

**Exploring Determinants of Exercise-Related Affect in Older Adults who Regularly Engage
in Aerobic Exercise**

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Abstract

Older adults (55+ years) are a growing percentage of the United States population. Older adults are at an increased risk of developing age-related non-communicable diseases that may decrease their quality of life and increase the burden placed on the economy. Although many known health benefits are associated with regular participation in aerobic exercise, poor long-term adherence remains a concern. Because feelings of pleasure/displeasure during exercise have been cited as contributors to future intentions and behaviors, researchers have begun exploring determinants of affective responses during exercise. However, research has primarily been conducted in university students, sedentary adults, and high-active adults. Understanding determinants of exercise-related affect in older adults represents an important research question that has yet to be addressed. The purpose of this study is to explore and understand determinants of recalled in-task affect to a regularly performed aerobic bout in older adult exercisers.

METHODS: Individuals participated in two Zoom sessions, each lasting approximately 30-minutes. A semi-structured interview guide to explore determinants of exercise-related affect from a regularly completed aerobic exercise session was used. Themes and subthemes were constructed using Braun and Clark's thematic analysis guide. **RESULTS:** Sixteen active older adults (11 women, 5 men, 61.4 ± 4.7 years) provided data in this study. Five themes emerged regarding determinants of recalled in-task affect. The first and second themes ('Environmental and External Conditions' and 'Social Context') were mentioned by most participants (87.5%). Three additional themes emerged: 'Pre-Exercise States', 'Process Barriers and Facilitators', and 'Performance'. **DISCUSSION:** Results supported novel findings regarding the environment and social context of exercise. Interoceptive cues were not cited, which could be due to the location of exercise (naturalistic vs. laboratory-based), more people exercising outside because of the

COVID-19 pandemic, the sample being more in-tune with environmental conditions, or the chosen exercise intensity. The results from this study also provided support for pre-exercise states and performance as determinants of exercise-related affect. Future research should explore determinants of exercise-related affect after the pandemic and in a naturalistic setting to determine if the environment and social context of exercise continue to emerge as important contributors to subjective exercise experiences.

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Chapter 1: Introduction

The exponential growth in the older adult population presents numerous challenges. Because of the “baby boom”- a surge in population due to a revitalized economy that occurred after World War II-the number of adults over the age 65 in America is forecasted to increase exponentially by the year 2030, at which time 1 in 5 people would be over the age 65 ("65 and Older Population Grows Rapidly as Baby Boomers Age," 2020; "Older People Projected to Outnumber Children for First Time in U.S. History," 2018). In 2018, 16% of the population was considered an older adult; this is a large increase, comparatively from the year 2000, when only 12.4% of the population was over age 65 (Vincent, 2010). Although 65 years of age is commonly viewed as the threshold to be considered an older adult, it is important to note that individuals aged 55 and older have also been categorized as older adults by numerous researchers (Chen, Yu, & Chang, 2021; Guimarães, Barbosa, & Meneghini, 2018; Miller, Bembien, & Bembien, 2021; Morris et al., 2017; Muellmann et al., 2018; Penninx, Deeg, Van Eijk, Beekman, & Guralnik, 2000), the National Health Interview Surveys' Family and Sample Adult questionnaires, (Schoenborn, Vickerie, & Powell-Griner, 2006) and the Center for Disease Control and Prevention's National Health Statistics Report (Schoenborn & Heyman, 2009) due to an increased likelihood of unfavorable health outcomes also observed within this age range. Older adult populations are at an increased risk of developing non-communicable diseases impacting physiological health, such as cardiovascular disease and cancer, as well as those impacting mental health, such as dementia and Alzheimer's (Jin, Simpkins, Ji, Leis, & Stambler, 2014). Additionally, the risk of falling increases as a person ages which leads to an increased risk of hip fractures due to loss of bone density (Bergen, Stevens, & Burns, 2016). The increase in

disease risk and injury risk due to aging has been called the “greatest economic burden” due to increased health care costs and decreases in the workforce because of physical or mental disabilities associated with aging (Jin et al., 2014). While calculating the total economic burden caused by the aging population is challenging, the Congressional Budget Office (CBO) has determined that at least half of the expected increase in Social Security spending and major health care costs (from 10.8% to 17.2%) are attributable to the aging population (Office, 2021). Also, the CBO determined that, without aging, the spending on Social security would be lower in 2051 than it was in 2019 (Office, 2021). Due to the increased risk of disease and injury, as well as the increased economic burden placed on healthcare, it is important to explore strategies to prevent and treat these non-communicable age-related diseases and injuries.

Physical activity has been demonstrated to be beneficial in decreasing disease risk and ameliorating symptoms associated with age-related diseases and conditions. Physical activity can be defined as any bodily movement that creates an energy expenditure above that of resting values (Caspersen, 1985). Health benefits include, but are not limited to, a decrease in cardiovascular risk, a decrease in respiratory muscle weakening, and a decrease in obesity risk (Westerterp, 2018). Researchers have suggested that regular participation in physical activity causes a decrease in all-cause mortality, a decrease in mental health disorders (Westerterp, 2018) and an improvement for quality of life. These health benefits are associated with partaking in physical activity in accordance with the Physical Activity Guidelines for Americans (PAGA) of 150 minutes per week of moderate aerobic activity and at least two days per week of total-body muscle strengthening activities (Piercy, 2018). The PAGA for older adults is the same as suggested guidelines for the general adult population, with the inclusion of two days of flexibility training per week (Nelson, 2007). Completing the recommended intensity and volume

of physical activity, which can be achieved through all four physical activity domains (transportation, leisure-time, occupational, domestic), has been shown to elicit better quality of life due to decreasing disease prevalence (Musich, 2017). Exercise is a subdivision of leisure-time physical activity that is a commonly promoted strategy to increase total physical activity levels. Exercise refers to activities that are planned, structured, and performed with the intention of maintaining or improving one or more components of physical fitness (Caspersen, 1985). Participation in regular exercise is beneficial to the older adult population as research has suggested that cardiovascular disease risk factors such as hypertension, blood glucose levels, and blood lipid levels may be positively impacted (Dishman, Sallis, & Orenstein, 1985; Fentem, 1994). Aerobic exercise is beneficial for improving cardiovascular function in older adults which allows for greater oxygen delivery to working muscles. Researchers have consistently developed exercise intervention programs for older adults (Cadore, Rodríguez-Mañas, Sinclair, & Izquierdo, 2013; García-Hermoso et al., 2020); however, long-term maintenance appears to be particularly difficult for a majority of individuals, including older adults.

Like many complex health behaviors, adherence to exercise programs has been found to be relatively poor. Research has suggested that approximately 50% of adults who begin an exercise program fail to continue the program (Dishman, 2001) and these rates may be higher in older adults (Findorff, Wyman, & Gross, 2009). Long-term studies demonstrate a decrease in adherence rates from early adoption stages (66%) to early maintenance stages (52%) (Oman & King, 1998). A systematic review of supervised exercise programs for patients with peripheral arterial disease found that on average, 54.1% of participants incompletely adhered to the exercise program (Harwood, Smith, Cayton, Broadbent, & Chetter, 2016). Finally, a study completed in the older adult population measuring adherence to different exercise programs found that only

1.2% of participants had complete data for completing at-home exercise for the entire duration of the study (12-week study); however, 78.2% of participants completed about half of the exercise program (Stineman et al., 2011). Without sufficient stimuli, health and fitness-related benefits (e.g., increased mitochondria, increased blood volume, increased muscle hypertrophy) gained from exercise will diminish over time (Martin & Dubbert, 1985; Middleton, Anton, & Perri, 2013). Due to the loss of health benefits associated with attrition, researchers have stated the importance of exploring determinants of exercise adherence.

Historically, enjoyment of exercise (i.e., a psychological state that refers to feelings of pleasure, liking, and fun directly related to the behavior itself) has been cited as a strong determinant of exercise adherence (Dishman et al., 1985). Given this purported importance of the psychological experience, substantial research efforts had been dedicated to exploring the impact of acute exercise components (e.g., mode, duration, intensity) on mood and emotional states, often referred to as affective responses. Favorable changes in variables such as well-being, energy, anxiety, and tension observed from pre-to-post session time points supported the notion “exercise feels good,” specifically at low and moderate intensities (Ekkekakis & Petruzzello, 2000, 2002). Such conclusions, however, are in direct contrast with the poor adherence rates consistently reported in the literature. Later research supported that, pre-to-post measurements are likely to capture a “rebound effect” (i.e., improvements in mood and emotional states were due to the removal of an aversive stimulus, rather than a reflection of affective responses during exercise (Backhouse, Ekkekakis, Biddle, Foskett, & Williams, 2007).

Within the past 20 years, research has shifted towards exploring how individuals feel during an exercise bout using brief measures of core affect. Core affect can be defined as a measure of psychological well-being that is usually a subconscious response to a stimulus

(Russell, 1980; Shouse, 2005; Zajonc, 1980). Core affect is composed of two dimensions: valence (pleasure/displeasure) and activation (arousal/sleepiness) (Russell, 1980, 2003). Due to the criticisms surrounding previous measurements of affect, research supports the measurement of in-task affect (Ekkekakis & Petruzzello, 2002), because measurements taken when the participant is under physical exertion stand to provide more accurate depictions of feelings and experiences specific to the behavior itself (Legrand, Joly, Bertucci, Soudain-Pineau, & Marcel, 2011; McAuley & Courneya, 1992). Further, ratings of in-task affect have been demonstrated to predict future exercise behavior (Kwan & Bryan, 2010; McAuley & Courneya, 1992) as well as intentions to exercise (Kwan & Bryan, 2010; Kwan & Bryan, 2010). Such outcomes may be explained by the Hedonic Theory of Motivation, which broadly states that people pursue pleasure and avoid pain (Higgins, 1997). More recently, the Affective-Reflective Theory (ART) of physical inactivity and exercise was developed to explain exercise behaviors and is the application of the hedonic principle to an exercise bout (Brand, 2018). This theory states that the initial “gut” responses to an exercise stimulus become encoded into a person’s subconscious mind and sway the person’s future behaviors when a similar stimulus occurs (Brand, 2018). Due to the relationship between previous affective responses and future behaviors, it is pertinent that researchers understand determinants of these affective responses in order to effectively predict and manage them to optimize exercise experiences.

Research has suggested that a primary determinant of affect is exercise intensity. Intensity, specifically below ventilatory threshold (VT) (Svedahl & MacIntosh, 2003), is generally associated with more positive in-task affect while intensity above the VT is generally associated with more negative in-task affect. The Dual-Mode Model (DMM) serves to explain the relationship between VT and in-task affect (Ekkekakis, 2009; Williams, 2008). “Dual-mode”

refers to the two factors that influence affective responses: cognitive and interoceptive (Williams, 2008). Interoceptive factors (e.g., heart rate, shortness of breath, localized muscular fatigue) determine affective responses at intensities above VT, as the body's physiological mechanisms attempt to maintain homeostasis. Cognitive factors, such as self-efficacy and goals, determine affective responses at or below VT because homeostasis is not threatened (Williams, 2008). However, the DMM also supports that substantial interindividual variability exists regarding the direction and magnitude of in-task affect when individuals exercise at or just below VT (McAuley & Courneya, 1992; McAuley, 2000; Rose, 2010; Welch, 2007). Additional research has also noted a degree of interindividual variability in direction and/or magnitude exists at below-VT and above-VT intensities as well (Ekkekakis, Hall, & Petruzzello, 2008; Welch, 2007). Taken together, intensity does not appear to be the sole determinant of exercise-related affect.

In an emerging body of literature, researchers have begun exploring additional determinants of in-task affective responses to exercise. Research has shown that self-efficacy has a positive, weak correlation with affective responses (Ekkekakis, Lind, & Vazou, 2010). Forecasted affect (i.e., prediction of future affective responses) has been cited as influencing ratings of in-task affect during exercise (Calder, Hargreaves, & Hodge, 2020; Rose, 2010). Pre-exercise affective and activation states (e.g., positive mood, low energy) have also emerged as contributors to in-task affect (Rose, 2010; Strohacker, Boyer, Smitherman, Cornelius, & Fazzino, 2017b). To date, these studies have been conducted in various populations (middle-aged sedentary and high-active women, middle-aged sedentary and active men, diseased populations) (Rose, 2007, 2010; Welch, 2007). Currently, no evidence exists regarding determinants of exercise-related affect specifically for older adults. Additional research is needed, as it is

premature to assume that previously observed determinants of affect can be extrapolated across all populations. Therefore, the purpose of this research is to explore and understand the determinants of affect in older adults who complete regular exercise.

Chapter 2: Literature Review

Older Adults

The number of adults in the United States of America classified as ‘older adults’ is continuing to increase which may lead to an increased burden regarding the economy and the healthcare system. The American College of Sports Medicine (ACSM) defines an older adult as a man or woman over the age of 65 or between the ages of 50 and 64 with significant and limiting chronic conditions (Nelson, 2007). Older adults can be classified into three age ranges: youngest-old (65-74 years), middle-old (75-84 years), and oldest-old (85+ years) (Lee, Oh, Park, Choi, & Wee, 2018). However, the National Health Statistics Report categorizes an older adult as someone who is 55 years of age or older (Schoenborn & Heyman, 2009). This report splits older adults into four age ranges: 55-64 years, 65-74 years, 75-84 years, and 85+ years (Schoenborn & Heyman, 2009). The National Health Interview Surveys’ Family and Sample Adult questionnaires group the 55-to-64 age range in the older adult category (Schoenborn et al., 2006). According to this survey, approximately 1 in 5 adults in the 55-to-64 age range are considered to be in ‘poor health’ (Schoenborn et al., 2006). Numerous research studies define an older adult as an individual aged 55 years or older. For example, a prospective cohort study examining depression and physical ability showed that adults in the 55-to-64-year age range displayed a significant decline in physical ability compared to baseline measures (Penninx et al., 2000).

The process of aging cannot be reversed; however, researchers have suggested assessments to gauge successful aging. The combination of objective and subjective measurements to assess successful aging is strongly suggested, where researchers may objectively measure the process of aging by examining individuals across three domains:

avoidance of diseases, social engagement with life, and high physical and cognitive functioning (Ferri, James, & Pruchno, 2009). Historically, researchers only assessed objective measurements of aging; however, gerontologists have pinpointed the relationship between subjective assessments of health and mortality rates (Ferri et al., 2009). Because of this, it has been proposed to conduct a dual assessment of aging that includes objective and subjective measurements. Research has suggested that older adults' rate themselves as aging successfully more often subjectively than objective measurements conclude (Strawbridge, Wallhagen, & Cohen, 2002). Successful aging has thus been identified as including avoidance of age-related diseases, social engagement, life satisfaction, positive affect, and perceived control (Ferri et al., 2009). Older adults who accomplish "successful aging" may experience a more positive quality of life compared to older adults who are diagnosed with multiple age-related diseases and have limited social engagement.

Exponential Population Growth

In the United States of America, as of 2016 there were 49.2 million older adults; this number is expected to continue to increase ("65 and Older Population Grows Rapidly as Baby Boomers Age," 2020). A population is considered an 'aged population' when more than 14% of the population is over the age of 65 (Lee et al., 2018). In the year 2016, 15.2% of the American population was already over the age of 65 ("65 and Older Population Grows Rapidly as Baby Boomers Age," 2020). This number is expected to exponentially increase in the next 10 years due to all children born during the baby boom that occurred after World War II entering the older adult age classification. By 2030, 1 in 5 Americans will be over 65 and in 2034, the number of older adults will surpass the number of children in America (77 million older adults, 76.5 million children) (Vincent, 2010; "Older People Projected to Outnumber Children for First Time in U.S.

History," 2018). The percentage of adults 65+ is forecasted to continue to increase until 2060, when 23% of the American population will be classified as older adults ("Older People Projected to Outnumber Children for First Time in U.S. History," 2018).

Physiological Concerns

As individuals enter older adulthood, there is an increased risk of developing age-related diseases that are non-communicable in nature. Age has continuously been cited as a determinant of disease risk by ACSM, such that an age of 45 years in men and 55 years in women is considered a positive risk factor for developing cardiovascular disease (Force, 2004). With the increased risk of developing diseases and the symptoms associated with these diseases, older adults face difficulties with performing daily living activities (Covinsky et al., 2003). Age-related diseases may lead to physiological changes in the body, including a loss of muscle mass, bone density, and cartilage.

Sarcopenia

Sarcopenia is defined as involuntary age-related loss of skeletal muscle mass or skeletal muscle function (Walston, 2012). The prevalence of sarcopenia in the older adult population ranges from 8.4% to 27.6%, depending on the method of testing (Beaudart, 2015). Although the causes of sarcopenia are multifactorial (hormonal change, increased inflammation, etc.), a main contributor to the development of sarcopenia are age-related molecular changes (Walston, 2012). From a physiological standpoint, the body is composed of approximately 60% skeletal muscle mass and 40% non-muscular tissue (Walston, 2012). Starting as early as the fourth decade of life, sarcopenia is associated with numerous negative health outcomes such as loss of muscular function (Walston, 2012). Sarcopenia is categorized into two classes (I and II) and the prevalence is higher in women where 50% aged 50-59 years display class I sarcopenia compared to 37% of

men (Janssen, 2002). With increasing age, the percentage of the population diagnosed with sarcopenia continues to rise where 61% of women and 43% of men aged 80+ display class I sarcopenia (Janssen, 2002). Skeletal muscle mass is a metabolic tissue; thus, the rapid decline in muscle mass in the older adult population poses an issue for weight maintenance (Yeung et al., 2019). Additionally, the loss of muscle may contribute to an increase in falls (Yeung et al., 2019). Older adults diagnosed with class II sarcopenia are two to three times more likely to suffer from a functional impairment than older adults without sarcopenia (Janssen, 2002).

Osteoporosis

Osteoporosis is defined as the loss of bone mass and categorized by an increase in frailty and risk of bone fracture ("Osteoporosis prevention, diagnosis, and therapy," 2000). Individuals who suffer from osteopenia, a condition marked by the initial loss of bone density, are more likely to develop osteoporosis. The National Health and Nutrition Examination Survey (NHANES) conducted in 2005 estimated that 49% of older adult women and 30% of older adult men had osteopenia in the femur (Looker, Melton, Harris, Borrud, & Shepherd, 2010). When researchers extrapolated this data to the U.S. Census Bureau estimate of the older adult population, it suggested that 40 million adults displayed low bone density of the femur (Looker et al., 2010). As the number of older adults in America is forecast to increase, the possible number of adults diagnosed with osteopenia may increase. While predictors of osteoporosis may differ, the easiest identifier of an increased risk of developing this disease is advanced age (Reginster, 2006). One million five-hundred thousand fractures are attributed to osteoporosis each year for Americans (Melton III et al., 1997). Hip fractures caused by osteoporosis have the highest risk of mortality due to the need for hospitalization after suffering a hip fracture (Cole, 2008). A study by Salkeld and colleagues (2000) in 194 women showed that 80% of respondents

would prefer death over being hospitalized because of a hip fracture (Salkeld et al., 2000). In the year 1990, there were 358,296 thousand hip fractures recorded for North Americans and due to the exponential growth in the number of older adults, this number is expected to increase to 763,228 thousand by the year 2050 (Cooper, 1992). Previous research studies have displayed a 13.3% mortality rate for patients who suffer a hip fracture (Choi et al., 2014) and this number could continue to rise within a 10-year timeframe.

