain. According to the behavioral, social, and self-regulating skills adolescents need at this stage of life, catered supplemental activity is necessary to reinforce functional connectivity and, therefore, cognitive control. Defined as an FA meditative practice, fixed ballet training is an accessible means of neural and physical exercise that promotes vital intraneural activity and development. Contrastingly, dynamic ballet training cannot fulfill the adolescent brain's necessity for such development because it does not engage the brain in a meditative way.

Based on my synthetization of the data and conclusions from separate studies concerning adolescent brain development and the neurological benefits of contemplative practice and fixed ballet training's consistency with focused attention meditation, I have concluded that fixed ballet training is optimal over dynamic ballet training. When applied as a form of active meditation, fixed ballet training can uniquely and simultaneously activate regions of the brain involved in cognitive control such as the dorsolateral prefrontal cortex, parietal cortex, and anterior cingulate cortex because of its trademark attention to a single object: the body. Without distraction from new or external elements, fixed ballet training is more beneficial than dynamic ballet training for developing the adolescent brain and is necessary for healthy development. Additionally, the benefits of combining meditation with a specific form of exercise allow for excellent development of myelinated pathways for maximum efficiency. For adolescents interested in or currently taking ballet, fixed ballet training is a worthwhile and beneficial approach to consider because of its maximum neurological benefits crucial for the adolescent brain.

V. FIXED BALLET TRAINING FOR ADOLESCENTS - A PROPOSED STUDY MODEL

When considering the critical brain development that occurs during adolescence, it is important to structure adolescent activities to encourage healthy and optimal development. With its substantial benefits for cognitive focus and sustained voluntary attention, fixed ballet training application is recommended for the healthy development of the adolescent brain. Supplemental activities should be structured with a keen eye toward what is best suited for students' needs. As my synthesis about fixed ballet training and its potential analogous benefits with fixed attention meditation is a new proposal, research is necessary to help push forward curriculum change and development to capitalize on adolescent brain plasticity. Though the structural changes supported by the studies above occur over the long term, there are key indications that these changes are taking place. For this purpose, in future directions, I propose two potential studies, quantitative and qualitative, to encourage ballet curriculum shifts, beginning at the collegiate level. I would also partner with a neuroscience to decide what methods would be optimal for this study.

Though the adolescent age range is defined from ages 10 to 24, it is impossible to develop a singular study that includes a thorough analysis of improved focus in each age. Therefore, the following studies will be aimed toward the undergraduate population, with an average age range of 18 through 24.

The university level is optimal for standardized studies on fixed ballet training because of the existing department structure, built-in participant population, ballet class level hierarchy, and teaching expectations which are measured through continual

assessment. First, standardization of curriculum at a department or area level is often part of the existing infrastructure that could easily implement fixed ballet training. Second, students are generally signed up for dance classes they have a desire to be in, and thus are more likely to be more motivated to engage in class. Third, collegiate dance classes, especially ballet, typically audition or ensure that students are in levels appropriate for their skill type, ensuring that students can handle the ballet curriculum for the semester. Finally, collegiate ballet classes have many professors qualified to teach and supplementally correct in fixed ballet classes. Based on the structure of the FA meditation studies discussed previously, as well as further studies by J. A. Brefczynski-Lewis and Lucas Lenhart, I propose the following fixed ballet training curriculum experiment as a potential collegiate study.[21,22,23,24,25]

Study 1

In select universities, dance departments would implement a fixed ballet training pilot program into half of their course curriculums, using dynamic ballet training methods as the control group for three semesters. At the beginning of the semester, all students who wanted to participate would undergo MRI and fMRI scans, allowing researchers to

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[21] Wendy Hasenkamp and Lawrence W. Barsalou, "Effects of Meditation Experience on Functional Connectivity of Distributed Brain Networks," *Frontiers in Human Neuroscience* 3 (March 2012): 1-14, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3290768/.

[22] Antoine Lutz et al., "Mental Training Enhances Attentional Stability: Neural and Behavioral Evidence," *The Journal of Neuroscience* 29, no. 42 (October 21, 2009): 13418-27, https://www.jneurosci.org/content/jneuro/29/42/13418.full.pdf.

[23] Grant S. Shields, et al., "Brain, Behavior, and Immunity," ELSEVIER, 1-12, https://doi.org/10.1016/j.bbi.2020.06.034.

[24] J. A. Brefczynski-Lewis et al., "Neural Correlates of Attentional Expertise in Long-Term Meditation Practitioners," *PNAS* 104, no. 27 (July 3, 2007).

[25] Lukas Lenhart et al., "Cortical Reorganization Processes in Meditation Naïve Participants Induced by 7 Weeks Focused Attention Meditation Training," *Behavioural Brain Research* 395 (October 1, 2020).

gather baseline data. To implement this training, each level would be given its own set of fixed barre combinations, as recorded on video, to fixed music and thus, timing. Each student would receive these videos to study and learn at home before the first week of class. As a result, the class would be repeated and practiced from the first class to the last. Simultaneously, the other half, the dynamic ballet classes, would continue in an ever-changing process with new combinations every class or every week to new music. Each group would be taught the same individual steps. However, the dynamic ballet class would change the combination of those steps each week.

In the short-term focused attention study by Lukas Lenhart et al., marked quantitative improvements were noted in just seven weeks (14 total hours) of focused attention meditation training. The average university semester is 15 weeks long, and the average ballet class occurs five days a week at the length of an hour and a half. This totals approximately 112.5 hours of in-class training by the end of the semester, and 225 and 312.5 hours in the second and third semesters, respectively. This length of time is highly sufficient to demonstrate benefits of short-term fixed ballet training on cognitive focus development and indicate potential long-term benefits. By the end of the three semesters, three groups would be highlighted, with group one (G1) exposed to one semester, or 112.5 hours of training, (G2) to two semesters, or 225 hours of training, and (G3) to three semesters, or 312.5 hours of training.

After completing a semester of either fixed ballet (FB) or dynamic ballet (DB), students would undergo an fMRI scan while asked to focus on their breathing, thus engaging in a stationary form of FA meditation. Key brain area activation, measured by detecting blood flow changes, would be analyzed specifically in the dorsolateral

prefrontal cortex, the superior frontal sulcus, supplementary motor area, and the intraparietal sulcus. Each area would be measured for increased blood flow, indicating activation and significant plastic changes supporting improved quality of voluntary suspension of attention.

Additionally, an MRI scan would be taken with the same breathing activity to obtain another activation measurement—oxygen consumption, and a brain volume measurement—specifically potential grey matter (GM) increases in the insula, caudate nucleus, and frontal cortices. Lenhart et al. noted that these changes indicate cortical reorganization, and "cortical reorganization processes in fronto-insular regions are associated to practiced FAM and promote sustained attention, self-control and self-awareness." In comparing the scans of FB students and DB students, as well as each designated group (G1, G2, G3), MRI scans should indicate increased activation and development of these areas in the FB students compared to the DB students, as well as the FB G3 compared to FB G1. It is expected that these results would support plastic changes and thus cognitive focus development in the fixed ballet training curriculum over the dynamic ballet training curriculum, as well as the substantial benefits achieved from longitudinal practice.

A longitudinal study over four years could also be completed to study the long-term beneficial changes. By following students who began their freshman year in the pilot program throughout their four years in the same FB or DB group, longitudinal data could be acquired to support or refute the claims regarding long-term FA meditation benefits.

Study 2

The second proposed study would include a survey sent out to the same groups involved in the pilot curriculum program, asking a series of questions at the beginning and end of the semester, with slightly differing wording, to gauge perceived cognitive focus improvements. Students would be asked to indicate which course they took and how many semesters they took the course. Questions would focus on the perceived focus benefits within the ballet class and their other university courses. Potential questions could include the following with bubbled answers ranging from simple Yes/No questions:

1. I find/found it easy to focus in ballet class……Yes/No
2. I find/found it easy to focus in my other classes……..…Yes/No
3. I found it easier to focus in my ballet class than my other classes…..….Yes/No
4. I found it easier to focus in my other classes than in the past……..Yes/No
5. I find ballet to be meditative……Yes/No
6. I found this ballet class to be meditative……..Yes/No
7. I found this ballet class was easier to focus on my technique…….....Yes/No
8. I found this ballet class was easier to focus on my mind-body connection……..Yes/No
9. I found it easier to find a single focus and focus on that……..Yes/No

Other potential questions could include the following with more specific ranges (Always, Often, Occasionally, Rarely, Never).

1. My mind drifts off when I am studying:

2. My mind drifts off in ballet class:
3. I find random noises or visuals to be distracting in ballet class:
4. I find random noises or visuals to be distracting in my other classes:

The results of these surveys would indicate the potential cognitive focus benefits as perceived by the students. While fMRI and MRI scans may indicate improvements through quantitative data, it is essential to understand if students perceive this benefit. Such data could help encourage fixed ballet training in university dance programs nationwide, making the benefits more widely accessible to the population that needs this cognitive development the most.

VI. SOCIAL DANCE FOR THE ELDERLY YEARS

With time, the physical body begins to decline naturally. Muscles lose strength and elasticity, cartilage between the joints begins to thin with wear, and senses start to dull. The brain naturally declines as well. For some, decline happens more rapidly, spurred by strong disease progression of the nervous system. Alzheimer's disease, Parkinson's disease, and dementia are common, age-related, and typically genetic degenerative diseases that impact the nerves. This section will concentrate on the benefits of social dance for those healthily aging in the elderly population and the increasing importance of specifically implementing social dance into the therapy of those with Parkinson's, Alzheimer's, and dementia.

The Frontal Lobe of the Aging Brain

As the body begins to decline naturally, the brain begins to age, decreasing in volume, signaling a loss of grey and white matter.[26,27] Unfortunately, for unclear reasons, the frontal lobe begins to lose volume and functionality more rapidly than its neighboring temporal lobes.[28] Queensland Health, the ministerial department responsible for public health in Queensland, Australia, lists many symptoms that may occur due to damage to the frontal lobes, whether through injury, disease, or natural aging. Some of these include loss of simple movement throughout the body, difficulty expressing language, impaired

[26]Huan Liu et al., "Aging of Cerebral White Matter," *Ageing Research Reviews* 34 (March 2017): 64, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5250573/.
[27]Faith M. Gunning-Dixon et al., "Aging of Cerebral White Matter: A Review of MRI Findings," *International Journal of Geriatric Psychiatry* 24, no. 2 (July 21, 2008), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2631089/.
[28]Rachel D. Samson and Carol A. Barnes, "Impact of Aging Brain Circuits on Cognition," *Special Issue: The Neurobiology of Aging and Alzheimer's Disease* 37, no. 12 (June 2013).

focus, mood fluctuations, difficulty in impulse inhibition, reduced motivation, and changes in social proclivity and personality.[29]

In an article addressing the aging brain, Ruth Peters of the Imperial College Faculty of Medicine in London, England, summarizes a study on brain volume in the prefrontal cortex in healthy patients conducted by psychologists Faith M Gunning-Dixon and Naftali Raz. In the study, 140 individuals from ages 50 to 81 years were prescreened for illnesses such as dementia or depression that could affect cognitive skills. "[They] found an association between increasing age, a reduction in prefrontal cortical volume, increased subcortical white matter lesions, and an increase in perseverative behaviour (decreased executive function)."[30] Their study showed links between brain volume and neurophysiological function. Even healthy participants had decreases in volume of the prefrontal cortex associated with increases in cognitive and behavioral difficulties. From a simple glance at this list of symptoms, it is clear that such alterations in the frontal lobe can change the essential parts of who a person is and how they function normally. These declines in biology are a natural part of aging, and the parallel decline in the quality of life is a struggle for many elderly individuals as their memory fades and cognitive and motor functions become difficult.

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[29]"Brain Map Frontal Lobes," Queensland Government, last modified January 21, 2021, https://www.health.qld.gov.au/abios/asp/bfrontal#:~:text=The%20frontal%20lobes%20are%20important,order%20to%20achieve%20a%20goal.

[30]R. Peters, "Ageing and the Brain," *Postgraduate Medical Journal*, February 2006, 84-88, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2596698/#:~:text=A%20study%20looking%20at%20cortical,and%20an%20increase%20in%20perseverative.

Rapid Aging - Degenerative Brain Diseases and Disorders

As discussed above, reduction in the volume of the prefrontal cortex alone can cause many difficulties for healthy elderly individuals. Though many elderly individuals can lead healthy lives with only moderate decline, many do not have brains that age healthily. Diseases and disorders caused by genetics, environment, lifestyle, or trauma can wreak havoc on the brain's natural aging process, causing it to decline at a much more rapid pace. Dementia, Alzheimer's, and Parkinson's are the primary diseases discussed in this paper for their prevalence within the elderly population.