The increase in fractures due to osteoporosis causes a financial burden for health services due to the growing need for nursing homes and home-based care following fractures in older adults (Melton III, Lau, Mautalen, Seeman, 2009). In the year 2005, 2 million fractures caused by osteoporosis were recorded for Americans and hip fractures specifically accounted for 72% of the costs (Cole, 2008). It is forecasted that by the year 2025, annual costs associated with fractures will rise by 50% (Cole, 2008). The population with the highest expected growth in amount of fractures is the 65-74 year age range (Burge, 2007). Fractures caused by osteoporosis may impact social networking and decrease physical functioning (Reginster, 2006), which can lead to a poorer quality of life and an increased likelihood of more fractures.

Arthritis

Arthritis is a common debilitating disease affecting the joint and connective tissues surrounding the joint (Hootman, 2012). The risk of developing arthritis increases with age (Dunlop, Song, Chang, 2001) and arthritis is considered one of the most prevalent chronic diseases in American adults (Hootman, 2012). In 2008, more than 21% of Americans had been diagnosed with arthritis and approximately 50% of the older adult population had arthritis (Helmick, 2008). Of the older adults who have arthritis, approximately 22% suffer from activity limitations due to this debilitating disease (Helmick, 2008). The high amount of arthritis-related

activity limitations is expected to increase as more adults fall into the older adult age range and that is why researchers have deemed arthritis to be a leading cause of disability (Helmick, 2008). Older adults living with arthritis reported that having arthritis limited their functional abilities and daily life activities (Dunlop, Song, Manheim, Shih, Chang, 2005). Arthritis-induced falls is a commonly reported finding in the literature, where 15.5% of the American population that experience falls state that the cause was arthritis (Barbour, 2014). Besides limitations regarding mobility, older adults experiencing arthritic symptoms are suggested to experience a lower health-related quality of life than older adults without arthritis (Dominick, 2004).

Psychological and Cognitive Concerns

Mental Health Disorders

Mental health disorders such as anxiety, depression, and psychiatric disorders have commonly been diagnosed in all age ranges. As the older adult population increases and the healthcare field becomes more prepared for elongated lifespans, the number of older adults being diagnosed with mental health disorders continues to grow (Zarit, 2007). However, the number of mental health practitioners in the geriatric population does not meet the growing need for professional help (approximately 4.2% of health care workers focus on geriatric populations) (Bartels, 2013; Zarit, 2007). Mental health disorders may lead to poorer health outcomes than physical illnesses alone, resulting in more trips to the emergency room (Bartels, 2013). In previous studies, around 15% of older adults experienced depression and more often than not, these adults simultaneously had a disease that affects physical health (Murrell, 1983).

Cognition

Cognition is impacted by aging, specifically related to attention and memory (Glisky, 2007). Attention is a complex cognitive process that is linked to many other cognitive domains

and can negatively impact a person's ability to efficiently complete daily tasks (Glisky, 2007). Decreased cognitive functioning in attention-related tasks has been attributed to poorer information processing (Glisky, 2007); thus, older adults are unable to focus on one specific task at hand or switch between mental tasks as well as adults without a cognitive impairment. Working memory, which is composed of reorganization of short-term memories, long-term memory, and problem solving, can also be impacted (Glisky, 2007). Issues related to working memory negatively impact older adults because so many activities in daily living involve decision making or problem solving and older adults with cognitive impairments are unable to perform these tasks (Glisky, 2007). Petersen and colleagues (2010) found that, out of 2,719 participants, 16% of participants were diagnosed with mild cognitive impairments, and 11% were diagnosed with amnesia (Petersen, 2010).

Dementia

Dementia is characterized by cognitive impairment of the brain and is usually accompanied by physical and mental deterioration (Health, 2007). Two categories of dementia have emerged: young-onset (occurs before the age of 65) and late-onset (occurs after the age of 65) (Health, 2007). The aging process can be accompanied by mild cognitive decline; however, the severity of cognitive impairment and functional disabilities that often accompany dementia distinguish this disease from the natural aging process (Health, 2007). While multiple conditions can lead to the development and/or cause the symptoms of dementia, Alzheimer's Disease accounts for approximately 60% of all dementia cases (Health, 2007). Alzheimer's Disease is a neurodegenerative disorder commonly characterized by memory loss (Mucke, 2009). The amount of people diagnosed with Alzheimer's is expected to rise from 5 million to approximately 11 million by the year 2050 (Mucke, 2009). Older adults diagnosed with

Alzheimer's Disease and other related dementias can expect to pay more in total healthcare costs than older adults who do not suffer from these diseases (\$14,508 versus \$10,096) (Deb, Sambamoorthi, Thornton, Schreurs, & Innes, 2018). The largest increase in expenditures pertained to home healthcare costs, where Alzheimer's patients paid about 34% more in fees (Deb et al., 2018).

Daily Function and Independent Living

Activities of daily living (ADL) are defined as the multitude of activities an individual completes throughout the day in order to complete the tasks needed, whether the activity be occupational (i.e., walking around a classroom to teach), domestic (i.e., shopping for groceries), or any other planned activity. These activities also refer to the ability to complete tasks deemed necessary for basic living purposes (i.e., brushing hair/teeth, getting dressed, getting out of a chair). The likelihood of developing non-communicable diseases such as osteoporosis, arthritis, and sarcopenia increases as individuals age, which tends to lead to decreased physical functioning ability. The decrease in functional ability can impact older adults negatively by increasing the possibility of becoming dependent on assistance (Avery, Kleppinger, Feinn, & Kenny, 2010). Being enrolled in an assisted living community may negatively impact individual's quality of life by decreasing autonomy for the individual and life-time care costs may cause a financial burden for families (Mitzner, 2011). In 1999, there were 811,000 Americans residing in assisted living residences (Mitzner, 2011) and that number continues to increase in the older adult population. In the United States, 40% of older adults have some sort of disability and 96% of that population require assistance (He, 2005).

Older adults who experience a transition state called 'frailty,' which refers to the reliance on assistance to perform activities of daily living and increased probability of dependence

throughout the later stages of life, may suffer other social, physical, and mental dysfunctions such as decreased muscle mass and decreased quality of life (Chou, Hwang, & Wu, 2012). Data from a study completed in 2001 by Desai and Weeks stated that 20% of older adults who need help with completing activities of daily living are not receiving the required assistance necessary to perform tasks (Desai, 2001). These individuals lack the ability to complete tasks alone and, without assistance, may not be able to perform necessary tasks such as eating or getting out of bed (Desai, 2001). This increased reliance on assistance may impact older adults' health-related quality of life by removing autonomy (Mitzner, 2011).

Covinsky and colleagues (2003) examined loss of function post-hospital stays and found that 35% of patients displayed a decline in ADL function from baseline measures to discharge from the hospital (Covinsky et al., 2003). Age was associated with failure to recover ADL function prior to discharge from hospitals (50% of patients over 85 displayed ADL functional decline) (Covinsky et al., 2003). Similarly, previous research has demonstrated that patients who displayed higher-ADL functional decline were more likely to be re-admitted to the hospital than patients with lower-ADL functional decline (Tonkikh et al., 2016). These results may demonstrate the importance of preventing and treating illness prior to hospitalization.

Economic Burden

The increase in disease-risk due to aging has been called the “greatest economic burden” due to increased health care costs and decreases in the workforce because of physical or mental disabilities associated with aging (Jin et al., 2014). It is deemed an ‘economic burden’ because of the monetary impact on healthcare and individuals diagnosed with these age-related diseases. In the year 2015, approximately \$50 billion were attributed to medical costs associated with fatal and nonfatal falls in the elderly (Florence et al., 2018). Osteoporotic fractures are steadily

increasing in the older adult population and the costs associated with fractures is forecast to double by the year 2050 in many developed countries (Reginster, 2006). To put this into perspective, in the year 2004, 26 billion dollars were charged from national hospitals for knee and hip replacements (Kim, 2008). Approximately 60% of these surgical charges were for adults aged 65-84 years old. Medicare was the primary source of financial compensation for these surgeries (Kim, 2008), which is funded by the Social Security Administration via tax dollars.

The many examples above are strictly associated with joint-replacements and fractures caused by osteoporosis, which does not take into consideration medical charges associated with other diseases such as diabetes, hypertension, cardiovascular disease, and more. Risks for developing these diseases exponentially increase, from about 40% for middle aged adults to about 70% for older adults (Yazdanyar, 2009). Direct costs associated with cardiovascular diseases were more than \$313 billion dollars in the year 2009, and this number is expected to increase 46% by the year 2025 (Yazdanyar, 2009). Older adults are at a higher risk of developing comorbidities- multiple diseases at one time- as well, which may lead to more hospital visits and an even higher financial burden for the nation. In 2013, 67% of older adults displayed multimorbidities and, as the older adult age range increased, so did the number of older adults with multimorbidities (50% for adults under age 65 to 81.5% of older adults above age 85) (Salive, 2013). As older adults continue to age, researchers have described an increase in visits to the emergency room and/or hospital during study periods, with older adults over the age of 85 identified as having the highest risk of visiting the emergency room (Lee et al., 2018). If no intervention occurs to delay or decrease the likelihood of age-related diseases, these numbers may continue to rise.

Physical Activity

Regular engagement in physical activity is commonly promoted to support the prevention and treatment of the numerous non-communicable diseases associated with aging that negatively impact quality of life and economic burden. Physical activity can be defined as any bodily movement, produced by skeletal muscle, that creates an energy expenditure above that of resting values (Caspersen, 1985). Numerous acute and chronic health benefits are associated with participating in physical activity in accordance with the recommended guidelines: 150 minutes per week of moderate aerobic activity and at least two days per week of total-body muscle strengthening activities (Piercy, 2018). The Physical Activity Guidelines for Americans (PAGA) can be met through four domains: domestic (i.e., mowing the lawn, doing laundry), transportation (i.e., cycling or walking to work), leisure-time (i.e., exercise, free-time), and job-related (i.e., lifting machinery, walking around a classroom). Health benefits such as decreased cardiovascular disease risk, reduced risk of all-cause mortality, and improved cognitive functioning are continually cited (Reiner, Niermann, Jekauc, & Woll, 2013; Saxena, Van Ommeren, Tang, & Armstrong, 2005; Vogel et al., 2009). In 2018, the guidelines also included new evidence for health benefits associated with physical activity, such as reduction in fall-risk for older adults (Piercy, 2018). Physical inactivity has been associated with numerous health declines in physical and mental functioning. For example, older adults who are more physically inactive tend to suffer more from mental health disorders such as depression and depressive-like symptoms (Win, 2011). In 2011 approximately 17% of the American population was considered physically inactive (Dumith, 2011). Physical inactivity is highly associated with an increased risk for developing cardiovascular disease, which accounted for 864,480 thousand deaths in the year 2005 (Yazdanyar, 2009). Older adults accounted for 82% of these cardiovascular disease-related

deaths (Yazdanyar, 2009). Although many researchers have cited information pertaining to the benefits of physical activity in decreasing disease risk and symptoms associated with diseases, physical inactivity remains a persistent problem.

Exercise

Exercise can be defined as a subset of leisure-time physical activity that is planned, structured, and performed with the intention of maintaining or improving one or more components of physical fitness (Caspersen, 1985). Physical fitness is composed of five components: aerobic endurance, flexibility, balance, static strength, and power (Tudor-Locke et al., 2011). Due to health benefits associated with physical activity, researchers commonly target exercise behaviors as a way to achieve the physical activity guidelines. Different modalities of exercise- flexibility training, resistance training, and aerobic training- all have a positive impact on the health of older adults. While participating in physical activity regularly may cause many positive health impacts alone, the benefits associated with acute and chronic exercise are substantial.

Exercise as a Treatment for Cardiovascular Disease

A sedentary lifestyle is a primary indicator of the development of cardiovascular disease (CVD) and regular participation in exercise may decrease the likelihood of developing CVD by 15-39% (Giada et al., 2008). Researchers have commonly cited aerobic exercise as being a “key to successful aging,” due to the benefits associated with increased oxygen consumption and the beneficial effects on lipid and glucose levels (Fleg, 2012). A common symptom associated with CVD and diseases linked to increasing CVD prevalence (such as type II diabetes) is chronic systemic inflammation. Exercise induces an anti-inflammatory response that decreases inflammation; thus, leading to a decrease in symptoms associated with the disease

(Wagenmakers & Pedersen, 2006). Participation in regular exercise is beneficial to the older adult population as research has suggested that CVD risk factors such as hypertension, blood glucose levels, and blood lipid levels may be positively impacted by regular participation in exercise (R. K. Dishman et al., 1985; Fentem, 1994). For example, brachial arterial blood flow impairment can be linked to aging and causes an increase in CVD risk. One of the acute benefits associated with regular aerobic exercise is an increased brachial artery dilation (Pierce, Eskurza, Walker, Fay, & Seals, 2011).

Exercise as a Treatment for Other Physiological Concerns

Exercise is a common treatment to other non-communicable diseases, such as sarcopenia and osteoporosis. The loss of muscle mass associated with aging is unavoidable; however, implementation of exercise programs may cause a reduction in the loss of muscle mass (Visvanathan & Chapman, 2010). Multimodal exercise (exercise consisting of resistance training, aerobic training, and balance) has been suggested specifically for older adults (Beckwée et al., 2019; Landi, Marzetti, Martone, Bernabei, & Onder, 2014). As research has shown that older adults spend a large portion of time sedentary, the inclusion of movement exercises, specifically weight-bearing exercises, helps combat loss of muscle mass and loss of bone density (Pearson, 2005). Improvements in muscle mass and bone density through balance and resistance training exercise may decrease the number of falls experienced by older adults in a year, allowing the person to remain living dependently and keep their autonomy (Tornero-Quñones, Sáez-Padilla, Espina Díaz, Abad Robles, & Sierra Robles, 2020). Regular participation in exercise is necessary for individuals to achieve these health benefits and exercise maintenance is a primary determinant of whether or not health benefits will continue (Timmons, Griffin, Cogan, Matthews, & Egan, 2020).

Exercise as a Treatment for Impaired Cognitive Functioning

Other age-related risk factors, such as impaired cognitive functioning, can be delayed or positively impacted by exercise. Aerobic-exercise-specific benefits have been suggested, including better sleep quality, improved quality of life, and improved cognitive functioning (Erickson & Kramer, 2009; Reid, 2010). Decreased cognitive functioning in older adults may lead to more hospital visits and an increased likelihood of reliance on healthcare to complete activities of daily living. Exercise induces structural changes in the brain that promotes neuroplasticity (the ability of the brain to form new synaptic connections) (Bavelier & Neville, 2002). These changes have been documented by looking at increased brain volume or increased white matter (a deep tissue that contains axons connecting the brain to other nerves in the body) (Serra et al., 2011). A decrease in white matter is linked to aging and may cause a decrease in cognitive functioning abilities because axons connected to other nerves in the spinal cord may wear away (Serra et al., 2011). Other benefits of exercise on cognitive functioning include an increase in memory abilities and an increase in attentional qualities (Kramer et al., 1999). The benefits of aerobic exercise on brain volume and blood flow to the brain have been well documented (Erickson & Kramer, 2009) and should direct practitioners towards prescribing aerobic exercise as a treatment for impaired cognitive functioning.

Exercise Adherence

Lack of adherence to exercise prescriptions present a major challenge. Adherence can be defined as the commitment to a specific belief or program and is reported in many long-term research studies (Chao, Foy, & Farmer, 2000; Dishman, 2001; Rhodes et al., 1999). Nonadherence to chronic illness treatment interventions such as health behavior change (including exercise and physical activity) and medication are reportedly high, with 50-80% of

individuals not continuing the intervention (Middleton et al., 2013). A 2006 review conducted by Marcus, et al., discovered that the average drop-out rate for interventions was approximately 45% (Marcus et al., 2006). Research has suggested that approximately 50% of participants who begin an exercise program fail to continue that program (Dishman et al., 1985). Findorff, Wyman, and Gross (2009) conducted a study examining exercise adherence in older adult women based on self-report measures demonstrated that 66% of women continued walking on a regular basis for at least two-years post-intervention (Findorff et al., 2009). However, few studies have examined exercise adherence in older adults in non-home-based interventions. Exercise adherence for home-based intervention strategies in the older adult population displays a wide range of adherence rates, from 14% (Tsauo, Leu, Chen, & Yang, 2005) to around 80% (Mangione, 2005). Acute positive exercise-related health outcomes may be reversed with the discontinuation of an exercise intervention (Martin & Dubbert, 1985; Middleton et al., 2013). For example, after a 12-month intervention, exercise-induced improvements of muscular strength, power, and endurance returned to baseline values within 15-months post-intervention in all individuals who did not continue exercising (Uusi-Rasi, Sievänen, Heinonen, Kannus, & Vuori, 2004). A primary concern is that many exercise benefits will diminish following behavioral cessation. For example, 4 to 14% of improvements in maximal oxygen uptake may be lost after short term (less than four weeks) discontinuation of exercise. Individuals who recently saw improvements in cardiac output due to exercise showed a 6.9% decline in cardiac output after exercise cessation (Miyashita, 1978). Individuals who have undergone more training are likely to have a larger decline in maximal oxygen uptake values; however, improvements to oxygen uptake can be maintained with physical activity (Mujika & Padilla, 2000).

Enjoyment as a Determinant for Exercise Adherence

Self Determination Theory (SDT) is a theory of motivation categorized by three basic psychological needs: autonomy, competence, and relatedness. SDT suggests that there are two categories of behaviors, one being self-determined in the hopes to achieve an intrinsic or extrinsic goal and the other an automated behavior or “mindless” behavior (Deci, 1980). Many self-determined behaviors are in response to the need for competence, or to satisfy an intrinsic motivator determined by feelings of oneself whereas automated behaviors rely on developed cognitions (Deci, 1980). Researchers have suggested that the enjoyment of an activity is linked to whether or not the activity satisfied the three basic psychological needs (Deci & Vansteenkiste, 2004). This is supported through studies displaying that the ability to work in a group satisfied the need for relatedness and led to higher levels of enjoyment (Nielson, 2014). Enjoyment can be defined as a positive cognitive appraisal that occurs when a person is able to satisfy a desire, need, or goal (Kimiecik, 1996). This idea suggests that if someone enjoys an activity, they are more likely to continue that activity than if the same person has a repeatedly bad experience. A systematic review conducted in 2007 suggested the lack of enjoyment for an exercise intervention to be a barrier in continuing that intervention (Burgess, Hassmén, & Pumpa, 2017). Furthermore, participants who enjoyed an exercise session also stated that the participation in exercise was motivated by possible health benefits and led to increased attendance with exercise classes (Vlachopoulos & Karageorghis, 2005). A significant correlation ($r=0.46$) has been found between enjoyment and level of exercise at baseline and at month 12 (Hagberg, 2009). However, levels of enjoyment decreased at each measurement point (3-month, 6-month, 12-month) (Hagberg, 2009). Thus, researchers have demonstrated that it is important to consider the psychological response to exercise in order to understand behavioral maintenance.