Dementia & Alzheimer's

Dementia is an umbrella term used to describe a series of symptoms that occur when the brain experiences a decline in function. Several different diseases can cause dementia, but most of them cause an abnormal build-up of protein within the brain, preventing the nerve cells from functioning as they should.[31] Subsequent nerve death and a decrease in volume cause difficulty in cognitive function and skills involved in everyday living.

According to the World Health Organization, the estimated population living with dementia is 5-8%, with almost 50 million worldwide. This number grows by almost 10 million new cases every year, and by the year 2030, it is projected that the total number of people living with dementia will reach almost 82 million.[32] Numbers are steadily rising

[31]"About Dementia," NHS UK, last modified June 25, 2020, https://www.nhs.uk/conditions/dementia/about/.

[32]"Dementia," World Health Organization, last modified September 21, 21, https://www.who.int/news-room/fact-sheets/detail/dementia#:~:text=Worldwide%2C%20around%2050%20million%20people%20have%20dementia%2C%20with%20nearly%2060,is%20between%205%2D8%25.

as dementia affects more individuals. In a study by Pittsburg Cardiovascular Health, researchers followed 532 individuals from 1998 to 2013.[33] In 2013, of the 160 subjects alive, almost 88% of the group had developed dementia or cognitive difficulties. Only 19 were deemed to be cognitively normal. Their Discussion section was simple in the abstract of the study: "Few survived free of dementia and disability. Prevention and delay of cognitive decline for this older population is an imperative."[34]

The most commonly known form of dementia is Alzheimer's disease (AD). Characterized by its destruction of memories and cognitive skills, this progressive disease occurs as abnormal proteins overcrowd the brain, forming two problematic features. First, amyloid plaques, or misfolded proteins, collect in between nerve cells, disrupting nerve cell function.[35] Second, tau, an essential protein in building the microtubules that transport nutrients within nerve cells, collapse and form tau tangles. As a result, the nerve cells cannot receive the critical nutrients they need to function and survive.[36] These trademark features can be found within the dissected, AD-inflicted brain that also shows clear signs of atrophy. As neural cells die in this progressive disease, damage appears to begin in the hippocampus, the memory center of the brain, and progresses throughout the entirety of the organ, ultimately resulting in death.

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[33] The mean age in 1998 was 79, and the mean age in 2013 was 93.

[34]Lewis H. Kuller et al., "Risk of Dementia and Death in the Long-term Follow-up of the Pittsburgh Cardiovascular Health Study–Cognition Study," *Alzheimer's & Dementia* 12, no. 2 (February 2016), https://www.sciencedirect.com/science/article/abs/pii/S1552526015029076.

[35]Sally Robertson, "What are Amyloid Plaques?," News-Medical, last modified August 23, 2018, https://www.news-medical.net/health/What-are-Amyloid-Plaques.aspx#:~:text=Amyloid%20plaques%20are%20aggregates%20of,memory%20and%20other%20cognitive%20functions.

[36]Ana Sandoiu, "Alzheimer's: How Do Tau Tangles Grow?," Medical News Today, last modified February 12, 2019, https://www.medicalnewstoday.com/articles/324425.

In a breakthrough study published in 2018, researchers from the Center for Vital Longevity at the University of Texas at Dallas reviewed the PET, or positron emission tomography, scans of 137 patients between ages 30 and 89. This scan uses a radioactive drug to produce a 3-D image of the organ and tissue processes within the body, revealing their functionality. They discovered that plaque begins to build gradually throughout the brain before symptoms begin.[37] This discovery means that build-up could occur over the years, eventually affecting one's memory and cognitive function.

As AD attacks the hippocampus, patients experience memory lapses. In the beginning, they may forget the current conversation, appointments, or where they placed their belongings. As the disease progresses, many patients get lost, forget the names of family members, have difficulty communicating, thinking, focusing, multitasking, making appropriate daily decisions, performing sequential tasks, and maintaining personality and behavior. In addition to the direct symptoms of AD, patients can experience depression, apathy, mood swings, aggressiveness, and delusions.[38] With the loss of basic abilities, many must live in assisted living and nursing homes to get aid in daily activities such as showering, eating, and basic living. Of those in nursing homes, almost 50% have some type of dementia or cognitive impairment.[39] Further, depression occurs at almost 30% among those with dementia and AD.[40]

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[37]JIll B. De Vis et al., "Arterial-spin-labeling (ASL) Perfusion MRI Predicts Cognitive Function in Elderly Individuals: A 4-Year Longitudinal Study," *Journal of Magnetic Resonance Imaging* 48, no. 2 (January 2, 2018): 449-58, https://onlinelibrary.wiley.com/doi/full/10.1002/jmri.25938?casa_token=ZCnLqQREPj8AAAAA%3Acq1WJqNBmQS19HgeUZHnAjqdnJBL5t6D3SoThazzPV10hg31hM4CHyokd014okMh-oquI2IBxun7ug.

[38]"Alzheimer's Disease," Mayo Clinic, https://www.mayoclinic.org/diseases-conditions/alzheimers-disease/symptoms-causes/syc-20350447.

[39]"Alzheimer's Association Releases Dementia Care Practice Recommendations for End-of-Life Care," Alzheimer's Association, https://www.alz.org/national/documents/release_082807_dcrecommends.pdf.

[40]David Kitching, "Depression in Dementia," *Australian Prescriber*, December 1, 2015, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4674029/.

Alzheimer's is a disease that is not only widely known but widely experienced. Within the United States, someone develops Alzheimer's dementia every 66 seconds, and by 2050, that statistic is expected to increase to one every 33 seconds.[41] In 2014, Alzheimer's came in as the sixth leading cause of all death in the United States, just behind stroke and unintentional injuries.[42]

Common Treatment for Alzheimer's Disease

Treatment for AD and dementia focuses on improving life quality and planning for the future because AD is deemed a terminal illness. However, steps can be taken to slow or lessen the symptoms of the disease. Management of AD primarily consists of pharmacologic and non-pharmacologic therapies that can be very costly. Further, many argue that the benefits gained are little compared to the expense. For example, cholinesterase inhibitors are often prescribed to aid in symptoms involving memory, thinking, and other cognitive processes. These medications increase levels of acetylcholine, a chemical involved in memory and cognition that is destroyed in AD patients by slowing down its breakdown. The process compensates for the loss of cells within the brain, but in efficacy tests, the degree of improvement in memory and cognitive skills was minimal.[43] According to Consumer Reports, the cost per month of

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[41] "2017 Alzheimer's Disease Facts and Figures," *Alzheimer's Association Report* 13, no. 4 (March 15, 2017), https://alz-journals.onlinelibrary.wiley.com/doi/10.1016/j.jalz.2017.02.001.

[42] Sherry L. Murphy et al., "Mortality in the United States, 2014," Centers for Disease Control and Prevention, last modified December 2015, https://www.cdc.gov/nchs/products/databriefs/db229.htm#:~:text=Statistics%20System%2C%20Mortality.-,What%20are%20the%20leading%20causes%20of%20death%3F,in%202013%20(Figure%203).

[43] "FDA-Approved Treatments for Alzheimer's," Alzheimer's Association, last modified August 2019, https://www.alz.org/media/documents/fda-approved-treatments-alzheimers-ts.pdf.

cholinesterase inhibitors ranges from $183 to $367, which is significant compared to the minimal benefit received.

According to the Alzheimer's Association, "Total national cost of caring for those with Alzheimer's and other dementias is estimated at $277 billion (not including unpaid caregiving) in 2018…"[44] This number includes the cost of healthcare, and long-term care and it is only expected to increase, amounting to almost 1.1 trillion in 2050. The high cost of medical treatment for dementia and AD is not feasible for many patients. Thus, exploration of lower-cost treatments and therapies is warranted.

Parkinson's Disease

According to the Parkinson's Foundation, almost one million people in the United States live with PD, with almost 10 million worldwide.[45] Parkinson's disease (PD) is another devastatingly progressive neurodegenerative disease of the brain characterized by difficulty moving due to lost balance, involuntary shaking or tremors, slowed movement, and stiffness in the muscles. PD wreaks havoc on the extrapyramidal system, which is involved in the causation of involuntary actions within the motor system.

Movement within the body relies primarily on the neurotransmitter dopamine, commonly known to be essential for reward signals and thinking. Dopamine does not dictate what movements occur, but a study in the Journal of Cognitive Neuroscience

[44]Mike Lynch, "New Alzheimer's Association Report Reveals Sharp Increases in Alzheimer's Prevalence, Deaths, Cost of Care," Alzheimer's Association, last modified May 30, 2018, https://www.alz.org/news/2018/new_alzheimer_s_association_report_reveals_sharp_i#:~:text=Total%20national%20cost%20of%20caring,other%20costs%20total%20%2430%20billion.

[45]"Statistics," Parkinson's Foundation, https://www.parkinson.org/Understanding-Parkinsons/Statistics#:~:text=Approximately%2060%2C000%20Americans%20are%20diagnosed,are%20diagnosed%20before%20age%2050.

found the importance of dopamine levels in humans. "[It] suggested that tonic levels of dopamine in the dorsal striatum may in part enable normal movement by encoding sensitivity to the energy cost of a movement, providing an implicit "motor motivational" signal for movement."[46] Dopamine is released as needed in response to what energy the movement requires. In patients with PD, dopaminergic neurons in the substantia nigra, the primary source of dopamine, degenerate and cause "resting tremor, rigidity, bradykinesia, i.e., a gradual slowness of spontaneous movement, and loss of postural reflexes or, in other words, poor balance and motor coordination." [47,48] Without needed dopamine levels to regulate the energy costs of movement, movement cannot correctly occur through the firing of neurons.

PD also causes atrophic changes in the cerebellum, the part of the brain responsible for coordination, posture, gait, and guided movements involving sensorimotor data, resulting in tremors, lack of coordination, and inability to walk regularly. This atrophy has been associated with cognitive decline because connectivity in large-scale cortical networks bridges multiple functioning parts of the brain to execute complex cognitive tasks.[49] Broken connectivity causes diminished function in these cognitive networks, resulting in dementia.

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[46]Sergei Gepshtein et al., "Dopamine Function and the Efficiency of Human Movement," *Journal of Cognitive Neuroscience* 26, no. 3 (March 2014), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4805420/.
[47]Shankar J. Chinta and Julie K. Andersen, "Dopaminergic Neurons," *The International Journal of Biochemistry & Cell Biology* 37, no. 5 (May 2005), https://www.sciencedirect.com/science/article/abs/pii/S1357272504003711.
[48]Lazaros C. Triarhou, "Dopamine and Parkinson's Disease," Madame Curie Bioscience Database, https://www.ncbi.nlm.nih.gov/books/NBK6271/.
[49]Claire O'Callaghan et al., "Cerebellar Atrophy in Parkinson's Disease and Its Implication for Network Connectivity," *Brain* 139, no. 3 (March 2016), https://academic.oup.com/brain/article/139/3/845/2468782#86283049.

According to an article by Danique L.M. Radder in the International Journal of Neuroscience, patients experience a wide range of symptoms beyond those involving motor function. “PwP [Patients with Parkinson’s] also experience a wide range of non-motor symptoms, including depression, cognitive impairment (e.g. executive dysfunction and dementia), apathy, visual impairments, fatigue and sleep problems.”[50] These additional symptoms can be a significant burden on patients, severely impacting their way of life beyond the physical impairments.

Common Treatment for Parkinson’s Disease

As with dementia and AD, there is no cure for PD, only treatment for symptoms. Treatment plans for patients with PD consist of a mix of occupational therapy to regain some motor function, medication to prevent tremors, and surgical options when medication is ineffective. Because of the complexity of the disease, treatments cannot consist of only one therapy. They must be, what doctors say, multimodal.

Multimodal treatments may include occupational therapy, medication, and deep brain stimulation. Occupational therapy consists of exercises aimed to build strength in movements involved in daily activities. Occupational therapists give patients simple exercises to work on at home to preserve some basic movements and regain others. Doctors often prescribe medications such as Rytary, a long-term treatment taken three times a day that turns into dopamine, increasing the dopamine levels within the brain. [51] This treatment, however, is not free of negative aspects. For example, Rytary may cause

[50]Danique L.M. Radder et al., "Physical Therapy and Occupational Therapy in Parkinson's Disease," *International Journal of Neuroscience* 127, no. 10 (2017): 930.
[51]Jennifer Mitri Williamson, "Rytary (levodopa/carbidopa)," Medical News Today, last modified August 28, 2020, https://www.medicalnewstoday.com/articles/rytary.

other movement disorders with many of the same PD symptoms or cause the initial symptoms to worsen between doses. Additionally, doctors say that Rytary is a long-term treatment because if a pill is missed or if the patient wants to stop taking it, withdrawal symptoms or dependency occurs. For a 40-day supply alone, the cost for Rytary is about $450, and for a long-term treatment to mitigate symptoms or cause more, this can be a costly solution for many. Others may opt for surgical methods such as deep brain stimulation (DBS), a treatment typically reserved for patients who do not respond to medication or develop a movement disorder from medication. Ultimately, achieving the correct balances of each of these treatments can take years.