Affective Responses to Exercise

Core Affect, Mood, and Emotion

Researchers have continuously used the terms feeling, emotion, mood, and affect interchangeably; however, it is important to understand the difference in these terms. Core affect can be defined as a measure of psychological well-being that is usually a subconscious response to a stimulus (Russell, 1980; Shouse, 2005; Zajonc, 1980). The Circumplex Model of Affect is recommended as a framework for measuring core affect (Ekkekakis & Petruzzello, 2002). Schlosberg (1952) first identified the circular, two-dimensional model by having participants categorize facial expressions into pre-set emotional categories and discovered three common axes: pleasant-unpleasant, attention-rejection, and tension-sleep. The last two axes were so highly correlated that they were collapsed into one axis. The Circumplex Model of Affect, later represented by Russell, is said to be separated into four sections, where opposite poles represent the opposite feeling: pleasure-misery, arousal-sleepiness (Russell, 1980). While other terms fall on the perimeter of the model, each term, or affect word, is represented by a specific level of the arousal and pleasure components (Russell, 1980). Core affect is a consciously accessible state that is composed of hedonic valence and arousal (Russell, 2003).

Affect refers to the “feeling tone,” and can be defined as the basis of all feelings, a person experiences at a specific time and can be characterized by valence, the positive or negative characteristic of feeling, or activation, the energetic/aroused state of feeling (Larsen & Prizmic, 2004). Valenced dimensions of pleasant or unpleasant feelings and felt arousal are the underlying dimensions of all moods and emotions, which give rise to other cognitions and cognitive appraisals. A feeling is a response that has been compared to previous experiences and labeled as positive or negative based on those previous experiences (Shouse, 2005). If the “feeling tone” is

mild and has no clear or definite reasoning, the term mood is used to refer to the feeling (Larsen & Prizmic, 2004). If the experienced “feeling tone” is strong and is the current conscious focus, emotion is used to refer to the feelings (Larsen & Prizmic, 2004). An emotion is the display of feeling and can be genuine or fake as emotions tend to be broadcast whereas feelings can be kept internally (Shouse, 2005). Affective responses play an important role in the subjective experience and, without affective responses, feelings would have no urgency which may negatively impact decision-making (Larsen & Prizmic, 2004; Shouse, 2005).

Theoretical Underpinnings of Affect and Decision-Making

Historically, researchers explored cognitive determinants of judgements and decision-making, without adequately exploring the possibility that affect may play a role in decisions. However, in 1980 researchers argued that affective reactions to a stimulus are often the first reaction (Zajonc, 1980) and a reliance on affect is often the quickest and easiest way to make a decision (Slovic, Finucane, Peters, & MacGregor, 2007). Because affective responses are subconscious reactions to an event, when a stimulus occurs that triggers an emotional response, the brain automatically searches for similar experiences that have previously occurred in the experiential system (Epstein, 1994). If the previous response was positive, the person displays positive feelings and attempts to reproduce the event (Epstein, 1994). This led to more researchers exploring how affective responses to stimuli may impact the decision-making process and the idea of *affect heuristics* (Slovic et al., 2007). Heuristics is broadly defined as the process of taking complex decision-making processes and reducing them to the simplest form. *Affect heuristics* is the application of affective responses to the decision-making process (Slovic et al., 2007).

The simple concept of *affect heuristics* coincides with the Hedonic Theory of Motivation, which suggests that human behavior is motivated by the avoidance of pain and the pursuit of pleasure. The Hedonic Theory helps define the link between affect and the continuation of an activity. A new theoretical model was created to explain this connection within the domains of exercise: The Affective-Reflective Theory (ART) of physical inactivity and exercise. The ART attempts to examine the idea that affective responses that occur during exercise may impact future decisions (Brand, 2018). The ART was created to address gaps in previous theoretical frameworks that focused mainly on individuals reflecting on past experiences as the main driver of future behaviors. Many theoretical underpinnings went into the development of the ART, but arguably the most important was Lewin's force-field theory. This theory postulates that behavior should be explored through "forces and "tensions." The force-field theory is composed of three components: behavior is the consequence of situation, the situation can be described by the dynamic field ("life space") that surrounds an individual, and the dynamic field has more influence on behavior change than past experience. This theory suggests that there are always two "vectors" (i.e., forces that act on a person), one pushing an individual towards an attractive prospect while the other pushes the individual towards a repulsive prospect (Lewin, 1943).

Force-field theory denotes that restraining forces may be a primary determinant of the inability to change; thus, the ART recognizes these restraining forces as momentary affective responses. The ART suggests that, when exposed to an exercise-related stimulus, a person will experience an automatic affect association, deemed a type-1 process. The affect valuation of a stimulus assigns either a positive or negative value to the stimulus, which then can either drive the individual to change or restrains the individual from making a change. When there are adequate self-control resources present, the person is able to reflect back on the automatic

affective valuation and this reflection forms the basis for a type-2 process. Without self-control resources, type-1 processes dominate which lead to impulsive reactions to the stimulus. The “gut” response to a stimulus can be stored as a belief and, when encountering that same stimulus, may receive the same response without reflection. If a person deliberately begins a type-2 process, that individual is able to make a decision that may propel them towards being active. If it repetitively occurs, this may increase the probability of encoding more future positive affective responses (Brand, 2018). There is a need to measure affective responses to exercise to better understand exercise adherence.

Measurement of Affect: Previous Approaches and Limitations

Historically, affective responses to exercise have been determined using change scores derived from pre- and post-exercise measurements. Many different measurement techniques have been utilized in research studies to capture affective responses. When the exercise-affect relationship began being analyzed, researchers used self-report scales such as the Profile of Mood States (POMS), the Multiple Affect Adjective Check List (MAACL), or the State-Trait Anxiety Inventory (STAI) mainly because these scales could be applied outside of a clinical setting (Ekkekakis & Petruzzello, 2000). These surveys were utilized to measure affective responses; however, they were developed to assess mood and emotional states. For example, the POMS (a 65-item mood scale) was created in 1981 to assess psychological distress (Curran, Andrykowski, & Studts, 1995), not to assess core affect (valence and/or activation). Because researchers suggested the need to develop scales strictly for the assessment of core affect, other scales, such as the Physical Activity Affect Scale (PAAS), the Positive Affect and Negative Affect Scale (PANAS), and the Self-Assessment Manikin (SAM) were used to measure exercise-related affect (Legrand et al., 2011; Williams, 2008). For example, the PANAS, developed in

1988, is composed of two mood scales, one measuring positive responses and the other measuring negative responses. Participants rate the extent to which they feel each emotion on the mood scale using a 5-point scale (Crawford & Henry, 2004). This scale, and others developed for the measurement of affect, have been determined to be valid and reliable assessments of affect.

In a series of publications from 2000 to 2002, Ekkekakis and Petruzzello provided in-depth criticism of these previous approaches. Firstly, researchers used the terms mood, emotion, and affect interchangeably in publications. For example, researchers have implied that the terms mood and affect are synonymous (Brown & Wang, 1992). Ekkekakis poses that researchers should choose which construct to focus their research on by determining the purpose and the researcher's knowledge base. For example, researchers in the exercise physiology field wishing to examine the link between exercise and adherence or wishing to utilize a descriptive approach should focus on affect as a construct because cognitive appraisals (e.g., enjoyment) are understudied in the literature. Affect has been suggested to be the least complex construct and due to limitations in the literature, it may be more beneficial to focus on a broad construct to understand feelings in regard to exercise (Ekkekakis & Petruzzello, 2000, 2002).

Secondly, the measurement technique utilized as an assessment for affect in studies has differed substantially and one measure has not been defined as the primary instrument. When the exercise-affect relationship was first explored, researchers wanted to demonstrate the affective benefits of exercise; thus, a reliance on self-report measurements developed in the 1960s occurred. These self-report measurements (e.g., POMS, MAACL) were originally developed as an assessment for psychological mood traits, not for an assessment of core affect in general (McNair, 1992; Zuckerman & Lubin, 1965). Originally, these scales were utilized because no other measurements had been developed for the non-clinical population, but due to the scales

being “measure-centric” an unrealistic picture of affect was painted in the literature. Although these self-report measurements were deemed valid, concerns arose due to the measurements not undergoing formal evaluations in regard to exercise (Dishman, 1995; Stone, 1995). This led to the development of alternative approaches that were aimed at assessing broad affective dimensions (e.g., the PANAS). However, frustration remained with the measurements not specifically pertaining to exercise, which led to the development of exercise-specific assessments. The same criticism surrounding the development of the PANAS surrounded the development of exercise-related scales, such as PAAS or the Exercise-induced Feeling Inventory (EFI): the rationale for developing new scales were motivated by the desire to create different, more relevant measures, not by the desire to understand affect as a construct more deeply (McAuley, Shaffer, & Rudolph, 1995). Although researchers utilize one or more scales in their studies to capture affective responses, the reasoning behind which measurement technique is used is rarely conceptualized but should depend on the affective construct being measured (valence versus arousal) (Ekkekakis & Petruzzello, 2000, 2002).

Lastly, the timing of the assessment of affective responses to exercise has been challenged. It has been suggested that post-exercise affective responses are unrelated to future exercise behaviors (Brand, 2018). Previous affect research focused on a pre-post measurement, where a scale was used to examine affective responses before an exercise bout and after. Historically, measurement scales consisted of multiple items (12 to 65) and researchers may have decided against measuring affect during exercise due to the impracticality and may have assumed in-task affective responses would increase linearly (Backhouse et al., 2007). This type of measurement cannot evaluate feelings of affect that occur throughout the exercise session and may capture a “rebound effect.” A rebound effect is the post-exercise increase in positive

feelings of affect. The common notion that exercise feels good may be linked to this problem, because if exercise really did elicit only good experiences during the bout, the number of physically inactive individuals could be smaller. In 2007, a research study conducted in active adult males demonstrated that pre-post affective responses to exercise remained stable while in-task affective responses decreased throughout the bout (Backhouse et al., 2007). The rebound effect has further been documented, as measurements of affect 15-minutes post-exercise completion were significantly higher than measurements conducted at baseline and throughout the experience (Kwan & Bryan, 2010). The dilemma surrounding pre-post measurement of exercise-related affect is well-understood, and a substantial body of literature has been dedicated to measuring in-task affect.

Measuring In-Task Affect and Its Associations with Exercise Behavior

In-task affect (i.e., affective responses to exercise during an exercise bout) is repeatedly measured in exercise studies. When measuring in-task affect, one instrument is utilized to repeatedly measure affective responses throughout the exercise session. The Feeling Scale (FS) is an 11-point scale that ranges from 5 (very good) to -5 (very bad) and is designed to assess pleasure/displeasure (Frijda, 1988). The FS has been determined to be valid and reliable for the measurement of affect (Hardy & Rejeski, 1989). The Felt Arousal Scale (FAS) (Svebak & Murgatroyd, 1985) is another commonly used instrument to measure in-task exercise-related affect and is commonly used in conjunction with the FS. The FAS was designed to measure activation (arousal/sleepiness) and is measured using a 6-point scale ranging from 1 (low arousal) to 6 (high arousal). The FAS has been determined to be valid and reliable (Svebak & Murgatroyd, 1985). Finally, the Affect Grid has been utilized as an instrument to measure exercise-related affect. The Affect Grid allows researchers to utilize one instrument to measure

both valence and activation and has been validated against previous instruments (Russell, Weiss, & Mendelsohn, 1989).

In-task affect has been suggested to be linked to future behaviors towards exercise. Affective responses to exercise, measured in-task, were linked to the frequency of voluntary exercise participation (Kwan & Bryan, 2010; Kwan & Bryan, 2010). Participants who experienced positive affective responses during the exercise bout and increased energy were more likely to participate in voluntary exercise in the following three-month period than participants who experienced negative affective responses (Kwan & Bryan, 2010). Affective responses during exercise have also been linked to posttest self-efficacy, or a person's beliefs in his/her own ability to perform exercise behaviors (McAuley & Courneya, 1992). Further, a study conducted in healthy, low active adults underwent a 12-month unsupervised physical activity study that utilized tailored constructs to increase total amount of physical activity. This study demonstrated that affect measured during exercise bouts was associated with physical activity level at months 6 and 12, whereas post-exercise affective responses were not associated with physical activity level. More importantly, affective scores at 6-months were predictive of physical activity levels at 12-months (Williams, Dunsiger, Jennings, & Marcus, 2012). Similar predictive responses have been noted in other studies conducted in sedentary adults (Williams et al., 2008). Researchers have measured forecasted in-task affect (i.e., how one perceives he/she might feel during exercise) and recalled in-task affect (i.e., how one recalls feeling during exercise). The importance of measuring in-task affect as a way to understand how responses to exercise may influence future behaviors has been acknowledged; however, understanding *why* in-task responses may differ among individuals has become an important topic.

Determinants of Affective Responses to Exercise

Exercise Intensity and the Dual Mode Model

Exercise intensity, surrounding the ventilatory threshold (VT) (Svedahl & MacIntosh, 2003), is suggested to be a primary determinant of affect. The Dual-Mode Model (DMM) helps define the relationship between exercise intensity and affective responses. The DMM specifies exercise intensity in regard to VT, which usually denotes moderate-intensity exercise (Svedahl & MacIntosh, 2003). Exercise performed below VT, at VT, and above VT all elicit different affective responses, with exercise performed at VT as the highest variability in affective responses. Exercise performed below VT usually corresponds with more positive affective responses and exercise performed above VT usually corresponds to negative affective responses. The “dual-mode” specified in the DMM refers to the two influences on affective responses: cognitive and interoceptive. Interoceptive responses influence affect at intensities greater than VT because the body is attempting to maintain homeostasis. Cognitive responses, such as self-efficacy and perceived goals, influence affect at or below VT because interoceptive influences are not prominent due to homeostasis being unthreatened. Intensities set at or below VT are more positive as these intensities are less likely to be influenced by either of the “dual-modes”.

Session intensity has also been shown to influence recalled in-task affective valence. In two studies, researchers-imposed exercise intensities in a ‘ramping down’ pattern (i.e., higher to lower intensity) throughout a single bout and demonstrated that this pattern improved the slope of pleasure (i.e., the direction of pleasure change and the rate at which it changes). The authors further demonstrated that recalled affect was more positive in participants if the slope of pleasure was also positive (Hutchinson, Zenko, Santich, & Dalton, 2020; Zenko, Ekkekakis, & Ariely, 2016a). While research assessing recalled in-task affect remains minimal, this work further

reinforces the well-established role that intensity imparts as a determinant of exercise-related affect.

Interindividual Variability in Affective Responses

Participants may respond to the same exercise experience with different affective responses, regardless of intensity. In the year 2000, Van Landuyt, Ekkekakis, Hall, and Petruzzello showed that idiographic responses (i.e., individual responses) of exercise-related affect do not track with nomothetic responses (i.e., generalized, averaged responses) in a study conducted using university students (mean age= 20 years). Average responses suggested that participants FS scores remained stable throughout exercise; however, idiographic results showed that only 14.3% of participants FS scores demonstrated this pattern, whereas most participants either experienced an increase (44.3%) or a decrease (41.3%) in affective valence during the exercise session (Van Landuyt, Ekkekakis, Hall, & Petruzzello, 2000). Such interindividual variability has been repeatedly demonstrated in subsequent research. In a study conducted in 20 inactive female students (mean age= 23 years), results displayed a high variability in affective responses just below VT, where 35% of participants reported a decline in feeling-scale responses (i.e. more displeasure) but 60% of participants reported no change to a standardized exercise bout (Welch, 2007). Research conducted in adults (mean age= 20 years) showed that individuals completing an imposed moderate-intensity treadmill exercise bout and a self-selected intensity bout had a variety of affective responses to moderate-intensity (11% increased, 63% decreased, and 26% remained stable) (Strohacker et al., 2017b). Other studies have documented more variability in affective responses at or below VT, whereas above VT usually correlates with more negative affective responses (Rose, 2007). This was displayed as 42% of affective responses below VT improved while 32% of affective responses below VT declined instead of all affective

responses below VT being improved (Rose, 2007). Likewise, the interindividual variability in affective responses at intensities below VT have been documented by Ekkekakis in 2008 (7% showed an increase, 50% showed no change, and 43% showed a decrease) with healthy adults (mean age= 56 years) subjects who performed a standardized 15-minute treadmill exercise bout (Ekkekakis, Backhouse, Gray, & Lind, 2008). Interindividual variability within this construct suggests that the workload is not the sole determinant of exercise-related affective responses.

Additional Determinants of Exercise-Related Affect

Self-efficacy (i.e., the feeling that an individual has the ability to complete a task) has previously been identified as a determinant of affect. McAuley, Talbot, and Martinez (1999) randomly assigned college-aged females to a high-efficacy (HE) or low-efficacy (LE) condition where, at the end of a cycle ergometer fitness assessment, participants in the HE group were manipulated to believe they performed well and participants in the LE group were manipulated to believe they performed poorly. Following the initial fitness assessment, participants were asked to return for a subsequent visit where they completed a 20-minute Stairmaster exercise session at a moderate-high intensity. A post-exercise self-efficacy measurement was completed by both groups immediately upon completion of the exercise bout and in-task affect was assessed every two minutes via the FS. In-task measures at each time point were found to be significantly correlated (r 's >0.60) with pre-exercise efficacy in the HE condition only (McAuley, Talbot, & Martinez, 1999). Rose and Parfitt (2010) conducted a study in low- and high-active women (mean age= 45 years) where 'think aloud' procedures were utilized to assess participant's thoughts after an affective response (measured via the FS and the FAS) was given. During a treadmill exercise bout, responses received using the 'think aloud' procedure were analyzed via thematic analysis and perceptions of ability ("I know I'm a good walker so I know I can do this")

were noted (Rose, 2010). Responses pertaining to perceptions of ability were also noted by researchers as influencers of affect when sedentary women (mean age= 39 years) were asked to indicate determinants of affect during exercise in a post-exercise interview (“I was not very confident that I was going to be able to do it, as soon as the incline went up I knew that it was going to be quite hard”) (Rose, 2007).

Forecasted affect (i.e., how a participant believes he/she will feel under exertion) has previously been explored as a determinant of exercise-related affect. Calder, Hargreaves, and Hodge (2020) determined forecasted affective responses after the completion of a treadmill exercise bout (via a visual scale) and explored influences on forecasted affect using thematic analysis. The researchers suggested that the perceived benefits from exercise, perceived intensity, and physiological sensations experienced during exercise influenced ratings of forecasted affect (Calder et al., 2020). Zenko, Ekkekakis, and Ariely (2016) measured valence (i.e., pleasure/ displeasure) during and after exercise using the FS and measured forecasted pleasure using the Empirical Valence Scale (EVS) in members of the undergraduate community. Participants were assigned to an increasing-intensity (0 Watts to 120% of Watts corresponding to VT) group or decreasing-intensity (120% to 0 Watts) group and completed a stationary arm cycling bout. FS ratings predicted all forecasted pleasure scores for both groups ($r's > 0.37$) (Zenko, Ekkekakis, & Ariely, 2016b).