Dance and the Aging Brain

When patients share concerns with doctors regarding natural aging, or more extreme stages of aging, such as those experienced by Parkinson's, Alzheimer's, and dementia patients, doctors prescribe the standard therapies above: medication, surgery, and monotonous occupational therapy. On the other hand, lifestyle changes such as healthy eating and exercise are often only suggestions. However, in rapidly developing research, it is increasingly evident that dance is an effective tool in the treatment plans of healthy elderly and those who have dementia, AD, or PD.

In an article published in the American Journal of Dance Therapy, Sandra Kay Lauffenburger identifies unique features in dance movement therapy (DMTP) that define it as multimodal. She notes its ability to "reduce stress, improve posture, balance, coordination, and fitness levels, increase levels of serotonin, and develop new neural connections in regions of the brain controlling executive functioning, long-term memory

and spatial recognition."[52] The multimodal nature of dance can be highly functional in a more holistic approach to therapy.

As the following studies demonstrate, dance is significantly multimodal, helping heal and treat from the inside out, supporting lasting change within the brain by harnessing its natural adaptive ability, helping prevent or slow decline depending on when activity is integrated, and improving quality of life.

Preventatively, dance is highly effective for dementia. In a 21-year study in the New England Journal of Medicine, several recreational activities were tested in their efficacy in maintaining mental acuity in aging. Researchers tested activities ranging from reading books and playing musical instruments to physical activities such as cycling, swimming, walking, and dancing. Results showed that the only physical activity offering such protection against the development of dementia was frequent dancing. In fact, there was a 76% reduced risk of dementia, the largest percentage of any of the cognitive or physical activities studied.[53] In this study, neurologist Dr. Robert Katzman proposed that "these persons are more resistant to the effects of dementia as a result of having greater cognitive reserve and increased complexity of neuronal synapses."[54] By dancing, people developed an abundance of new neural pathways, accessing the brain's plasticity, thus protecting their brains against the cognitive decline experienced in dementia.

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[52]Sandra Kay Lauffenburger, "'Something More': The Unique Features of Dance Movement Therapy/Psychotherapy," *American Journal of Dance Therapy*, March 9, 2020, 19.
[53]Joe Verghese et al., "Leisure Activities and the Risk of Dementia in the Elderly," *The New England Journal of Medicine*, June 19, 2003.
[54]Powers, "Use It or Lose," Stanford Dance.

Why Social Dance?

However, it is emphasized that not just any type of dancing reaps these benefits; only those types that require the brain to make as many split-second decisions as possible. In contrast to the benefits of memorized ballet training on the adolescent mind, regarding the meditation and synaptic pruning, Richard Powers of Stanford emphasizes that simply memorizing steps is unhelpful in fighting neurodegenerative diseases:

> Types of dance that rely on retracing the same memorized steps will form no new connections in the brain. Improvements to cognitive function occur when we learn something *new*, something we haven't done before. The dancers in the recent study who showed the most resistance to dementia practiced what is referred to as freestyle social dancing – foxtrot, waltz, swing, tango, and Latin dance.[55]

When the brain engages in split-second, rapid fire-decision making, new pathways are generated because old pathways are unreliable. On the other hand, rote memory, or retracing memorized paths and daily activities, does not engage plasticity. The more brain functions an activity requires, the more significant the increase in neural connectivity. For this reason, just as Powers notes, social dance is optimal because it integrates parts of the brain involved in rationalization, kinesthetics, sensory, and emotions.

Social dance, characterized by styles such as foxtrot, waltz, swing, rumba, and cha cha, is a partner dance genre involving many different steps that can be learned and used in, essentially, an infinite number of sequences. Classes can be led in one of two ways. The first method includes free-form dancing, where the leader of the pair must

[55]Powers, "Use It or Lose," Stanford Dance.

choose what steps to do on the spot. The second method involves learning a new routine each week, but the teacher begins the class by recalling the routine from the week before, and the pairs dance that one first.

In either class, each pairing member has complex responsibilities that challenge the brain, forcing the creation of new pathways. Of the pair, the leader must make split-second decisions on what move to lead the follower in next, signal the move through the appropriate tension in the leading hand, and follow-through in leading the partner through the move correctly. Alternatively, the follower must be actively "listening" to the partner. As the follower interprets the signals given by the leader, the follower must decide which step is intended and make the split-second decision to commit and follow through with that step. Sometimes, a signal may be misread, and an incorrect step may occur, but social dance allows mistakes to be made and, most importantly, lessons learned.

Additionally, in social dance, changing partners is quite frequent. Often, with each new partner comes a change of leading and how one follows. Dancers must interpret sensory, social, and musical information and then adjust accordingly. Social dance continually engages each partner in decision-making moments, challenging and activating the plasticity in the brain.

Social Dance and Alzheimer's Disease

In the previously mentioned 21-year study in the New England Journal of Medicine, results revealed that engaging in dance created so many new connections within the brain that when connections were lost, as a result of natural aging, the new connections compensated for the lost connections. As a result, cognitive decline was

slowed. These benefits of dance extend beyond dementia. Alzheimer's and Parkinson's diseases result from damaged and lost connections within the brain and, therefore, can also be positively impacted by dance.

For those diagnosed with AD, social dance is a highly accessible way to slow the disease progression by increasing volume in areas such as the hippocampus, which is involved in learning and memory. In a study by Dr. Kathrin Rehfeld of the German center for Neurodegenerative Diseases in Germany, one group participated in a 90-minute social dance lesson with a new combination each week for 18 months.[56] The other group engaged in 90 minutes of repetitive strength-enduring training each week. Rehfeld observed that participants in the social dance group were challenged when they needed to recall the combinations without memory cues from the teacher. MRI scans revealed that while both groups showed an increase in hippocampal volume, social dancers showed a much more significant increase. Additionally, only the dance group showed an increase in newly formed connections within the dentate gyrus of the hippocampus, an area associated with memory. This finding indicates that, unlike repetitive exercise, social dance can help slow the decline of memory by developing new connections within this hippocampus area. The hippocampus can still function with the new connections, perhaps not at its full capacity but an improved level, benefitting memory and learning abilities. Further, the new connections can slow the decline of memory in AD patients, giving them more time with their memory and their loved ones, thus improving their quality of life.

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[56]Kathrin Rehfeld et al., "Dance Training Is Superior to Repetitive Physical Exercise in Inducing Brain Plasticity in the Elderly," *PLOS One*, July 11, 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6040685/.

The benefits of social dance for AD patients have been explored and confirmed in numerous studies. An article from the Current Alzheimer Research journal, Alicia Ruiz-Muelle and Maria M. López-Rodríguez organized a systematic review of 12 studies involving 349 total participants. The purpose and conclusion of this review are to confirm the positive effect of dance therapy on physical function, cognitive skill, psychological well-being, and overall quality of life for AD patients.[57] Furthermore, the studies compiled show the therapeutic nature of dance in slowing decline and improving the quality of life for AD patients by improving their direct symptoms from the inside out, including those that occur due to AD, such as depression and anxiety.

Social Dance for Parkinson's Disease

For those diagnosed with PD, dance has also been proven to be highly beneficial, even necessary. With PD patients, movement in the simplest forms is often a struggle. While walking is a basic form of propulsion and traveling, the many complex yet automatic processes involved are deeply affected by PD. Worthen-Chaudhari recommends tango dance classes, noting that they have effectively improved balance and "locomotor rehabilitation" in patients with PD.[58] Tango, a social dance style, is beneficial beyond the rapid-fire decision-making general social dance requires because it consciously focuses on walking while adding deliberate pauses and accents. Tango dance puts walking into a new and different context than just something done daily. Learning to walk in the way they always have, like in occupational therapy, can be slow because

[57]Alicia Ruiz-Muelle and María López-Rodríguez, "Dance for People with Alzheimer's Disease: A Systematic Review," *Current Alzheimer Research*, January 1, 2019].
[58] Lise C. Worthen-Chaudhari, "New Partnerships Between Dance and Neuroscience: Embedding the Arts for Neurorecovery," *Dance Research* 29 (2011): 471.

these connections in the brain are not new, just damaged. In this instance, particularly, social dance is highly beneficial because it gives individuals a new way to approach everyday movement and relearn it, rewiring the brain around the damage that inhibits their ability to walk normally.

In an article titled "Dance for Parkinson's Disease at the Stanford Neuroscience Health Center" published by Stanford Medicine, physicians acknowledged the multimodal approach that needs to occur in treating Parkinson's. "As Physicians we stress the importance of physical activity, social interaction, and mental stimulation to our patients with Parkinson's disease…Dance for PD gives them all three."[59] Social dance *is* the multimodal form of therapy elderly individuals need. In fact, in response to the numerous studies done on the efficacy of social dance in the therapy of PD patients, Dance for PD® was founded in 2001. The group, guided by an advisory board made up of world-renowned neuroscientists, neurologists, dance professionals, and researchers from the field of healthcare integrates social dance into its many dance classes designed as therapy for PD patients. Their program cites over 38 peer-reviewed studies linking dance to improved motor, cognitive, psychological, and social function, many of which directly refer to social dance. In other words, science provides the basic framework for this program. Experienced dancers and dance instructors can undergo a year-long training program to become certified to teach Dance for PD® classes, ensuring that PD patients are being taught properly and safely.

[59]Ruthann Richter, "Dance Benefits Parkinson's Patients," Stanford Medicine, last modified 2017, https://stanmed.stanford.edu/2017winter/dance-for-parkinsons-disease-at-the-stanford-neuroscience-health-center.html.

When described, social dance can sound complex, especially considering the disabilities that dementia, AD, and PD patients face. However, the social dance technique and leading cues involved are simple and can increase in difficulty with one's level, always giving one new material to learn. In addition, as many elderly individuals have difficulty moving because of stiff joints, inflexibility, or other movement problems, social dance provides an accessible form of therapy that can adapt as their mobility changes.

Social Dance and Mental Well-Being

Perhaps more importantly than benefits involving cognitive or motor function, social dance provides positive experiences that guard against isolation and depression. According to Mental Health America, of the United States' 65+ population of 34 million, more than two million suffer from some form of depression.[60] This ratio only increases when depression rates are considered within each population suffering from PD, AD, and dementia. Approximately 30%-40% of PD patients, 25% of AD patients, and 15%-20% of dementia patients have some form of depression.[61,62,63] Thus, in addition to the reduced quality of life caused by these diseases, depression affects the mental and emotional well-being of many patients. Other patients who may or may not have depression also struggle socially as communication and daily living become difficult. According to a study by

[60]"Depression in Older Adults: More Facts," Mental Health America, https://www.mhanational.org/depression-older-adults-more-facts.
[61]Pasquale G. Frisina et al., "Depression in Parkinson's Disease: Health Risks, Etiology, and Treatment Options," *Neuropsychiatric Disease and Treatment* 4 (February 2008), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2515908/#:~:text=Depression%20is%20found%20in%20about,health%2Drelated%20quality%20of%20life.
[62]Constantine G. Lyketsos, Lourdes DelCampo, and Martin Steinberg, "Treating Depression in Alzheimer Disease: Efficacy and Safety of Sertraline Therapy, and the Benefits of Depression Reduction: The DIADS," *Arch Gen Psychiatry* 60 (2003), https://jamanetwork.com/journals/jamapsychiatry/fullarticle/207604.
[63]Esther Oh, "Depression in Patient with Dementia," Johns Hopkins Medicine, https://www.hopkinsmedicine.org/gec/studies/depression_dementia.html.

Parkinson's Victoria, a charity in Australia, "1 in 2 (55%) of people living with Parkinson's say they often feel socially isolated as a result of having Parkinson's."[64] This is where the social aspect of dance is vitally important. Not only does social dance provide a form of exercise, but it also gives a space to interact with others. Social dance at a non-professional level is an enjoyable social activity that does not require verbal communication. As a patient dances with a partner, they each feel the warmth of human connection, both social and physical.

In a study by Donald Roberson Jr. and Jana Pelclova and two social dancing groups, questionnaires and a focus group lead to three main findings. First, social dance is a physical activity that enhances one's health. Second, unlike other dance classes, social dance encourages an atmosphere that is welcoming, community-centered, playful, and spontaneous. Third, scheduled dance events allow for positive reconnection with one's memory and personal history because of the music and discussion with other dancers.[65] They found that music helped patients bring memories to the forefront of their minds, often sparking joy and sentiment.