Sala, Baldwin, and Williams (2016) recruited healthy young adults (mean age= 26 years) in order to assess how anticipated affect (pride and regret) and anticipatory affective responses (affective associations and attitudes) effects variance in in-task affective responses (measured via the FS during and after exercise). Anticipated affect (i.e., the expectation of an exercise-related affective response (Williams, Rhodes, & Conner, 2019)) was measured using two questions on a

7-point Likert scale: “If I did not exercise regularly during the next month, I would regret it,” and “If I were to exercise regularly during the next month, I would be proud.” Anticipated affect (anticipated regret [$\beta=0.35$] and anticipated pride [$\beta=0.31$]) was significantly associated with in-task affective responses and was predictive of in-task affective responses. Affective associations (i.e., the automated association between current and previous exercise-related affect (David M Williams et al., 2019)) were assessed using six items, all beginning with the same statement (“When I think about exercising, I feel...”) rated on a 5-point Likert scale. Affective attitudes (i.e., evaluations of exercise-related affect (Williams et al., 2019)) were assessed using three items, all beginning with the same statement (“For me, exercising regularly will be...”) rated on a 7-point Likert scale. Anticipatory affective responses (i.e., pre-exercise affective states) was significantly associated with in-task affect (affective associations [$\beta= 0.34$] and affective attitudes [$\beta=0.37$]), however, they were not predictive of in-task affective responses (Sala, Baldwin, & Williams, 2016).

Pre-exercise affective (i.e., how a participant feels before an exercise bout) and activation states have been demonstrated to impact in-task affect valence. Rose and Parfitt (2010) recruited low- and high-active women (45 ± 10 years) to complete two exercise bouts on a treadmill: one at a prescribed intensity around VT and one at a self-selected intensity. Using a ‘think aloud’ procedure, participants provided ratings of in-task affect (using the FS and the FAS) every five minutes and followed the rating with the thought process underlying the response. Pre-exercise mood states, general valence (“I think overall I feel good because I’ve had a good day”), and perceptions of energy were commonly cited by participants as having influenced in-task affective ratings. However, the authors suggested that pre-exercise affective states only influenced in-task affective responses during the first 10 to 15 minutes of exercise (Rose, 2010). Strohacker et. al

(2017) recruited insufficiently active university students to undergo moderate-intensity treadmill exercise and demonstrated that, not only were pre-exercise energy index scores correlated with mean in-task affect ($r=0.569$), but they were also predictive of in-task affect ($\beta=0.499$) when controlling for hypothesized correlates (e.g., maximal oxygen consumption, body mass index, general enjoyment of exercise) (Strohacker et al., 2017b).

Summary and Conclusion

Due to the increased risk of developing non-communicable age-related diseases that could be prevented or treated with exercise, researchers should explore exercise-related affective responses for older adults in order to positively influence physical activity levels in this population. The literature suggests that there may be numerous determinants of exercise-related affect and that individuals may associate different determinants with positive or negative affect. Studies have utilized various populations and modalities to capture in-task affective responses; however, many of these studies were conducted in a laboratory setting and with imposed exercise. Although researchers have reached a consensus of the importance of measuring in-task affect (Ekkekakis et al., 2010; Williams, 2008), most research has been conducted in younger populations and, without research studies exploring determinants of exercise-related affect specifically in the older adult population, researchers cannot generalize results to older adults.

Aim

To explore determinants of exercise-related affect in older adults who regularly complete aerobic exercise.

Chapter 3: Methods

Methodology

The goal of the current research study is to understand determinants of exercise-related affect in older adults who participate in regular aerobic exercise. Qualitative studies allow for researchers to explore lived human experiences in natural settings. In order to intervene on this specific population, researchers first must understand the overall exercise experience, and qualitative analyses allow researchers to accomplish that goal (Flick, Von Kardorff, & Steinke, 2004). Interviews were chosen instead of focus groups due to the ability to explore one specific participant's exercise background, in the hopes of the participant being more willing to reflect on negative experiences in a one-on-one setting where they might be uncomfortable sharing in a group setting.

Theoretical Framework: Paradigm and Methodology

In research, a theoretical lens is used to provide an orienting lens for the study and can guide researchers towards what issues and people need to be studied (Creswell & Creswell, 2017). This qualitative study will function within an interpretive interview methodology under a constructivist paradigm. The constructivist approach allows the researcher to construct a shared reality by analyzing lived experiences. Specifically, what is reality is derived from the community and determines what is useful (Denzin & Lincoln, 2011). In this study, determinants of exercise-related affect for individuals were explored and used to understand (i.e., construct a reality) determinants of affect for the population (regular aerobic exercisers, older adults). Within this paradigm, an interpretive interview methodology was chosen due to the focus on collecting descriptive information regarding participants' lived experiences (Atkinson & Silverman, 1997).

Population

We enrolled 18 participants (13 women, 5 men) between the ages of 55 and 85 years old who reported regularly engaging in aerobic exercise. Inclusionary criteria was as follows: a) aged 55-85 years old, b) self-reported regular participation (at least 90-minutes per week of at least moderate intensity) in aerobic volitional exercise (i.e., not required physical therapy or cardiac rehabilitation), c) not suffer from any cognitive impairments that would impact the ability to remember a general exercise session, d) own a computer or other personal device with a camera, and e) own a smartphone capable of downloading an application for heart rate assessment. All participants met inclusionary criteria and were enrolled in the study. One participant failed to respond to the one-on-one scheduling email for the semi-structured interview and was dropped from the study. One participant chose to discuss a non-continuous aerobic sport for their interview; therefore, data from only 16 participants were used for thematic analysis.

Procedures

Recruitment

Upon approval from the University of Tennessee, Knoxville's Institutional Review Board, participants were recruited via a purposeful sampling approach using social media posts (Facebook) (Appendix A), through email listservs (Appendix B), and using electronic flyers (Appendix C). Participants interested in the study reached out to the principal investigator (PI) via email in order to schedule an initial screening session via Zoom. Individuals who did not respond within 48-hours of the initial scheduling email were sent a follow-up scheduling email. In preparation for the screening session, interested individuals were emailed an electronic copy of the informed consent document (Appendix D) and detailed instructions (Appendix E), containing text and images, to download the smartphone application 'Instant Heart Rate.'

Interested individuals were sent a reminder email 48-hours in advance of the initial screening session that included an active Zoom link. Recruitment was conducted on a rolling basis from January 13 to March 24, 2021. Twenty-five people contacted the PI about the study. Eighteen of those individuals were initially enrolled in the study.

Initial Zoom Session (Screening, Informed Consent, Participant Characteristics)

Screenings to assess eligibility requirements were conducted via Zoom © (an online videoconferencing platform) by the PI on a rolling basis between the dates of January 25 and March 22, 2021. Upon entering the video call, participants were asked to choose a pseudonym that was used to refer to information provided in the recorded session and then asked for their permission to record the session. The PI manually changed the participant's name in the Zoom © platform to their chosen pseudonym prior to recording the session. Individuals were asked to confirm that they owned a smartphone and a personal device with a camera and microphone, were 55-85 years old, participated in regular aerobic exercise (at least 30-minutes per day, at least 3-days per week, for the past 3-months), and did not suffer from cognitive impairments that would impact the ability to accurately recall a recent aerobic exercise session. Individuals found to be ineligible were thanked for their time, informed that they did not meet the eligibility criteria, and informed that the video recording would be destroyed immediately.

Those who met all eligibility criteria underwent informed consent procedures. The PI reviewed the study purpose, expectations, risks and benefits, and contact information. The individual was encouraged to follow along by viewing the shared screen of the researcher. Participants were encouraged to ask questions or express concerns throughout this process and the PI periodically paused to ensure the material was understood. Those who chose to not enroll, were thanked for their time and informed that the video recording of the session

was destroyed immediately upon ending the session. Those who expressed continued interest in becoming a participant were asked to read the two consent statements located at the bottom of the informed consent document and verbally stated whether or not they wished to become a participant.

Enrolled participants were then asked a series of questions to denote basic demographic characteristics (gender, height, weight). The PI then verbally and visually presented items to assess current health status and baseline psychological traits. Current health status was assessed using the Physical Activity Readiness Questionnaire (PAR-Q+) (Appendix F) as a guide. Exercise motivation type was assessed using the Behavioral Regulation in Exercise Questionnaire (BREQ)-2 (Appendix G). General enjoyment of physical activity was assessed using the Physical Activity Enjoyment Scale (PACES) (Appendix H). Assessment of the role intensity plays in exercise behavior was assessed using the Preference for and Tolerance of the Intensity of Exercise Questionnaire (PRETIE-Q) (Appendix I). The PI manually transcribed responses to each survey item. This process allowed participants to ask questions, in real-time, regarding content and clarification.

The final portion of the initial session was conducted to ascertain a seated heart rate value as a proxy for aerobic fitness. Participants were asked to follow the previously provided instructions to download the Instant Heart Rate application. This free application gives a resting heart rate reading which was used to categorize the participant's fitness level. Following a 5-minute period of quiet, seated rest, the participant was asked to open the application and place their index finger over the camera located on the back of the phone. The face of the phone showed a count-down for how long the finger must remain: until the flashlight on the back of the phone turns off and a heart rate reading showed on the face of the phone. Once the PI recorded

the participants' heart rate, the participant was asked to schedule the second session to conduct the interview. An email reminder with the Zoom © link was sent 48-hours in advance of this session.

One-On-One Interview

Out of all participants, 62.5% chose to remain in the initial Zoom © session, take a 15-minute break, and participate in the semi-structured interview. Of those who did not remain, a second Zoom © session was scheduled for a subsequent day (mean= 6.2 days, range= 1-11 days). Upon entering the Zoom © call, the participant was again asked for permission to record the session and reminded of their previously chosen pseudonym.

The PI utilized an interview guide (Appendix J) designed for a semi-structured interview format to address the primary research aim. The interview guide was constructed to allow participants to elaborate on their exercise bouts. The interview guide underwent pilot testing with an individual that met the inclusionary criteria to be a participant in the study and then underwent bias testing, where the PI acted as the participant in order to determine potential biases.

The interview guide was separated into four distinct sections, each consisting of semi-structured questions. The first section asked participants to describe a regular aerobic exercise bout, going into detail about type, time, intensity, and location. The participants were then asked to recall how this regular aerobic exercise bout felt to them, and what influenced those feelings. This section served two purposes: to incite the participant to relive a regular exercise experience which will hopefully lead to better recall of the event, and to explore determinants of affect for a regular exercise bout. The second section asked the participant to reflect on an exercise bout of the same nature that felt better than normal (i.e., more pleasant). The third section asked the participant to reflect on an exercise bout of the same nature that felt worse than usual (i.e., more

unpleasant). The fourth section focused on how the COVID-19 pandemic impacted regular exercise behaviors and whether the exercise experience was more positive or more negative. At the end of the interview, the participant was asked if they have any additional information that they believed to be important to the purpose of this research.

The PI utilized the Zoom © audio transcript as a base to manually transcribe data on a rolling basis. Upon completion of the transcription process, the PI emailed the transcribed data to the participant for member-checking in order to retain accuracy of the data. The PI assigned random numbers to the transcribed data in order to decrease the possibility of associating the pseudonym with the participant. Participants had approximately one week to review their transcriptions and send edits back to the PI. Interviews were conducted until saturation (i.e., no new information can be gleaned from the interviews) was reached (Fusch & Ness, 2015).

Instrumentation

Physical Activity Readiness Questionnaire +. The PAR-Q+ is an evidence-based health screening tool (Bredin, Gledhill, Jamnik, & Warburton, 2013) used to identify possible health restrictions or limitations in participating in physical activity. The PAR-Q+ consists of seven yes/no questions ascertaining general health outcomes (e.g., hypertension). If the participant responds “no” to the first seven questions, the additional pages that elaborate on health conditions need not be answered because the participant is assumed to not display signs/symptoms of cardiovascular, metabolic, or renal disease.

Preference for and Tolerance of the Intensity of Exercise Questionnaire. The PRETIE-Q is a 16-item survey that assesses differences regarding participants’ exercise intensity preferences (“I’d rather go slow during my workout, even if that means taking more time”) and intensity tolerance (“I block out the feelings of fatigue when exercising”). Each statement that assesses

preferences or tolerances is used with a 5-point Likert-scale (1=totally disagree to 5=totally agree). Preference for exercise intensity and tolerance of exercise intensity are scored independently. Scores for both subscales range between 8 and 40. This instrument has been found to be valid and reliable (Ekkekakis, Hall, & Petruzzello, 2005; Ekkekakis, Thome, Petruzzello, & Hall, 2008).

Physical Activity Enjoyment Scale. The PACES contains 18 items assessed on a 7-point Likert-scale with opposite directions at each end (1= I enjoy it or it makes me depressed, 7= I hate it or it makes me happy). Scores for the PACES range between 18-126, with higher scores indicating higher enjoyment. The PACES has been found to be reliable and valid (Kendzierski & DeCarlo, 1991).

Behavioral Regulation in Exercise Questionnaire. The BREQ-2 is composed of 18 items and assesses behavioral regulations in an exercise context using four subscales: external, introjected, identified, intrinsic, and amotivation. A 5-point scale ranging from 0 (“not true”) to 4 (“very true”) is utilized to score each subscale item. The relative autonomy index (RAI) is a score derived from all subscales that describes how self-determined respondents are at that time. Possible scores range between -24 and +20, and higher (positive) scores indicate higher levels of autonomy within the respondent. The BREQ-2 has been determined to be valid (Markland & Tobin, 2004).

Zoom ©. Zoom © is a videoconferencing platform ideal for business functions. Unlike other videoconferencing platforms, Zoom © includes the ability to securely record and store the recording without the use of a third-party software. Zoom © has been validated as a way to collect qualitative data in health-related fields (Archibald, Ambagtsheer, Casey, & Lawless, 2019).

Instant Heart Rate Application (Azumio, Inc.). This application utilizes photoplethysmography imaging to determine pulse rate non-invasively. The Instant Heart Rate application has been validated against electrocardiograms for measuring resting and exercise heart rate (Mitchell, Graff, Hedt, & Simmons, 2016; Pipitprapat, Harnchoowong, Suchonwanit, & Sriphrapadang, 2018).

Data Analysis

Prior to conducting the data analysis, the PI and additional members of the research team conducted a bias meeting. Biases (“personal issues that make it difficult to respond objectively to the data” pg. 539) (Hill, Thompson, & Williams, 1997) should be taken into consideration when conducting qualitative research. This is conducted to discuss potential personal biases in order to control these biases during the analysis (Hill et al., 2005).

Constructed themes and subthemes were explored utilizing Braun and Clark’s (2006) guide for thematic analysis (Braun & Clarke, 2006). This analysis approach utilizes a six-step process: familiarizing oneself with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. During the first stage, the PI read through the transcribed data multiple times, until comfortable with the material. During this phase the PI started taking notes about initial coding ideas. After becoming familiar with the data, the PI began identifying and naming codes throughout the data. Codes represent a feature noticed in the data set that is important to the research question. The formation of initial codes helps group raw data; however, coding is the organizational part of the analysis, not the results. After generating initial codes, the PI grouped codes that are similar into themes. The PI sorted all codes into themes and subthemes initially and may start determining significance of specific themes during this phase. The PI individually examined created themes and subthemes

as well as the raw data sorted into these themes. The PI then determined whether each individual theme has enough supporting data to stand alone or if themes should be combined into one. The PI then began naming and defining themes. During this phase, the PI had already determined which themes will remain and which will be combined. This step in the process is important for determining the central idea of each theme individually and all themes overall. Each individual theme will be described in detail in the analysis. The last phase of the thematic analysis begins after all themes have been named and defined. During this phase, the PI chose specific quotes from the raw data to represent themes and attempted to write the results in a way that explains the importance of each individual theme and the relation to the overall research question.

The PI and a secondary reviewer independently categorized participants' responses into constructed themes and subthemes in order to determine interobserver agreement (IOA). This is completed by calculating the proportion of measures agreed upon and should reach at least 80% (Horner et al., 2005). If IOA was less than 80%, the PI and the secondary reviewer would determine where major discrepancies occurred and attempt to determine why the disagreement occurred. The data would then be recategorized and the PI and secondary reviewer would again independently categorize responses. Pending IOA above 80%, any other discrepancies would be discussed until 100% agreement, with an outside reviewer acting as a tiebreaker.

The PI and a secondary reviewer conducted IOA for themes and subthemes regarding the degree of pleasantness of regularly performed exercise sessions. IOA was not conducted for themes regarding changes in volume or pandemic-related changes. Initial IOA reached 83%. The PI and the secondary reviewer held discussions until 100% agreement was reached.

Position Statement

I am very interested in the older adult population and have family members who suffer from non-communicable diseases (e.g., breast cancer, emphysema). I am interested in understanding what may negatively impact participation in exercise in order to create an intervention that will combat deterrents. It may be difficult not to treat collected data as an answer to the physical inactivity issue in this population. I may attempt to “help” participants combat barriers to exercise when discussing negative determinants of affect instead of just listening to their responses. In order to combat these biases, several methods for controlling them will be put into place.

Trustworthiness

To promote trustworthiness of the data, safeguards were utilized to aid the PI in controlling biases. The semi-structured interview guide underwent pilot testing, where mock data was utilized to supplement the lack of actual data. The PI also acted as a participant in order to outline potential biases and assumptions she has so that the biases may be controlled (Hycner, 1985). Pilot interviews were conducted with individuals close to the sample population, which allowed the PI to refine questions so that they were applicable. Further, pilot interviews were recorded via Zoom similar to the actual interviews in order to undergo fidelity testing (Bellg et al., 2004). Zoom audio transcriptions were utilized to start the transcribing process. The PI downloaded the Zoom audio transcription and then listened to each recording to make corrections to the transcriptions. All data was coded by hand to ensure a deep understanding of the data and pseudonyms were used for all participants to retain confidentiality. Member-checking helped to ensure reliability as did the utilization of a secondary reviewer.

Risks to Participants and Associated Protections

Participants were informed of any and all risks associated with participation in this study prior to engaging in any data collection. The greatest risk associated with interviews is the possible breach in confidentiality. In order to combat this, participants were asked to choose a pseudonym which was used to refer to all transcribed data, recordings, and demographic information. The PI manually replaced the participant's name with their chosen pseudonym prior to recording either session. Recordings were transcribed by the PI and only members of the research team have access to the recordings and transcriptions. The goal of this research was to only collect necessary data outlined by the research aims. The risk of a breach in confidentiality is minimal, however, if at any time the participant felt uncomfortable, he/she could opt out of the interview and any collected data would be destroyed.

Chapter 4: Results

Demographics

During the enrollment period, twenty-five people contacted the PI about the study. Eighteen of those individuals were initially enrolled in the study. One participant did not respond to either the initial interview scheduling email nor the follow-up email and was removed from the study. One participant failed to utilize a continuous aerobic activity for the semi-structured interview and was thus also removed from the study. Thus, data from 16 participants were included in the content analysis.

Regarding participant's self-reported exercise behavior, all participants achieved higher than the inclusionary criteria of 90 minutes per week (mean=236.9 minutes, SD=121, range= 120 – 600 minutes). Regarding the primary exercise modality, 25% of participants engaged in walking, 25% engaged in cycling, 18.8% engaged in running, 18.8% engaged in hiking, and 12.5% engaged in swimming. Body mass index (BMI) results estimated that 6.25% of participants were underweight (below 18.5 kg/m²), 56.25% were normal weight (18.5 – 24.9 kg/m²), 37.5% were overweight (25.0 – 29.9 kg/m²), and 0% were obese (30.0 kg/m² and above). The most commonly diagnosed disease in this sample of participants was arthritis (31.3%), followed by osteoporosis/osteopenia (12.5%), cardiovascular disease (12.5%), and metabolic disorders (12.5%). No participants had been diagnosed with renal disorders. Only 18.8% of participants were not diagnosed with any disorders or diseases. Table 1 displays additional demographic information pertaining to the 16 participants. Table 2 displays results from surveys utilized to collect information about the enjoyment of physical activity, preferred intensity levels, and motivation to participate in physical activity.

Table 1. Demographic Information for Older Adults who Regularly Engage in Aerobic Exercise

Variable	Men (n=5)			Women (n=11)			Total (n=16)		
	M	SD	Range	M	SD	Range	M	SD	Range
Age (years)	59.8	4.0	55-63	62.1	5.0	57-69	61.4	4.7	55-69
BMI (kg/m ²)	26.1	2.7	22.4-29.4	22.5	3.6	17.1-29.6	23.7	3.7	17.1-29.6
HR (bpm)	70.2	10.3	63-81	63.9	9.5	49-82	66.0	9.8	49-82

BMI= Body Mass Index; kg= Kilograms; m= Meters; M= Mean; n= Number; HR= Heart Rate;
SD= Standard Deviation; bpm= beats per minute

Table 2. Means (M) and Standard Deviations (SD) of Older Adults (n=16) Regarding Baseline Trait Survey Responses

	Men	Women	Total
Variable	M (SD)	M (SD)	M (SD)
BREQ-2			
Amotivation	0 (0)	0 (0)	0 (0)
External Regulation	0.4 (0.5)	0.4 (0.7)	0.4 (0.6)
Introjected Regulation	1.6 (0.8)	1.9 (1.1)	1.8 (1.0)
Identified Regulation	3.8 (0.2)	3.9 (0.3)	3.8 (0.3)
Intrinsic Regulation	3.7 (0.5)	3.5 (0.6)	3.5 (0.6)
RAI	16.1 (2.5)	15.2 (2.7)	15.5 (2.6)
PRETIE-Q			
Preference	25.2 (5.9)	22.2 (5.2)	23.1 (5.4)
Tolerance	27.6 (1.7)	27.3 (4.6)	27.4 (3.8)
		110.5	113.3
PACES	119.2 (7.9)	(13.7)	(12.6)

BREQ-2= Behavioral Regulation in Exercise Questionnaire; PRETIE-Q= Preference for and Tolerance of the Intensity of Exercise Questionnaire; PACES= Physical Activity Enjoyment Scale; RAI= relative autonomy index

Regarding feelings pertaining to regularly completed aerobic exercise sessions, participants generally reported feeling good or enjoying their regular exercise. For example, Chichi simply stated “[I feel] very, very happy.” Other participants gave more information about general exercise (Grammy T stated, “I love every time I get an opportunity to, you know, get out so it’s always a joy for me.”). Three participants linked general feelings during exercise to a sense of accomplishment when the exercise session was completed. For example, Mari stated, “I always feel like I’ve accomplished something.” However, some participants stated that general feelings pertaining to exercise were not all pleasant. Blackberry stated early in the semi-structured interview that, “different times I may just feel like I wish I were done.” Another participant, Sam, mentioned that higher intensity aerobic exercise can be unpleasant physiologically (“I’ll do some like high intensity... and that pretty much sucks... it can be pretty awful”). Furthermore, Kelly reported being, “glad when it’s [exercise] over,” and stated, “I just never am really happy when I’m doing it, but I know I need to do it and usually I feel better when it’s over.”

Themes and Subthemes

Two major themes emerged in regard to the impact of COVID-19 and five major themes emerged regarding determinants of affective responses to participants’ regularly performed exercise behavior. These five major themes and subthemes, as well as the proportion of respondents indicating each theme, are summarized in Table 3. We utilized excerpts from all interview transcriptions to provide additional detail supporting each major theme and subtheme in the subsequent sections.

Table 3. Summary of Themes and Subthemes Regarding the Determinants of the Degree of Pleasantness Experienced During Exercise

Theme (% of responses)	Subtheme	Representative Quotes	Contextual Information
Environmental and External Conditions (87.5%)	Weather	"The unpleasantness usually comes from weather conditions for me" -Grammy T	More unpleasant session
	Temperature	"About the only time I've ever felt where it's unpleasant is when it's really either very cold out or it's really very hot" -Nick	More unpleasant session
	Geographical Context	"I can be really happy if it is a different route" -Blackberry	More pleasant session
Social Context (87.5%)		"It's much more pleasant when I walk with my wife" -Cincinnati	More pleasant session
	Interruptions	"My favorite trail I can't go on because there's an event" -Bubbe	More unpleasant session
Pre-Exercise States (81.3%)	Perceived Energy	"I just feel like I'm dragging, yeah, I don't have any energy" -Kelly	More unpleasant session
Process Barriers and Facilitators (75%)	Body Integrity	"If I have pulled a muscle" - Mariposa	More unpleasant session
	Time	"A lot of times it's the time of day that I work out that makes a difference" -Twin Mom	More unpleasant session
	Mental Distractions	"Other times I'm too distracted with things and worries that are running through my head" - Princess	More unpleasant session
	Equipment/ Attire	"If you don't wear the proper footwear" -Mari	More unpleasant session
Performance (75%)		"Lack of performance... lack of getting your heart rate up" -Sam	More unpleasant session

COVID-19-related changes in exercise behavior and affective responses varied.

Participants explained how COVID-19 impacted their exercise behaviors and whether these impacts were more pleasant, more unpleasant, or neither. Results demonstrated that 37.5% of participants stated that exercise was experienced as more pleasant, 25% stated that exercise was more unpleasant, and 37.5% stated that exercise was neither more pleasant nor more unpleasant. Two themes emerged in regard to pandemic-related impacts: 1) Loss and 2) Adaptability.

Loss experienced during the COVID-19 pandemic determines affective responses during regularly performed exercise sessions.

COVID-19 has drastically changed people's lives and potentially impacted exercise behaviors. Three subthemes emerged as a result of losses experienced due to the pandemic: 1) Loss of Facility, 2) Loss of Socialization, and 3) Loss of Competition.

The first subtheme described the loss of exercise facilities. The majority of participants (68.8%) cited that the major impact of COVID-19 was the change in location that resulted from lockdown protocols. Four participants stated that gyms being closed down negatively impacted their regular exercise behaviors ("I'm not able to go to the gym" -Cincinnati) while three participants stated that swimming pools were closed due to the pandemic ("I'm a swimmer too and that got shut down just almost completely" -Blackberry). Participants stated that the loss of facilities due to the pandemic led to more unpleasant exercise sessions.

The second subtheme was related to the loss of socialization due to the pandemic. Participants stated that COVID-19 negatively impacted their ability to exercise with friends. For example, Jay stated, "I normally would go with other people and you know, this year I stuck to just myself," and Nick stated, "I have some friends that I go hiking with... we've not gone as

often.” Other participants, such as Mari, linked the loss of socialization caused by the pandemic to the loss of facilities (“not nearly as much fun as being in a class or... being in the gym with other people”). Participants who experienced a loss of socialization generally stated that exercise was more unpleasant than usual.

The third subtheme that emerged, albeit less frequently, was related to the loss of competitions. Grammy T recognized the loss of major cycling competitions with statements such as, “we lost some really big competitions,” and “I’ve missed the competition.” Similarly, Jay, affirmed this negative impact of COVID-19, stating that “all the competitions were cancelled,” and a “lack of comradery and competition [resulted from COVID-19].” Participants that experienced a loss of competition stated that this caused exercise to be more unpleasant.

Participant’s ability to adapt to COVID-19 related changes determines affective responses of regularly performed aerobic exercise sessions.

Although COVID-19 impacted exercise behaviors for the majority of participants, many were reportedly able to adapt in order to continue exercising. A major change caused by the pandemic was a loss of participant’s regular exercise location (e.g., gyms). Due to this, participants created new ways to accumulate exercise by finding new locations to exercise. For example, Bubbe stated, “I’ve tried to turn every space into something that involved exercise,” and Cincinnati stated, “we reached out and found an outside source that we could do this [exercise] socially distanced.” Other participants used the losses caused by the pandemic to try new exercise modalities (“I signed up for... 26-kilometer Birkin Binder ski race and I’ve never done anything like that before” Grammy T). However, while the loss of facilities caused exercise to be more unpleasant for many participants, some stated that exercise was neither more pleasant nor more unpleasant due to their ability to adapt. Louis demonstrated this with statements such

as, “I have had to adjust where I go swimming,” and Wonder Woman demonstrated it with “the trail system is a little bit too crowded in COVID... so I decided I’m not going to walk on the trail anymore.”

Restrictions created due to COVID-19 (e.g., virtual work, social distancing, change in facility hours) enhanced many participants ability to exercise due to increased availability to exercise. Seven participants stated that COVID-19 increased their exercise behavior. Factors that led to increased behavior were caused by the participant’s ability to adapt to pandemic-related changes. Sam and Twin Mom both displayed adaptations to negative impacts of the pandemic by viewing exercise as a way to escape reality (“there’s nothing else going on... it’s truly my escape,” -Sam; “I could just walk... to clear my head and clear my thoughts,” -Twin Mom).

Four participants stated that, while the pandemic did impact their regular exercise behaviors, they adapted to these changes because exercise was already an important part of their life. For example, Bubbe stated, “it was already an important part of my life, so I didn’t let go of that,” and Cincinati declared, “it’s important to us.” Other participants provided more information on how exercise was already important. Kelly expressed the importance of exercise with statements like, “it’s incorporated into my life, so it doesn’t matter with what’s going to happen, I mean... I tell my students exercise should be like brushing your teeth, I mean, that’s something you should do every day.”

The environment determines affective responses to regularly performed aerobic exercise bouts.

Participants generally cited environmental conditions as a primary determinant of the pleasantness of their recalled exercise sessions. Recurring factors represented in this theme

allowed for the emergence of four subthemes: 1) Weather, 2) Temperature, 3) Geographical Context, and 4) Uncontrollable External Factors.

The first subtheme was related to the weather. Some participants cited weather conditions when recalling a time when their regularly performed exercise was more pleasant than usual (Wonder Woman simply stated, “it was perfect weather”). Other participants provided more information about the specific weather conditions (e.g., humid, sunny) that impacted their regular exercise positively. For example, Chichi stated, “when the sun is shining it just makes you so much happier,” and Jay stated, “when there’s a tail wind, the sun is out, and the temperature is right [exercise is more pleasant].” However, participants also cited weather as a factor that caused regular exercise sessions to be more unpleasant. Grammy T indicated that, “the unpleasantness usually comes from weather conditions for me,” and Chichi agreed, stating an “overcast day, rainy, and, you know, that’s a bad thing.” One participant linked environmental conditions such as weather to physiological responses experienced during the exercise session. For example, Kelly revealed, “the air quality... that really affects my run if I feel like I’m wheezing.”

The second subtheme was related to the specific temperature. Some participants cited temperature as a positive factor that caused regular exercise sessions to be more pleasant. For example, Twin Mom simply stated, “I love it when it’s hot,” and Cincinati mentioned, “when the sun’s out and it’s warmer” led to a more pleasant walk. However, not all participants cited warm weather as a factor that generally increased the pleasantness of their regular exercise. Kelly described the temperature with, “it can be really uncomfortable when it’s... 90 degrees [Fahrenheit] and you know the humidity is high.” Participants also mentioned that cooler weather contributed to regular exercise being more pleasant. For example, Mari stated, “a cool,

humidity free day” is more pleasant. However, as with warmer weather, participants cited cooler weather as a factor that could cause regular exercise to be more unpleasant. Grammy T expressed this with, “if it’s... let’s say it’s 37 degrees [Fahrenheit] and it started to rain, I’m kind of wishing I was somewhere else.” Nick declared that both warm and cool temperatures could lead to a more unpleasant exercise session with statements such as, “about the only time I’ve ever felt where it’s unpleasant is when it’s really either very cold out or it’s really very hot.”

The third subtheme, geographical context, was related to how the location of exercise determined the pleasantness of recalled regular exercise sessions. For example, when asked about a time when exercise had been more unpleasant, Kelly stated, “I definitely can’t run on a treadmill,” and Blackberry stated, “I can really be happy if it is a different route” in response to a question about a more pleasant session. Princess described the outside surroundings as a factor that may cause regular exercise to be more pleasant or more unpleasant (“the surroundings, the trail conditions”) as did Bubbe (“there are trails you have to avoid because, again, they just get too muddy”). Other participants, such as Nick and Bubbe, cited the potential views that could be seen during an exercise session as a factor that increased the pleasantness of regular exercise (“there’s more wildlife out there” -Nick; “this whole woods and river scene is just, just uninterrupted” -Bubbe).

The fourth subtheme was related to uncontrollable, non-weather-related external factors, or interruptions. For example, when asked what factors can make their usual exercise sessions more unpleasant, Grammy T stated, “traffic and stop lights and those kinds of things can be interruptions,” and Jay stated, “a motorist letting me know I shouldn’t be on the same road as them.” Bubbe cited events as a potential interruption that previously caused regular exercise to be more unpleasant (“my favorite trail I can’t go on because there’s an event”). One participant,

Mariposa, linked interruptions caused by animals to a more unpleasant exercise session (“when I’ve walked with one of the foster dogs and they get a little bit unruly”).

The social context of exercise determines affective responses to a regularly completed exercise session.

The second theme that emerged was related to the social context of the exercise bout. The social context of exercise could lead to a more pleasant exercise experience. For example, Kelly stated, “I do like when, you know, I do get a chance to run with friends,” and Mariposa stated, “more of an opportunity to stop and talk with other people.” Some participants, like Cincinnati, cited the company on the walk as a factor that increased the pleasantness of the exercise session (“it’s much more pleasant when I walk with my wife”). Factors such as competition or challenge impacted the pleasantness of regular exercise sessions. Chichi affirmed this with, “if I had someone there, maybe to push me a little bit harder.” However, the social context of exercise can also create a more unpleasant experience. For example, Nick stated, “when I encounter a lot of people out on the trail it’s usually a little less pleasant.” Similarly, Margaret Clark exemplified the effect of crowding with, “if I have to share [a swimming lane],” as a factor that decreased the pleasantness of exercise.

Pre-exercise states determines affective responses experienced during a regular aerobic exercise session.

The third theme that emerged in regard to recalled regular exercise sessions was pre-exercise states. Participants generally cited either psychological factors or physiological factors as contributors to the increased/decreased pleasantness of their regularly performed exercise. Recurring factors represented in the data led to the emergence of two subthemes: 1) Perceived Energy and 2) Body Integrity.

The first subtheme was related to perceived energy or lack thereof, generally categorized by fatigue. Participants who cited fatigue or lack of sleep stated that it made exercise more unpleasant. Kelly affirmed this relationship with, “I just feel like I’m dragging, yeah, I don’t have any energy,” as did Louis with, “lack of sleep can make the initial start of a workout unpleasant.” When asked about a more unpleasant exercise session, Chichi discussed energy levels and their negative impact on performance (“so being older, it’s hard to sleep at night... so you hop on your bike... and then you’re just exhausted”). Blackberry provided information about how increased energy levels impacted a more pleasant exercise session and changed physical performance with, “going a little faster and have more pep or energy.” However, most participants who discussed perceived energy as a factor only linked insufficient energy levels to a recalled more unpleasant exercise session.

The second subtheme was related to perceptions of body integrity. Multiple participants stated that physical aches were likely to make exercise more unpleasant. For example, when asked about a more unpleasant exercise session, Mariposa declared, “if I have a pulled muscle,” and “you know, your hip hurts a little bit.” Sam stated, “an achy muscle or something tight,” caused a regular exercise session to be more unpleasant. Jay discussed how body integrity impacted physical performance (“I’d have to slow down because of... an ache... certainly couldn’t get the same quality of a workout”). Furthermore, Princess provided a response related to muscles warming up as a determinant of a more unpleasant exercise session (“sometimes my legs just aren’t warming up”).

Participants encounter barriers and facilitators before and during exercise that determine affective responses to regularly performed aerobic exercise.

The fourth theme pertained to post-initiation process barriers and facilitators. Participants encountered barriers and/or enablers while participating in their regular exercise sessions; however, the barriers did not cause the participant to stop the exercise session. Recurring factors regarding process barriers and facilitators led to the emergence of three subthemes: 1) Equipment/Attire, 2) Mental Distractions, and 3) Time.

The first subtheme was related to the facility, the proper clothing, and exercise equipment as determinants of a more pleasant or more unpleasant regularly completed exercise session. One participant stated that exercise was more pleasant during the pandemic due to the re-opening of exercise facilities commonly used (“having access to the facility was just key” -Margaret Clark). Mari stated, “if you don’t wear the proper footwear” as a factor that decreased the pleasantness of exercise and Mariposa declared, “if the weather is good and I can wear shorts instead of pants,” as a factor that increased the pleasantness of exercise. Exercise equipment was also mentioned in regard to a more pleasant exercise session by Grammy T and Wonder Woman (“my bike was working really well, that’s always a plus,”-Grammy T; “I have a new helmet that lets me play audiobooks” -Wonder Woman).

The second subtheme, mentioned less frequently, was related to mental distractions that could occur during an exercise session. One participant stated that being distracted during exercise caused a previous exercise session to be more unpleasant with, “other times I’m too distracted with things and worries that are running through my head” (Princess). However, another participant, Wonder Woman, stated that mental distractions regularly caused exercise to be more pleasant with this statement: “I just like ran for two hours and 15 minutes and listened to

this awesome book and it's, like, the only thing that could have got me through a half marathon with absolutely no training."