In fact, after reviewing the benefits and testimonials of the study, Roberson Jr. and Pelclova concluded, "Communities should be encouraged to establish social dance as an option for all ages, especially older adults," thereby acknowledging the many benefits it can provide to communities as a whole. About elderly adults specifically, they noted that the scheduled, set apart dance time allows the elderly to engage in life-affirming situations like taking care of one's appearance in preparation for social experiences.

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[64]"When Parkinson's Leads to Social Isolation," Parkinson's Victoria, last modified November 13, 2017, https://www.parkinsonsvic.org.au/about-us/media-release/when-parkinsons-leads-to-social-isolation.
[65]Donald N. Roberson, Jr and Jana Pelclova, "Social Dancing and Older Adults: Playground for Physical Activity," *Ageing International* 39 (2014): 124-43.

Getting ready and dressing appropriately allows older adults to feel in control of their life, even when uncontrollable aspects, like health, threaten their autonomy. Commonly, assisted living homes allow elderly residents to wander, engaging in activities here and there. However, when these individuals can attend a dance class at a set time and place, it gives them structure and opportunity to access personal autonomy. Social dance brings them to an environment where they can feel safe to engage with others, restoring their social confidence while simultaneously improving their neural connectedness and physical fitness.

VII. Conclusion

Social dance is the multimodal approach elderly individuals need whether they are aging healthily or rapidly. Unlike medication, which aims to solve symptoms of aging temporarily, social dance movement aids structurally from the inside out, offering lasting change and benefits for the elderly brain. With its ability to create new networks of neural connections, social dance can be highly effective in the prevention and treatment of rapid aging, encouraging the brain toward healthy aging in any context. Social dance is an accessible, multimodal form of therapy that reignites confidence, social connections, and motivation while creating new neural connections which support delayed aging and renewed function. Further, dancing creatively using simple steps helps improve gaits and motor functions, helping elderly individuals feel "able" again.

With numerous studies demonstrating the benefits of social dance on the elderly brain, dance movement therapy should be more widely prescribed, not merely suggested, as a multimodal form of therapy. Likewise, echoing Roberson Jr. and Pelclova, dance must be more commonly integrated and established within communities, especially those with higher populations of elderly individuals. It is vital that the elderly have a place to take a social dance class. For healthy elderly with no negative aging symptoms, traveling to a class may be feasible. For others, like those in assisted living homes, physical or cognitive difficulties arise that can make travel impossible. For this reason, social dance must be integrated into the activities scheduled at assisted living facilities.

When an activity, like social dance, is made more available to a population who could benefit, that population is more likely to integrate that activity into their daily lives functionally than if that activity lacked the same availability. In an assisted living home,

where life can begin to feel the same every day, the ever-changing nature of social dance classes would be extremely valuable.

VIII. A PLAN IN PRACTICE - INTERVIEW WITH JOSH LANCASTER

Numerous studies demonstrate the substantial benefits of social dance on the elderly brain. Dance movement therapy as a multimodal form of therapy must be more commonly integrated and established within elderly communities. By identifying and overcoming barriers to implementation, further progress can be made.

To understand the intricacies of independent and assisted living facilities, and their complex residential schedules, I interviewed Josh Lancaster, the Senior Executive Director of Fairfield Village of Layton in Utah. This continuing care senior living community supports high-functioning elderly residents and those who need more daily assistance from certified nursing assistants. The purpose of the interview was to gather information about the potential difficulties senior living facilities might encounter in implementing regular social dance activities into the regularly offered activities. Lancaster emphasized two forefront difficulties that shape how and what activities are offered.

First, cost, more specifically budget, is a potential barrier in adding new activities to the schedule. Lancaster noted that many senior living facilities have a slim budget to allocate for different activities. When asked whether a small fee of $5 per social dance class would be feasible, Lancaster explained that typically, senior residents pay a flat fee with the expectation that food, services, and activities are all-inclusive. This makes it challenging to ask residents to pay outside of the original cost, which they try to limit. Observing the numbers, for a bi-weekly social dance class with an expected attendance of 15, one month could cost around $600. According to Lancaster, for the average senior

living facility, this number almost entirely fills the overall activities budget allocated for each building on the premises, making other activities impossible.

When a suggestion to offer the social dance classes on a volunteer basis was proposed, Lancaster said that implementing such a plan would be much more feasible for the typical budgets seen in senior living facilities. Lancaster then noted a second, larger barrier in implementing physically involved activities: motivation. Setting aside cost, he explained that nurses have difficulty helping residents find the motivation to leave their apartment, especially to exercise. “Our residents are on medication, don’t feel well, or have joint pain. There is a long list of reasons they would give you as to why they couldn’t participate.” For many residents, despite its importance, exercise can present as a difficult-to-accomplish activity. He noted that this lack of motivation to be physical largely shapes how the budget is created, as funds are allocated to activities that residents are more likely to attend, which are typically less physically involved.

When asked if motivation could be increased by creating awareness surrounding the benefits of a physically social activity like social dance, Lancaster emphatically said yes. He then identified two main factors that could make the implementation of an activity, like social dance, successful. First, Lancaster agreed that awareness of the benefits is a paramount solution. When residents know how social dance could benefit them and improve their way of living, they are much more likely to take that first step in trying it out. That first step, as Lancaster emphasized, is the second major factor in the success of an activity like social dance. “There’s an element of, once somebody tries it and enjoys it, then they are much more likely to come back.” He agreed that when residents take the first step to experience an activity, realizing they can do it and that it is

an entertaining part of their day, they are much more likely to engage with it regularly. Interestingly, Lancaster added that the BYU Ballroom Team goes to Fairfield Village around three times a year to perform and encourage some dancing afterward. When asked if residents appeared receptive, Lancaster confirmed that after watching dance, residents were more inclined to get up and try some of the moves they had just seen, even if for just a moment.

After the discussion, Lancaster acknowledged that the information and the subsequent plan I had presented were unique and could be highly beneficial to his residents. “The type of dance program that you are talking about would be highly beneficial, and I think that people would participate. You don’t hear about a lot of programs like this.” When asked how plans like this could be implemented at facilities such as Fairfield Village, Lancaster noted that plans are created, supported by evidence of benefits, and given to the Vitality Director for potential approval and implementation.