The third subtheme that emerged, and was noted the most frequently, was related to the time of day or the amount of time that could be dedicated to exercise. Participants stated that having to rush a workout or finish a workout early due to a lack of time would cause exercise to be more unpleasant. For example, when asked about a time when regular exercise was more unpleasant, Mariposa stated, "if I feel kind of pinched for time." Chichi provided more information about the lack of time, citing the workday as a determinant for how much time could be dedicated to exercise. Chichi declared, "[during the week] it's 35, 40, 45 minutes... and those aren't fun at all... that's just trying to make yourself better," and also, "when I don't have to go to work, and I can take my time." Other participants cited the time of day as a cause of a more pleasant or more unpleasant regular exercise session. Twin Mom revealed, "a lot of times it's the time of day that I work out that makes a difference." Kelly provided more information as to what specific times of day impacted the pleasantness of regular exercise with statements like, "it's really hard late in the afternoon to exercise," and also linked the time of day to body integrity with, "in the evening time, it's really difficult, my legs feel heavy."

Perceptions of performance during the exercise session determines recalled affective responses for regularly completed exercise bouts.

The fifth theme that emerged was related to overall performance during regularly completed exercise sessions. Participants described their perceptions of their performance as a determinant of a more pleasant or more unpleasant regularly completed exercise session. For example, Sam simply stated, "lack of performance... lack of getting your heart rate up" caused exercise to be more unpleasant. Jay provided more information about the exercise performance

and why satisfaction was decreased with the following statement: “you can’t continue at the pace you would like to go.” Margaret Clark cited exercise techniques as a reason exercise was more unpleasant with statements like, “I wasn’t breathing properly, I wasn’t kicking my feet properly.” One participant, Blackberry, linked feelings associated with accomplishment to overall performance satisfaction (“I fall behind and get discouraged,” and “you’re just proud, or you know, good feelings of accomplishment”). The possibility of challenge or competition was described by two participants as a potential way to increase the pleasantness of exercise. For example, when asked about a more pleasant exercise session, Louis stated, “having someone similar to your workout pace next to you improves the pleasantness,” and Chichi affirmed, “if I had someone there, maybe to push me a little bit harder.” Participants stated that the amount of effort required by regular exercise sessions led to a more pleasant/unpleasant session. For example, Jay declared, “you’re going along at a good clip but you’re not really needing to put a huge effort in,” and Kelly agreed with, “I like to be able to run faster... I like to feel that lightness.” Participants cited physiological responses during exercise as factor that caused regular exercise to be more pleasant or more unpleasant. Kelly exemplified how interoceptive cues impacted exercise with statements like, “my breathing is more labored; my legs just feel like they’re not moving.” When asked about a more unpleasant exercise session, Wonder Woman stated that the intensity of the session caused physiological responses (“I raised my heart rate higher for a longer period,” and “just how hard my heart was working. That was just like not normal”).

Changes in volume occur with feelings of displeasure.

The majority of participants (75%) stated that, when experiencing an unpleasant exercise session, they were more likely to reduce the volume (i.e., intensity, duration) of the

predetermined exercise session. Mari and Mariposa both declared that more unpleasant sessions led to a shorter walk (“it shortens the walk significantly,” -Mari; and “I would say it usually shortens it a bit” -Mariposa). One participant, Wonder Woman, actually stated that more unpleasant exercise sessions led to an increased duration; however, the increased duration was due to a change in intensity level (“we did the same mileage,” “it took us a little bit longer”). Jay declared, “I’d have to slow down because of... an ache,” and Cincinnati stated, “it’ll slow us down a little bit, but not much,” when asked about how volume was influenced during more unpleasant exercise sessions. Grammy T and Louis were less specific about which aspect of volume changed, stating that more unpleasant exercise sessions caused the intensity to be reduced (“probably going to shorten the ride and back off on the intensity,” -Grammy T; “the intensity is reduced because you cannot push yourself in warm water,” -Louis).

Changes in volume may or may not occur with feelings of increased pleasure.

When asked how the intensity/duration of exercise was impacted during a more pleasant session, 56% of participants stated that the duration or intensity of the exercise session did not change (Mari stated, “I don’t really think it affects it [exercise] at all”). Three participants stated that they continued to do the activity as planned. For example, Grammy T stated, “I mean, it [exercise] just was what it was supposed to be,” and Wonder Woman declared, “I did the exact same route, I did it in the same amount of time.” However, 44% of participants stated that a more pleasant exercise session changed the volume of exercise. In general, participants stated that increased pleasantness led to an increased duration and/or intensity. For example, Princess simply stated, “I probably went longer,” and Cincinnati stated that, “we’re able to motivate each other to work harder, walk faster.”

Chapter 5: Discussion

The primary aim of the current research study was to explore determinants of recalled exercise-related affect in older adults who regularly complete a repeated mode of aerobic exercise. Because all data collection took place during the pandemic, all interpretations of data should be considered through this lens. Five major themes emerged related to determinants of recalled exercise-related affect: 1) Environmental and External Conditions, 2) Social Context, 3) Pre-Exercise States, 4) Process Barriers and Facilitators, and 5) Performance. Theme one and theme two encompassed the majority of responses, each being discussed by 87.5% of participants. Within the Environment theme, responses generally referenced the weather, temperature, or other conditions that were experienced in an outside environment. The second theme, Social Context, was categorized by responses pertaining to comraderies and how these relationships increased or decreased the pleasantness of a regularly completed exercise session. Theme three, Pre-Exercise States, was categorized by responses related to perceived energy levels and body integrity. Within theme four, Process Barriers and Facilitators, participants generally discussed the amount of available time to participate in exercise and exercise equipment. Finally, the fifth theme, Performance, was represented by physiological responses to exercise and descriptions of overall exercise performance. Results from this research parallel findings from previous research, as well as demonstrate novel findings pertaining to a sample of older adults.

Participants utilized in this study were considered regular exercisers according to ACSM screening guidelines (at least 90 minutes per week of aerobic exercise). Furthermore, participants seemed to be relatively healthy, with 62.5% being estimated as normal weight or underweight and 37.5% estimated as overweight according to Body Mass Index (BMI) based on self-reported

values for height and weight. These results are below the regularly reported BMI statistics for the 55+ age range (39.8% obese, 35.3% overweight) (Matsunaga, Lim, Davis, & Chen, 2021). Results also demonstrated this population to be lower than the average percentage of adults diagnosed with cardiovascular disease (24.6%) (Steeves, Shiroma, Conger, Van Domelen, & Harris, 2019), arthritis (50.7%) (Matsunaga et al., 2021), and metabolic diseases (25.2%) (Matsunaga et al., 2021). Resting heart rate (HR) results demonstrated lower than average norms for the 50+ age range for healthy adults (participants: average= 66 bpm; 50–70-year age range: average 73.5 bpm) (Avram et al., 2019). As increased volumes of aerobic exercise have previously been linked to lower disease risks, it is plausible that participants from this study displayed lower than average disease states due to their participation in regular aerobic exercise.

A primary novel finding of this research study was that affective responses to recalled exercise sessions were reportedly due to the environment in which exercise was performed. Studies have demonstrated a relationship between the environment and levels of physical activity. Cauwenberg and colleagues conducted a systematic review in 2011 examining the relationship between the environment and levels of objective and subjective physical activity (Van Cauwenberg et al., 2011). This review showed that, while there are a limited number of studies exploring this relationship, a positive relationship was found between access to facilities and urbanization on total recreational physical activity (Van Cauwenberg et al., 2011). Furthermore, a systematic review of qualitative studies conducted in 2014 discovered two themes also demonstrated in this study: aesthetics (natural scenery) and environmental conditions (weather and environmental quality) (Moran et al., 2014). Poor outside conditions may negatively impact affective responses to exercise which in turn may negatively impact overall exercise behaviors. A study conducted by Dunton and colleagues found that 62% of

adults reported engaging in physical activity outside and concluded that the variability in affective responses was related to where physical activity occurred (inside versus outside) (Dunton, Liao, Intille, Huh, & Leventhal, 2015).

Although many research studies have determined that interoceptive cues are a primary determinant of affective responses during an exercise bout (Beaumont, Ferrara, & Strohacker, 2021; Rose, 2010; Welch, 2007), reference to such cues were relatively minimal in the interview transcripts from the current study. One reason interoceptive cues may have been noted less was due to the location of exercise. Studies examining determinants of affect generally impose an exercise bout on participants, and conduct research in a laboratory setting where the environment is tightly controlled and participants are not allowed to use distractions (e.g., music, television, talking). This research study used recalled regularly completed aerobic exercise sessions that occurred, for the majority of participants, in an outside environment. While exercising in a laboratory setting, participants may be more aware of physiological responses to exercise as there is no change in the environment (e.g., regulated temperature, no potential weather interruptions, etc.). The majority of participants (87.5%) reported engaging in exercise outside. Participants also stated that environmental conditions were a primary determinant of what caused exercise to be more pleasant or more unpleasant. COVID-19 caused facilities to temporarily shut-down and impacted participants' primary exercise location (e.g., gyms, indoor pools) (Constandt et al., 2020; Wong et al., 2020). This caused more participants to exercise outside year-round and to experience environmental conditions more often. This may be one factor that influenced participants' responses, causing participants to cite the environment more often. Another probable reason as to why interoceptive cues were not mentioned often in this study could be that participants discussed recalled aerobic exercise sessions that they regularly

complete, which may only include exercise sessions that are at a lesser intensity. Due to the qualitative nature of this research study, we are unable to determine whether participants exercise below, at, or above VT; however, most participants reported participating in moderate intensity exercise, thus, they may be more in tune with cognitive responses to exercise rather than physiological. Results may demonstrate that regular exercisers choose to exercise at lower intensities in order to avoid negative physiological responses to exercise. Furthermore, the study population utilized may be more aware of outside conditions, thus mentioning the environment instead of interoceptive cues (No & Kwak, 2016; Yang, Weng, & Zhang, 2014). This could demonstrate that participants did experience physiological responses to exercise but, instead of relating them to interoceptive cues directly, they related them to the environment. For example, Kelly stated, “it can be really uncomfortable when it’s... 90 degrees [Fahrenheit] and you know the humidity is high,” and also revealed, “the air quality... that really affects my run if I feel like I’m wheezing.”

Similar to our findings regarding environmental aspects as a determinant of recalled in-task affect, participants’ reference to social aspects of exercise as determinants of exercise-related affect have not previously been reported in the literature. Again, this is likely due to the majority of prior work occurring in laboratory settings where participants engaged in exercise alone, without substantial interaction researchers. However, substantial research exists supporting a link between social context and other important determinants of behavioral maintenance. For example, a study conducted in older adults (80+) by McAuley and colleagues (2000) discovered that participants who exercised in groups demonstrated significantly improved feeling state responses compared to participants who exercised alone (McAuley, Blissmer, Katula, & Duncan, 2000). Feeling state responses were measured using the Subjective exercise

Experiences Scale and collected prior to and following each exercise condition (McAuley et al., 2000). McAuley and colleagues conducted a study in 2003 examining the relationship between social support, self-efficacy, and exercise (McAuley, Jerome, Marquez, Elavsky, & Blissmer, 2003). Results demonstrated that participants who had greater social support experienced a stronger sense of self-efficacy towards exercise (McAuley et al., 2003). Furthermore, participants in the exercise group exercised more frequently and had greater perceived levels of social support, which positively influenced levels of self-efficacy (McAuley et al., 2003). Lachman, et al. (2018), cited social support as a behavioral strategy to motivate inactive older adults to participate in exercise (Lachman, Lipsitz, Lubben, Castaneda-Sceppa, & Jette, 2018). Finally, a systematic review published in 2017 discovered that social support specific to physical activity was positively related to levels of physical activity in older adults (Smith, Banting, Eime, O'Sullivan, & Van Uffelen, 2017). It is important to note that people exercising in a naturalistic setting are impacted by external factors such as social support whereas people exercising in a laboratory setting are not; therefore, future research exploring determinants of exercise-related affect in a naturalistic setting may provide support for social context as an important determinant of exercise-related affect.

Older adults indicate that the pre-exercise state influenced recalled affective responses. Participants discussed energy levels and body integrity experienced prior to exercise as a determinant of recalled in-task affective responses (“have more pep or energy” -Blackberry; “lack of sleep can make the initial start of a workout unpleasant” -Louis). These results support existing literature when researchers explored determinants of reported affect. Rose and Parfitt (2010) previously demonstrated negative pre-exercise states (i.e., feeling tired, in a bad mood) led to more negative affective responses (Rose, 2010). A study conducted by Beaumont and

colleagues measured recalled affective responses to volitional exercise performed in a university fitness center by university students. Participants completed a survey upon departing the facility that included visual analog scales as well as an open-ended question to expand upon affective responses. Results demonstrated factors related to energy levels and physical condition as determinants of recalled exercise-related affect (Beaumont et al., 2021). Strohacker et al. examined how energy index scores correlated with feeling scale responses in sedentary university students. Results demonstrated that energy index was positively correlated with feeling state responses, indicating that pre-exercise energy levels effects affective responses (Strohacker, Boyer, Smitherman, Cornelius, & Fazzino, 2017a). These results are also in-line with the idea that a bidirectional relationship between exercise and mental/physical well-being exists. Numerous research studies have previously examined the relationship between physical activity, well-being, and mental health, determining that exercise is a catalyst for well-being. Researchers have indicated that well-being and mental health may also be a pre-condition for physical activity and thus, have focused on the idea of readiness-to-exercise. Strohacker et al. explored readiness to participate in low-demand and high-demand aerobic bouts and found similar themes related to body integrity for both forms of exercise and similarly found that a lack of energy prior to exercise influenced in-task affective responses (Strohacker et al., 2017a; Strohacker, Zakrajsek, Schaltegger, & Springer, 2019).

A particularly interesting finding was that no participant had a difficult time recalling an exercise session that was more unpleasant. The Hedonic Theory of Motivation suggests that human behavior is motivated by the avoidance of pain and the pursuit of pleasure. However, when asked about a more pleasant exercise session and how the volume of exercise was impacted, the majority of participants stated that a more pleasant exercise session did not change

the pre-determined volume. This could propose that the pursuit of pleasure may not be the primary driver of the decision-making process. The Affective-Reflective Theory (ART) of physical inactivity and exercise expands on the Hedonic Theory and explains how future behaviors may be driven by automatic affective responses to exercise (Brand, 2018). The ART posits that type-1 processes dominate the decision-making process when self-control resources are not present, making the momentary positive or negative reaction to a stimulus the deciding factor. Participants utilized in this study experienced unpleasant exercise sessions but continue participating in exercise, and generally do not stop the exercise session even when it is unpleasant. This may suggest that regular exercisers are able to utilize type-2 processes more often and that the immediate negative affective response may not always determine the decision to continue exercising. This may be due to their coping mechanisms. The concept of salutogenesis claims that individuals exist in a continuum between health and illness throughout their life and that stressful situations may negatively impact health (Antonovsky, 1996). This concept posits that individuals cope with stressful situations in different ways depending on the adequacy of their coping mechanisms (i.e., better coping mechanisms allows the individual to be impacted less by stress) (Thiel, Seiberth, & Mayer, 2013). Participants in this population encountered barriers while exercising in the form of interruptions, weather, availability, etc.; however, these individuals did not stop exercising due to encountered barriers but adapted. For example, participants generally cited that a more unpleasant exercise session caused them to adapt during the bout by changing location or the volume of exercise (e.g., duration or intensity). These findings demonstrate that unpleasant exercise sessions are inevitable and may suggest that it is more important to decrease the number of unpleasant exercise sessions than to make exercise in general more pleasurable.

Limitations

This research study was not without limitations. Although the older adult population was specifically recruited as participants due to the gap noted in the literature, the participants were in the lower end of the eligible age range for older adults (55-69 years) in this study. Therefore, results can only be generalized to the younger older adult range. Likewise, only active older adults were recruited for this study and all older adults surpassed the inclusionary criteria for aerobic activity (90 minutes per week) by a large amount (30-510 minutes). Results from this study are exclusionary to sedentary older adults. Participants who were recruited to be in this study participated in aerobic exercise. People who mainly participate in a different modality of exercise (e.g., resistance training, sprint training) may not demonstrate the same determinants of exercise-related affect and thus these results are not universal. Furthermore, participants in this study were mostly women; therefore, results may not pertain to all older adults or mostly male populations. Research was also conducted, and results collected, during COVID-19; this means that results may differ after the pandemic has ended and future research should explore determinants of exercise-related affect in a naturalistic environment after the pandemic. Finally, due to the qualitative structure of this research study, all exercise volumes and affective responses were self-reported. Limitations do exist within this methodology due to the reliance on self-report as recall memory may not always be reliable. Qualitative methodologies utilizing interviews may lead to social desirability bias; however, we believe this to be negated as we informed participants that there were no wrong or right answers, and no participant expressed difficulty in recalling an unpleasant exercise session.

Future Directions

Future research should explore determinants of exercise-related affect in older adults who are considered unhealthy and considered sedentary, as results from this study can only be generalized to an active and healthy older adult population. Due to all research being conducted during the pandemic, determinants of exercise-related affect should be explored in older adults conducted in a naturalistic setting after the pandemic, to provide more support for the relationship between pre-exercise states and affect and to determine if the pandemic influenced affective responses by changing the location of exercise (i.e., more participants exercising outside). Furthermore, this research study provided two novel determinants of exercise-related affect, and future studies should explore aerobic exercise in naturalistic environments to determine if the environment and social context of exercise continue to be demonstrated. Finally, as older adults as a population have minimal research as it pertains to affective responses and exercise, future research should utilize the older adult population specifically and impose a workload in a laboratory-based setting to see if the interindividual variability focused around VT is seen in this population.

Conclusion

We aimed to explore determinants of recalled exercise-related affect in older adults who complete regular aerobic exercise due to the impact affective responses may have on future behaviors. Results provided support for previous determinants of exercise-related affect such as pre-exercise states and performance. This research study also supported two novel findings related to the social context of exercise and the environment, both of which were reported by the majority of participants. This study expanded on the literature surrounding affective responses to exercise and focused on a population that had yet to be studied. Further, this research explored

recalled aerobic exercise sessions that were conducted in a naturalistic environment, which differs from the multitude of studies conducted in laboratory settings with imposed exercise. Future research should focus on older adults and exercise completed in naturalistic settings, as there remains a gap in the literature.

References

- 65 and Older Population Grows Rapidly as Baby Boomers Age. (2020). [Press release].
Retrieved from <https://www.census.gov/newsroom/press-releases/2020/65-older-population-grows.html>
- Antonovsky, A. (1996). The salutogenic model as a theory to guide health promotion. *Health promotion international*, 11(1), 11-18.
- Archibald, M. M., Ambagtsheer, R. C., Casey, M. G., & Lawless, M. (2019). Using Zoom videoconferencing for qualitative data collection: perceptions and experiences of researchers and participants. *International Journal of Qualitative Methods*, 18, 1609406919874596.
- Atkinson, P., & Silverman, D. (1997). Kundera's Immortality: The interview society and the invention of the self. *Qualitative inquiry*, 3(3), 304-325.
- Avery, E., Kleppinger, A., Feinn, R., & Kenny, A. M. (2010). Determinants of living situation in a population of community-dwelling and assisted living-dwelling elders. *Journal of the American Medical Directors Association*, 11(2), 140-144.
doi:10.1016/j.jamda.2009.07.006
- Avram, R., Tison, G. H., Aschbacher, K., Kuhar, P., Vittinghoff, E., Butzner, M., . . . Marcus, G. M. (2019). Real-world heart rate norms in the Health eHeart study. *NPJ digital medicine*, 2(1), 1-10.
- Backhouse, S. H., Ekkekakis, P., Biddle, S. J., Foskett, A., & Williams, C. (2007). Exercise makes people feel better but people are inactive: paradox or artifact? *Journal of sport and exercise psychology*, 29(4), 498-517.

- Barbour, K. E. S., J.A.; Helmick, C.G.; Luo, Y.H.; Murphy, L.B.; Hootman, J.M.; Theis, K.; Anderson, L.A.; Baker, N.A.; Sugerman, D.E. (2014). Falls and fall injuries among adults with arthritis- United States, 2012. *Morbidity and mortality weekly report*, 63(17), 379-383.
- Bartels, S. J. N., J.A. (2013). The underside of the silver tsunami- Older adults and mental health care. *The New England Journal of Medicine*, 368, 493-496.
- Bavelier, D., & Neville, H. J. (2002). Cross-modal plasticity: where and how? *Nature Reviews Neuroscience*, 3(6), 443-452.
- Beaudart, C. R., J.Y.; Slomian, J.; Buckinx, F.; Dardenne, N.; Quabron, A.; Slangen, C.; Gillain, S.; Petermans, J.; Bruyere, O. (2015). Estimation of sarcopenia prevalence using various assessment tools. *Experimental Gerontology*, 61, 31-37.
- Beaumont, C., Ferrara, P., & Strohacker, K. (2021). Exploring determinants of recalled in-task affective valence during recreational exercise. *Physiology & Behavior*, 230, 113261.
- Beckwée, D., Delaere, A., Aelbrecht, S., Baert, V., Beaudart, C., Bruyère, O., . . . Bautmans, I. (2019). Exercise interventions for the prevention and treatment of sarcopenia. A systematic umbrella review. *The journal of nutrition, health & aging*, 23(6), 494-502.
- Bellg, A. J., Borrelli, B., Resnick, B., Hecht, J., Minicucci, D. S., Ory, M., . . . Czajkowski, S. (2004). Enhancing treatment fidelity in health behavior change studies: best practices and recommendations from the NIH Behavior Change Consortium. *Health psychology*, 23(5), 443.
- Bergen, G., Stevens, M. R., & Burns, E. R. (2016). Falls and fall injuries among adults aged ≥ 65 years—United States, 2014. *Morbidity and mortality weekly report*, 65(37), 993-998.

- Brand, R. E., P. (2018). Affective-Reflective Theory of physical inactivity and exercise: Foundations and preliminary evidence. *German Journal of exercise and Sport Research*, 48(6).
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101. doi:10.1191/1478088706qp063oa
- Bredin, S. S., Gledhill, N., Jamnik, V. K., & Warburton, D. E. (2013). PAR-Q+ and ePARmed-X+: new risk stratification and physical activity clearance strategy for physicians and patients alike. *Canadian Family Physician*, 59(3), 273-277.
- Brown, D., & Wang, Y. (1992). The relationships among exercise training, aerobic capacity, and psychological well-being in the general population. *Med Exerc Nutr Health*, 1, 125-142.
- Burge, R. D.-H., B.; Solomon, D.H.; Wong, J.B.; King, A.; Tostson, A. (2007). Incidence and economic burden of osteoporosis-related fractures in the United States, 2005-2025. *Journal of bone and mineral research*, 22(3).
- Burgess, E., Hassmén, P., & Pumpa, K. L. (2017). Determinants of adherence to lifestyle intervention in adults with obesity: a systematic review. *Clinical obesity*, 7(3), 123-135.
- Cadore, E. L., Rodríguez-Mañas, L., Sinclair, A., & Izquierdo, M. (2013). Effects of different exercise interventions on risk of falls, gait ability, and balance in physically frail older adults: a systematic review. *Rejuvenation Research*, 16(2), 105-114.
doi:10.1089/rej.2012.1397
- Calder, A. J., Hargreaves, E. A., & Hodge, K. (2020). Great Expectations: A Qualitative Analysis of the Factors That Influence Affective Forecasts for Exercise. *International Journal of Environmental Research and Public Health*, 17(2), 551.

- Caspersen, C. J. P., K.E.; Christenson, G.M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports* (1974), 100(2), 126-131.
- Chao, D., Foy, C. G., & Farmer, D. (2000). Exercise adherence among older adults: challenges and strategies. *Controlled clinical trials*, 21(5), S212-S217.
- Chen, M.-H., Yu, C.-L., & Chang, S.-H. (2021). Constant Daily Exercise to Keep the Doctor Away: A Study of Adherence to Physical Exercise Using a Gym in Individuals Older Than 55 Years. *International Journal of Qualitative Studies on Health and Well-being*, 16(1), 1859174.
- Choi, H. J., Kim, E., Shin, Y. J., Choi, B. Y., Kim, Y. H., & Lim, T. H. (2014). The timing of surgery and mortality in elderly hip fractures: a retrospective, multicenteric cohort study. *Indian journal of orthopaedics*, 48, 599-604.
- Chou, C.-H., Hwang, C.-L., & Wu, Y.-T. (2012). Effect of Exercise on Physical Function, Daily Living Activities, and Quality of Life in the Frail Older Adults: A Meta-Analysis. *Archives of physical medicine and rehabilitation*, 93(2), 237-244.
doi:10.1016/j.apmr.2011.08.042
- Cole, Z. A. D., E.M.; Cooper, C. (2008). Osteoporosis epidemiology update. *Current Rheumatology Reports*, 10, 92-96.
- Constandt, B., Thibaut, E., De Bosscher, V., Scheerder, J., Ricour, M., & Willem, A. (2020). Exercising in times of lockdown: an analysis of the impact of COVID-19 on levels and patterns of exercise among adults in Belgium. *International Journal of Environmental Research and Public Health*, 17(11), 4144.

- Cooper, C. C., G.; Melton III, L.J. (1992). Hip fractures in the elderly: A world-wide projection. *Osteoporosis International* 2, 285-289.
- Covinsky, K. E., Palmer, R. M., Fortinsky, R. H., Counsell, S. R., Stewart, A. L., Kresevic, D., . . . Landefeld, C. S. (2003). Loss of Independence in Activities of Daily Living in Older Adults Hospitalized with Medical Illnesses: Increased Vulnerability with Age. *Journal of the American Geriatrics Society*, 51(4), 451-458. doi:<https://doi.org/10.1046/j.1532-5415.2003.51152.x>
- Crawford, J. R., & Henry, J. D. (2004). The Positive and Negative Affect Schedule (PANAS): Construct validity, measurement properties and normative data in a large non-clinical sample. *British journal of clinical psychology*, 43(3), 245-265.
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*: Sage publications.
- Curran, S. L., Andrykowski, M. A., & Studts, J. L. (1995). Short form of the profile of mood states (POMS-SF): psychometric information. *Psychological assessment*, 7(1), 80.
- Deb, A., Sambamoorthi, U., Thornton, J. D., Schreurs, B., & Innes, K. (2018). Direct medical expenditures associated with Alzheimer's and related dementias (ADRD) in a nationally representative sample of older adults—an excess cost approach. *Aging & mental health*, 22(5), 619-624.
- Deci, E. L., & Vansteenkiste, M. (2004). Self-determination theory and basic need satisfaction: Understanding human development in positive psychology. *Ricerche di psicologia*.
- Deci, E. L. R., R.M. (1980). Self-determination theory: When mind mediates behavior. *The Journal of Mind and Behavior*, 1(1), 33-43.
- Denzin, N. K., & Lincoln, Y. S. (2011). *The Sage handbook of qualitative research*: sage.

- Desai, M. M. L., H.R.; Weeks. J.D. (2001). Unmet need for personal assistance with activities of daily living among older adults. *The Gerontologist*, 41(1), 82-88.
- Dishman, R. K. (1995). Physical activity and public health: mental health. *Quest*, 47(3), 362-385.
- Dishman, R. K. (2001). The problem of exercise adherence: Fighting sloth in nations with market economics. *Quest*, 53(3), 279-294.
- Dishman, R. K., Sallis, J. F., & Orenstein, D. R. (1985). The determinants of physical activity and exercise. *Public Health Rep*, 100(2), 158-171. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/3920714>
- Dominick, K. L. A., F.M.; Gold, C.H.; Heller, D.A. (2004). Health-related quality of life among older adults with arthritis. *Health and Quality of Life Outcomes*, 2.
- Dumith, S. C. H., P.C.; Reis, R.S.; Kohl III, H.W. (2011). Worldwide prevalence of physical inactivity and its association with human development index in 76 countries. *Preventative medicine*, 53, 24-28.
- Dunlop, D. D. M., L.M.; Song, J.; Chang, R.W. (2001). Arthritis prevalence and activity limitations in older adults. *Arthritis and Rheumatism*, 44(1), 212-221.
- Dunlop, D. D. S., P.; Song, J.; Manheim, L.M.; Shih, V.; Chang, R.W. (2005). Risk factors for functional decline in older adults with arthritis. *Arthritis and Rheumatism*, 52(4), 1274-1282.
- Dunton, G. F., Liao, Y., Intille, S., Huh, J., & Leventhal, A. (2015). Momentary assessment of contextual influences on affective response during physical activity. *Health psychology*, 34(12), 1145.

- Ekkekakis, P. (2009). The dual-mode theory of affective responses to exercise in metatheoretical context: I. initial impetus, basic postulates, and philosophical framework. *International review of sport and exercise psychology*, 2(1).
- Ekkekakis, P., Backhouse, S. H., Gray, C., & Lind, E. (2008). Walking is popular among adults but is it pleasant? A framework for clarifying the link between walking and affect as illustrated in two studies. *Psychology of Sport and Exercise*, 9(3), 246-264.
doi:<https://doi.org/10.1016/j.psychsport.2007.04.004>
- Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2005). Some like it vigorous: Measuring individual differences in the preference for and tolerance of exercise intensity. *Journal of sport and exercise psychology*, 27(3), 350-374.
- Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2008). The relationship between exercise intensity and affective responses demystified: to crack the 40-year-old nut, replace the 40-year-old nutcracker! *Annals of Behavioral Medicine*, 35(2), 136-149.
- Ekkekakis, P., Lind, E., & Vazou, S. (2010). Affective responses to increasing levels of exercise intensity in normal-weight, overweight, and obese middle-aged women. *Obesity*, 18(1), 79-85.
- Ekkekakis, P., & Petruzzello, S. J. (2000). Analysis of the affect measurement conundrum in exercise psychology: I. Fundamental issues. *Psychology of Sport and Exercise*, 1(2), 71-88. doi:[https://doi.org/10.1016/S1469-0292\(00\)00010-8](https://doi.org/10.1016/S1469-0292(00)00010-8)
- Ekkekakis, P., & Petruzzello, S. J. (2002). Analysis of the affect measurement conundrum in exercise psychology: IV. A conceptual case for the affect circumplex. *Psychology of Sport and Exercise*, 3(1), 35-63. doi:[https://doi.org/10.1016/S1469-0292\(01\)00028-0](https://doi.org/10.1016/S1469-0292(01)00028-0)

- Ekkekakis, P., Thome, J., Petruzzello, S. J., & Hall, E. E. (2008). The Preference for and Tolerance of the Intensity of Exercise Questionnaire: a psychometric evaluation among college women. *J Sports Sci*, 26(5), 499-510. doi:10.1080/02640410701624523
- Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist*, 49(8), 709.
- Erickson, K. I., & Kramer, A. F. (2009). Aerobic exercise effects on cognitive and neural plasticity in older adults. *Br J Sports Med*, 43(1), 22-24. doi:10.1136/bjsm.2008.052498
- Fentem, P. H. (1994). ABC of sports medicine. Benefits of exercise in health and disease. *BMJ*, 308(6939), 1291-1295. doi:10.1136/bmj.308.6939.1291
- Ferri, C., James, I., & Pruchno, R. (2009). Successful Aging: Definitions and Subjective Assessment According to Older Adults. *Clinical Gerontologist*, 32(4), 379-388. doi:10.1080/07317110802677302
- Findorff, M. J., Wyman, J. F., & Gross, C. R. (2009). Predictors of long-term exercise adherence in a community-based sample of older women. *J Womens Health (Larchmt)*, 18(11), 1769-1776. doi:10.1089/jwh.2008.1265
- Fleg, J. L. (2012). Aerobic exercise in the elderly: a key to successful aging. *Discovery Medicine*.
- Flick, U., Von Kardorff, E., & Steinke, I. (2004). What is qualitative research? An introduction to the field. *A companion to qualitative research*, 3-11.
- Florence, C. S., Bergen, G., Atherly, A., Burns, E., Stevens, J., & Drake, C. (2018). Medical Costs of Fatal and Nonfatal Falls in Older Adults. *Journal of the American Geriatrics Society*, 66(4), 693-698. doi:<https://doi.org/10.1111/jgs.15304>

- Force, U. P. S. T. (2004). Screening for coronary heart disease. *Rockville, Md: Agency for Healthcare Research and Quality*.
- Frijda, N. H. (1988). The laws of emotion. *American Psychologist*, 43(5), 349.
- Fusch, P. I., & Ness, L. R. (2015). Are we there yet? Data saturation in qualitative research. *The qualitative report*, 20(9), 1408.
- García-Hermoso, A., Ramirez-Vélez, R., Sáez de Asteasu, M. L., Martínez-Velilla, N., Zambom-Ferraresi, F., Valenzuela, P. L., . . . Izquierdo, M. (2020). Safety and Effectiveness of Long-Term Exercise Interventions in Older Adults: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Sports Medicine*, 50(6), 1095-1106.
doi:10.1007/s40279-020-01259-y
- Giada, F., Biffi, A., Agostoni, P., Anedda, A., Belardinelli, R., Carlon, R., . . . De Francesco, A. (2008). Exercise prescription for the prevention and treatment of cardiovascular diseases: part I. *Journal of cardiovascular medicine*, 9(5), 529-544.
- Glisky, E. L. (2007). Changes in Cognitive Function in Human Aging. In D. R. Riddle (Ed.), *Brain Aging: Models, Methods, and Mechanisms*. Boca Raton (FL).
- Grayson K. Vincent, V. A. V. (2010). The Next Four Decades: The Older Population in the United States: 2010 to 2050 [Press release]. Retrieved from
<https://www.census.gov/content/dam/Census/library/publications/2010/demo/p25-1138.pdf>
- Guimarães, A. V., Barbosa, A. R., & Meneghini, V. (2018). Active videogame-based physical activity vs. aerobic exercise and cognitive performance in older adults: a randomized controlled trial. *Journal of Physical Education and Sport*, 18(1), 203-209.

- Hagberg, L. A. L., B.; Nyberg, L.; Hellenius, M.L. (2009). Importance of enjoyment when promoting physical exercise. *Scandinavian journal of medicine and science in sports*, 19, 740-747.
- Hardy, C. J., & Rejeski, W. J. (1989). Not what, but how one feels: the measurement of affect during exercise. *Journal of sport and exercise psychology*, 11(3), 304-317.
- Harwood, A.-E., Smith, G. E., Cayton, T., Broadbent, E., & Chetter, I. C. (2016). A systematic review of the uptake and adherence rates to supervised exercise programs in patients with intermittent claudication. *Annals of vascular surgery*, 34, 280-289.
- He, W., Manisha Sengupta, Victoria A. Velkoff, Kimberly A. DeBarros. (2005). 65+ in the United States: 2005. *Current Population Reports*, 23-209.
- Health, N. C. C. f. M. (2007). Dementia. *Dementia: A NICE-SCIE Guideline on Supporting People With Dementia and Their Carers in Health and Social Care*.
- Helmick, C. G. F., D.T.; Lawrence, R.C.; Gabriel, S.; Hirsch, R.; Kwoh, C.K.; Liang, M.H.; Kremers, H.M.; Mayes, M.D.; Merkel, P.A.; Pillemer, S.R.; Reveille, J.D.; Stone, J.H. (2008). Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. *Arthritis and Rheumatism*, 58(1), 15-25.
- Higgins, E. T. (1997). Beyond pleasure and pain. *American Psychologist*, 52(12), 1280-1300.
- Hill, C. E., Knox, S., Thompson, B. J., Williams, E. N., Hess, S. A., & Ladany, N. (2005). Consensual qualitative research: An update. *Journal of counseling psychology*, 52(2), 196.
- Hill, C. E., Thompson, B. J., & Williams, E. N. (1997). A guide to conducting consensual qualitative research. *The counseling psychologist*, 25(4), 517-572.

- Hootman, J. M. H., C.G.; Brady, T.J. (2012). A public health approach to addressing arthritis in older adults: The most common cause of disability. *American Journal of Public Health*, 102, 426-433.
- Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional children*, 71(2), 165-179.
- Hutchinson, J. C., Zenko, Z., Santich, S., & Dalton, P. C. (2020). Increasing the Pleasure and Enjoyment of Exercise: A Novel Resistance-Training Protocol. *Journal of sport and exercise psychology*, 42(2), 143-152.
- Hycner, R. H. (1985). Some guidelines for the phenomenological analysis of interview data. *Human studies*, 8(3), 279-303.
- Janssen, I. H., S.B.; Ross, R. (2002). Low relative skeletal muscle mass (Sarcopenia) in older persons is associated with functional impairment and physical disability. *JAGS*, 50(5).
- Jin, K., Simpkins, J. W., Ji, X., Leis, M., & Stambler, I. (2014). The Critical Need to Promote Research of Aging and Aging-related Diseases to Improve Health and Longevity of the Elderly Population. *Aging and disease*, 6(1), 1-5. doi:10.14336/AD.2014.1210
- Kendzierski, D., & DeCarlo, K. J. (1991). Physical activity enjoyment scale: Two validation studies. *Journal of Sport & Exercise Psychology*, 13(1).
- Kim, S. (2008). Changes in surgical loads and economic burden of hip and knee replacements in the US: 1997-2004. *Arthritis and Rheumatism*, 59(4), 481-488.
- Kimiecik, J. C. H., A.T. (1996). What is enjoyment? A conceptual/ definitional analysis with implications for sport and exercise psychology. *Journal of sport and exercise psychology*, 18, 247-263.