IX. SOCIAL DANCE FOR THE ELDERLY - A PROPOSED PLAN

With the knowledge I gathered from Josh Lancaster about the potential boundaries and keys to success, as well as the substantially proven benefits, I have developed a proposal to implement Jitter & Jive, a social dance program, at senior facilities like Fairfield Village. The proposal below is a submissible, standardized, formatted plan, created with the intention that in future directions, it could be submitted to Fairfield Village's Vitality Director for approval and implementation. The plan, as submitted, would contain the statistics and studies included in this thesis, provided as evidence supporting the implementation of the Jitter & Jive Social Dance Program:

Proposal:

Social dance is the multimodal approach to aging that elderly individuals need whether aging healthily or rapidly. Unlike medication, which aims to solve temporarily solve aging symptoms, social dance movement aids structurally from the inside out, offering lasting change and benefits for the elderly brain. With its ability to create new networks of neural connections, social dance can be highly effective in the prevention and treatment of rapid aging, encouraging the brain toward healthy aging in any context. Social dance is an accessible, multimodal form of therapy that reignites confidence, social connections, and motivation while creating new neural connections which support delayed aging and renewed functioning. Integrating and implementing a regular social dance program within the activities schedule for all elderly individuals at Fairfield Village would be a significant step toward helping to encourage healthy aging through socializing and exercise. In response to the concerns surrounding cost and participation, I

have developed the following proposal for Jitter & Jive, Fairfield's Social Dance Program.

Cost: The program would move forward on a volunteer basis. Through Brigham Young University, clubs and classes can be developed and petitioned for approval. In the instance of this social dance program, at the approval of Marci Edginton, students taking DANCE 386: Methods of Teaching Social Dance would have the opportunity to practice their pedagogy training at a bronze level with participants from Fairfield Village during the Fall and Winter semesters. As students are required to create and execute a lesson plan as part of their final, this unique experience could serve as a one-of-a-kind learning and teaching experience. As students practice teaching steps and technique, residents would have the opportunity to attend a free social dance class at no additional cost to the Vitality Director. Additionally, with DANCE 386 as a prerequisite class, Dance Education students could also use DANCE 500R as a dance internship, engaging in this unique teaching experience for credit and practice, giving communities like Fairfield more opportunities for volunteer-basis classes.

Frequency and Numbers: In consideration of currently scheduled activities, a single weekly class would be offered in the beginning stages of the program, which would increase to bi-weekly, and then tri-weekly based on attendance, participation numbers, and skill level. Beginning at this frequency would be essential to build strength and stamina gradually, encouraging residents to engage in a physical activity in which they could feel rewarded as they improve. At the same time, this gradual increase in frequency

would allow the class to be continually accessible to all, even those just beginning in the later stages of the program.

Ideally, class ratios would include one student teacher per four students. Other volunteers would substitute in for partners as needed in leading or following positions. If they are not needed to even out the numbers, volunteers would walk around answering questions or assisting those hard of hearing while correcting technique to ensure safety. This would ensure that all participants could safely participate with a partner.

Method of Increasing Awareness: As a significant part of increasing participation is increasing awareness, it would be paramount to create educational pamphlets distributed at each senior living building. Such pamphlets would include basic statistics and explanations of benefits to seniors from regular social dancing, according to their level of aging. There would be a section specifically for healthy aging, dementia, Parkinson's, Alzheimer's, and other difficulties that many residents face. This would allow each resident to learn how social dance could benefit their health as an individual, making the experience of social dancing meaningful and personal. Essentially, it would give them an initial reason to step into the class. Spreading this awareness would, in theory, encourage individuals to take the class for the first time, allowing them to see if they enjoy the class and then pursue regular attendance.

To gauge interest and awareness, after the pamphlets are received, residents would be sent a brief survey with questions concerning topics such as how likely they would be to attend, what days work best for them, what social dance styles they enjoy, and what their favorite dances were from younger years. These kinds of questions would

help shift social dance from being known as physical exercise, which could be discouraging to residents, to being a fun, social activity. This survey could also give student instructors valuable guidance in planning their classes, genuinely making the program a catered experience.

Method of Execution: As Josh Lancaster had mentioned, Fairfield Village residents were highly receptive to the BYU Ballroom Dance Company performances and subsequent dancing in the past. Drawing on this success, three key factors may help encourage the success of this program.

1. Pre-Class Performance: To raise the enthusiasm of residents, small pre-class performances would be given, allowing residents to see what social dance steps they could learn and the possibilities with which they could be arranged. Through this visual, residents could witness the joy others achieve through dance and be encouraged to experience that excitement for themselves.
2. Music: Because music is a powerful tool in memory recall and mood, residents would be encouraged to submit music requests. By using music they are familiar with, the classes become more personal and more likely to be attended.
3. Additional Activities: Encouraging the culmination of practice and experience, medals contests and end-of-semester balls could be offered. Both of these experiences could encourage regular practice and attendance, giving residents events to look forward to.

XI. FINAL CONCLUSION

As sustained focus becomes vital for adolescents' success, especially in a digitally driven world where information is automatically accessible, fixed ballet training is necessary. By making meditation, and thus, meditation's benefits, accessible for restless youth, fixed ballet must be more widely implemented, encouraging adolescents to take practice and focus into their own hands. As increased implementation and research occur, parents and teachers will witness the remarkable transformation in focus and motivation that takes place.

Social dance is a necessary addition to treatment plans for elderly individuals at a critical time window for slowed or rapid neurological decline. Though difficult, it is crucial to find multimodal therapies that benefit mentally, physically, and socially while helping maximize brain networks, more effectively fighting the rapid development of degenerative diseases. Social dance programs must be more widely structured and implemented in senior living homes with particular attention to potential barriers, providing both social interaction and physical therapy movement for the elderly with cognitive and physical difficulties. As this activity provides proven benefits for both the mind and body, dancers can witness social dance's ability to change and improve health holistically.

As explored throughout this thesis, beyond the interpersonal, motivational, and creative skills it delivers, dance training provides significant neural benefits to the developing adolescent brain from ages 10-24 and the healthily aging brain, with implications for healthy aging and prevention or delay of symptoms of dementia, Alzheimer's disease, and Parkinson's disease. Within the vast history of cultures worldwide, dance has held its place in ceremonies of worship, celebration, courtship, ritual, and even healing. This basic,

intuitive understanding of dance's potential has benefitted humans for centuries. With the convergence of research in recent years, it has become critically apparent that dance can contribute distinct benefits according to the dance style and method defined and therefore should be explored to a higher degree.

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