- Kramer, A. F., Hahn, S., Cohen, N. J., Banich, M. T., McAuley, E., Harrison, C. R., . . . Boileau, R. A. (1999). Ageing, fitness and neurocognitive function. *Nature*, 400(6743), 418-419.
- Kwan, B. M., & Bryan, A. (2010). In-task and post-task affective response to exercise: translating exercise intentions into behaviour. *Br J Health Psychol*, 15(Pt 1), 115-131. doi:10.1348/135910709X433267
- Kwan, B. M., & Bryan, A. D. (2010). Affective response to exercise as a component of exercise motivation: Attitudes, norms, self-efficacy, and temporal stability of intentions. *Psychol Sport Exerc*, 11(1), 71-79. doi:10.1016/j.psychsport.2009.05.010
- Lachman, M. E., Lipsitz, L., Lubben, J., Castaneda-Sceppa, C., & Jette, A. M. (2018). When adults don't exercise: Behavioral strategies to increase physical activity in sedentary middle-aged and older adults. *Innovation in aging*, 2(1), igy007.
- Landi, F., Marzetti, E., Martone, A. M., Bernabei, R., & Onder, G. (2014). Exercise as a remedy for sarcopenia. *Current Opinion in Clinical Nutrition & Metabolic Care*, 17(1), 25-31.
- Larsen, R. J., & Prizmic, Z. (2004). Affect regulation. *Handbook of self-regulation: Research, theory, and applications*, 40-61.
- Lee, S. B., Oh, J. H., Park, J. H., Choi, S. P., & Wee, J. H. (2018). Differences in youngest-old, middle-old, and oldest-old patients who visit the emergency department. *Clin Exp Emerg Med*, 5(4), 249-255. doi:10.15441/ceem.17.261
- Legrand, F. D., Joly, P. M., Bertucci, W. M., Soudain-Pineau, M. A., & Marcel, J. (2011). Interactive-Virtual Reality (IVR) Exercise: An Examination of In-Task and Pre-to-Post Exercise Affective Changes. *Journal of Applied Sport Psychology*, 23(1), 65-75. doi:10.1080/10413200.2010.523754
- Lewin, K. (1943). Defining the 'field at a given time.'. *Psychological Review*, 50(3), 292.

- Looker, A. C., Melton, L. J., 3rd, Harris, T. B., Borrud, L. G., & Shepherd, J. A. (2010). Prevalence and trends in low femur bone density among older US adults: NHANES 2005-2006 compared with NHANES III. *J Bone Miner Res*, 25(1), 64-71. doi:10.1359/jbmr.090706
- Mangione, K. K. C., R.L.; Tomlinson, S.S.; Palombaro, K.M. (2005). Can elderly patients who have had a hip fracture perform moderate- to high- intensity exercise at home? *Phys Ther*, 85(8), 727-739.
- Marcus, B. H., Williams, D. M., Dubbert, P. M., Sallis, J. F., King, A. C., Yancey, A. K., . . . Outcomes, R. (2006). Physical activity intervention studies: what we know and what we need to know: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity); Council on Cardiovascular Disease in the Young; and the Interdisciplinary Working Group on Quality of Care and Outcomes Research. *Circulation*, 114(24), 2739-2752. doi:10.1161/CIRCULATIONAHA.106.179683
- Markland, D., & Tobin, V. (2004). A Modification to the Behavioural Regulation in Exercise Questionnaire to Include an Assessment of Amotivation. *Journal of Sport & Exercise Psychology*, 26, 191-196. doi:10.1123/jsep.26.2.191
- Martin, J. E., & Dubbert, P. M. (1985). Adherence to exercise. *Exerc Sport Sci Rev*, 13, 137-167. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/3891367>
- Matsunaga, M., Lim, E., Davis, J., & Chen, J. J. (2021). Dietary quality associated with self-reported diabetes, osteoarthritis, and rheumatoid arthritis among younger and older us adults: a cross-sectional study using NHANES 2011–2016. *Nutrients*, 13(2), 545.

- McAuley, E., Blissmer, B., Katula, J., & Duncan, T. E. (2000). Exercise environment, self-efficacy, and affective responses to acute exercise in older adults. *Psychology & Health, 15*(3), 341-355. doi:10.1080/08870440008401997
- McAuley, E., & Courneya, K. S. (1992). Self-Efficacy Relationships With Affective and Exertion Responses to Exercise¹. *Journal of Applied Social Psychology, 22*(4), 312-326. doi:10.1111/j.1559-1816.1992.tb01542.x
- McAuley, E., Jerome, G. J., Marquez, D. X., Elavsky, S., & Blissmer, B. (2003). Exercise self-efficacy in older adults: social, affective, and behavioral influences. *Annals of Behavioral Medicine, 25*(1), 1-7.
- McAuley, E., Shaffer, S. M., & Rudolph, D. (1995). Affective responses to acute exercise in elderly impaired males: The moderating effects of self-efficacy and age. *The International Journal of Aging and Human Development, 41*(1), 13-27.
- McAuley, E., Talbot, H.-M., & Martinez, S. (1999). Manipulating self-efficacy in the exercise environment in women: Influences on affective responses. *Health psychology, 18*(3), 288.
- McAuley, E. B., B. (2000). Self-efficacy determinants and consequences of physical activity. *Exercise and sport science reviews, 28*(2), 85-88.
- McNair, D. M. (1992). Profile of mood states. *Educational and Industrial Testing Service.*
- Melton III, L. J., Thamer, M., Ray, N. F., Chan, J. K., Chesnut III, C. H., Einhorn, T. A., . . . Siris, E. S. (1997). Fractures Attributable to Osteoporosis: Report from the National Osteoporosis Foundation. *Journal of bone and mineral research, 12*(1), 16-23. doi:10.1359/jbmr.1997.12.1.16
- Melton III, L. J. J., O.; Lau, E.; Mautalen, C.A.; Seeman, E. (2009). Osteoporosis and the global competition for health care resources. *Journal of bone and mineral research, 19*(7).

- Middleton, K. R., Anton, S. D., & Perri, M. G. (2013). Long-term adherence to health behavior change. *American journal of lifestyle medicine*, 7(6), 395-404.
- Miller, R. M., Bemben, D. A., & Bemben, M. G. (2021). The influence of sex, training intensity, and frequency on muscular adaptations to 40 weeks of resistance exercise in older adults. *Experimental Gerontology*, 143, 111174.
- Mitchell, K., Graff, M., Hedt, C., & Simmons, J. (2016). Reliability and validity of a smartphone pulse rate application for the assessment of resting and elevated pulse rate. *Physiotherapy Theory and Practice*, 32(6), 494-499. doi:10.1080/09593985.2016.1203046
- Mitzner, T. L. C., T.L.; Kemp, C.C.; Rogers, W.A. . (2011). Older adults' need for assistance as a function of living environment. *Proc Hum Factors Ergon Soc Annu Meet.*, 55(1), 152-156.
- Miyashita, M. (1978). Training and detraining effects on aerobic power in middle-aged and older men.
- Moran, M., Van Cauwenberg, J., Hercky-Linnewiel, R., Cerin, E., Deforche, B., & Plaut, P. (2014). Understanding the relationships between the physical environment and physical activity in older adults: a systematic review of qualitative studies. *International journal of behavioral nutrition and physical activity*, 11(1), 1-12.
- Morris, J. K., Vidoni, E. D., Johnson, D. K., Van Sciver, A., Mahnken, J. D., Honea, R. A., . . . Swerdlow, R. H. (2017). Aerobic exercise for Alzheimer's disease: a randomized controlled pilot trial. *PloS one*, 12(2), e0170547.
- Mucke, L. (2009). Alzheimer's disease. *Nature*, 461(7266), 895-897.

- Muellmann, S., Forberger, S., Möllers, T., Bröring, E., Zeeb, H., & Pischke, C. R. (2018). Effectiveness of eHealth interventions for the promotion of physical activity in older adults: a systematic review. *Preventive medicine*, 108, 93-110.
- Mujika, I., & Padilla, S. (2000). Detraining: Loss of Training-Induced Physiological and Performance Adaptations. Part II. *Sports Medicine*, 30(3), 145-154.
doi:10.2165/00007256-200030030-00001
- Murrell, S. A. H., S.; Wright, K. (1983). Prevalence of depression and its correlates in older adults. *American Journal of Epidemiology*, 117(2), 173-185.
- Musich, S. W., S.S.; Hawkins, K.; Greame, C. (2017). The frequency and health benefits of physical activity for older adults. *Population health management*, 20(3).
- Nelson, M. E. R., W.J.; Blair, S.N.; Duncan, P.W.; Judge, J.O. (2007). Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation*, 116(9), 1094-1105.
- Nielson, G. W., J.M.; Jensen, C.J.; Schmidt, J.F.; Andersen, T.R. (2014). Health promotion: The impact of beliefs of health beliefs, social relations and enjoyment on exercise continuation. *Scandinavian journal of medicine and science in sports*, 24, 66-75.
- No, M., & Kwak, H.-B. (2016). Effects of environmental temperature on physiological responses during submaximal and maximal exercises in soccer players. *Integrative medicine research*, 5(3), 216-222.
- Office, C. B. (2021). *The 2021 Long-Term Budget Outlook*. Retrieved from CBO.gov:
https://www.cbo.gov/publication/57038#_idTextAnchor024

- Older People Projected to Outnumber Children for First Time in U.S. History. (2018). [Press release]. Retrieved from <https://www.census.gov/newsroom/press-releases/2018/cb18-41-population-projections.html>
- Oman, R. F., & King, A. C. (1998). Predicting the adoption and maintenance of exercise participation using self-efficacy and previous exercise participation rates. *American Journal of Health Promotion*, 12(3), 154-161.
- Osteoporosis prevention, diagnosis, and therapy. (2000). *NIH Consensus Statement*, 17(1), 1-45.
- Pearson, J. A. B., E.; Pifalo, W.B.; Palaggo-Toy, T.; Krohn, K. (2005). A lifestyle modification intervention for the treatment of osteoporosis. *American Journal of Health Promotion*, 20(1).
- Penninx, B. W., Deeg, D. J., Van Eijk, J. T. M., Beekman, A. T., & Guralnik, J. M. (2000). Changes in depression and physical decline in older adults: a longitudinal perspective. *Journal of affective disorders*, 61(1-2), 1-12.
- Petersen, R. C. R., R.O.; Knopman, D.S.; Geda, Y.E.; Cha, R.H.; Pankratz, V.S.; Boeve, B.F.; Tangalos, E.G.; Ivnik, R.J.; Rocca, W.A. (2010). Prevalence of mild cognitive impairment is higher in men. *Neurology*, 75(10), 889-897.
- Pierce, G. L., Eskurza, I., Walker, A. E., Fay, T. N., & Seals, D. R. (2011). Sex-specific effects of habitual aerobic exercise on brachial artery flow-mediated dilation in middle-aged and older adults. *Clin Sci (Lond)*, 120(1), 13-23. doi:10.1042/CS20100174
- Piercy, K. L. T., R.P.; Ballard, R.M.; Carlson, S.A.; Fulton, J.E.; Galuska, D.A.; George, S.M.; Olson, R.D. (2018). The physical activity guidelines for Americans. *JAMA*, 320(19), 2020-2028.

- Pipitprapat, W., Harnchoowong, S., Suchonwanit, P., & Sriphrapradang, C. (2018). The validation of smartphone applications for heart rate measurement. *Annals of Medicine*, 50(8), 721-727. doi:10.1080/07853890.2018.1531144
- Reginster, J. Y. B., N. (2006). Osteoporosis: A still increasing prevalence. *Bone*, 38(2), 4-9.
- Reid, K. J. B., K.G.; Lu, B.; Naylor, R.; Wolfe, L.; Zee. P.C. (2010). Aerobic exercise improves self-reported sleep and quality of life in older adults with insomnia. *Sleep Medicine*, 11(9), 934-940.
- Reiner, M., Niermann, C., Jekauc, D., & Woll, A. (2013). Long-term health benefits of physical activity—a systematic review of longitudinal studies. *BMC public health*, 13(1), 1-9.
- Rhodes, R. E., Martin, A. D., Taunton, J. E., Rhodes, E. C., Donnelly, M., & Elliot, J. (1999). Factors associated with exercise adherence among older adults. *Sports Medicine*, 28(6), 397-411.
- Rose, E. A. P., G. (2007). A quantitative analysis and qualitative explanation of the individual differences in affective responses to prescribed and self-selected exercise intensities. *Journal of sport and exercise psychology*, 29, 281-309.
- Rose, E. A. P., G. (2010). Pleasant for some and unpleasant for others: a protocol analysis of the cognitive factors that influence affective responses to exercise. *International journal of behavioral nutrition and physical activity*, 7(15).
- Russell, J. A. (1980). A circumplex model of affect. *Journal of personality and social psychology*, 39(6), 1161-1178.
- Russell, J. A. (2003). Core Affect and the Psychological Construction of Emotion. *Psychological Review*, 110(1), 145-172.

- Russell, J. A., Weiss, A., & Mendelsohn, G. A. (1989). Affect grid: a single-item scale of pleasure and arousal. *Journal of personality and social psychology*, 57(3), 493.
- Sala, M., Baldwin, A. S., & Williams, D. M. (2016). Affective and cognitive predictors of affective response to exercise: Examining unique and overlapping variance. *Psychology of Sport and Exercise*, 27, 1-8.
- Salive, M. E. (2013). Multimorbidity in Older Adults. *Epidemiologic Reviews*, 35(1), 75-83.
doi:10.1093/epirev/mxs009
- Salkeld, G., Ameratunga, S. N., Cameron, I., Cumming, R., Easter, S., Seymour, J., . . . Brown, P. M. (2000). Quality of life related to fear of falling and hip fracture in older women: a time trade off studyCommentary: older people's perspectives on life after hip fractures. *BMJ*, 320(7231), 341-346.
- Saxena, S., Van Ommeren, M., Tang, K., & Armstrong, T. (2005). Mental health benefits of physical activity. *Journal of Mental Health*, 14(5), 445-451.
- Schoenborn, C. A., & Heyman, K. M. (2009). Health characteristics of adults aged 55 years and over: United States, 2004–2007. *Natl Health Stat Report*, 16, 1-31.
- Schoenborn, C. A., Vickerie, J. L., & Powell-Griner, E. (2006). Health characteristics of adults 55 years of age and over: United States, 2000-2003. *Adv Data*, 370(370), 1-31.
- Serra, L., Cercignani, M., Petrosini, L., Basile, B., Perri, R., Fadda, L., . . . Carlesimo, G. A. (2011). Neuroanatomical correlates of cognitive reserve in Alzheimer disease. *Rejuvenation Research*, 14(2), 143-151.
- Shouse, E. (2005). Feeling, emotion, affect. *M/c journal*, 8(6), 26.

- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research*, 177(3), 1333-1352.
doi:<https://doi.org/10.1016/j.ejor.2005.04.006>
- Smith, G. L., Banting, L., Eime, R., O'Sullivan, G., & Van Uffelen, J. G. (2017). The association between social support and physical activity in older adults: a systematic review. *International journal of behavioral nutrition and physical activity*, 14(1), 1-21.
- Steeves, J. A., Shiroma, E. J., Conger, S. A., Van Domelen, D., & Harris, T. B. (2019). Physical activity patterns and multimorbidity burden of older adults with different levels of functional status: NHANES 2003–2006. *Disability and Health Journal*, 12(3), 495-502.
doi:<https://doi.org/10.1016/j.dhjo.2019.02.005>
- Stineman, M. G., Strumpf, N., Kurichi, J. E., Charles, J., Grisso, J. A., & Jayadevappa, R. (2011). Attempts to Reach the Oldest and Frailest: Recruitment, Adherence, and Retention of Urban Elderly Persons to a Falls Reduction Exercise Program. *The Gerontologist*, 51(suppl_1), S59-S72. doi:10.1093/geront/gnr012
- Stone, A. A. (1995). Measurement of Affective response.
- Strawbridge, W. J., Wallhagen, M. I., & Cohen, R. D. (2002). Successful Aging and Well-Being: Self-Rated Compared With Rowe and Kahn. *The Gerontologist*, 42(6), 727-733.
doi:10.1093/geront/42.6.727
- Strohacker, K., Boyer, W. R., Smitherman, K. N., Cornelius, E., & Fazzino, D. (2017a). Assessing energy level as a marker of aerobic exercise readiness: A pilot investigation. *International journal of exercise science*, 10(1), 62.
- Strohacker, K., Boyer, W. R., Smitherman, K. N., Cornelius, E., & Fazzino, D. (2017b). Assessing Energy Level as a Marker of Aerobic Exercise Readiness: A Pilot

- Investigation. *International journal of exercise science*, 10(1), 62-75. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/28479948>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5214334/>
- Strohacker, K., Zakrajsek, R. A., Schaltegger, E. T., & Springer, C. M. (2019). Readiness to perform aerobic activity in adults with obesity: A thematic analysis of online surveys. *Research Quarterly for exercise and Sport*, 90(4), 619-628.
- Svebak, S., & Murgatroyd, S. (1985). Metamotivational dominance: a multimethod validation of reversal theory constructs. *Journal of personality and social psychology*, 48(1), 107.
- Svedahl, K., & MacIntosh, B. R. (2003). Anaerobic threshold: the concept and methods of measurement. *Can J Appl Physiol*, 28(2), 299-323. doi:10.1139/h03-023
- Thiel, A., Seiberth, K., & Mayer, J. (2013). Lektion 13. Soziale Konflikte im Sport. *Sportsoziologie-Ein Lehrbuch in*, 13, 360-381.
- Timmons, J. F., Griffin, C., Cogan, K. E., Matthews, J., & Egan, B. (2020). Exercise maintenance in older adults 1 year after completion of a supervised training intervention. *Journal of the American Geriatrics Society*, 68(1), 163-169.
- Tonkikh, O., Shadmi, E., Flaks-Manov, N., Hoshen, M., Balicer, R. D., & Zisberg, A. (2016). Functional status before and during acute hospitalization and readmission risk identification. *J Hosp Med*, 11(9), 636-641. doi:10.1002/jhm.2595
- Tornero-Quñones, I., Sáez-Padilla, J., Espina Díaz, A., Abad Robles, M. T., & Sierra Robles, Á. (2020). Functional ability, frailty and risk of falls in the elderly: Relations with autonomy in daily living. *International Journal of Environmental Research and Public Health*, 17(3), 1006.

- Tsauo, J.-Y., Leu, W.-S., Chen, Y.-T., & Yang, R.-S. (2005). Effects on function and quality of life of postoperative home-based physical therapy for patients with hip fracture. *Archives of physical medicine and rehabilitation*, 86(10), 1953-1957.
- Tudor-Locke, C., Craig, C. L., Brown, W. J., Clemes, S. A., De Cocker, K., Giles-Corti, B., . . . Blair, S. N. (2011). How many steps/day are enough? For adults. *The international journal of behavioral nutrition and physical activity*, 8, 79-79. doi:10.1186/1479-5868-8-79
- Uusi-Rasi, K., Sievänen, H., Heinonen, A., Kannus, P., & Vuori, I. (2004). Effect of discontinuation of alendronate treatment and exercise on bone mass and physical fitness: 15-month follow-up of a randomized, controlled trial. *Bone*, 35(3), 799-805.
doi:<https://doi.org/10.1016/j.bone.2004.05.003>
- Van Cauwenberg, J., De Bourdeaudhuij, I., De Meester, F., Van Dyck, D., Salmon, J., Clarys, P., & Deforche, B. (2011). Relationship between the physical environment and physical activity in older adults: a systematic review. *Health & place*, 17(2), 458-469.
- Van Landuyt, L. M., Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2000). Throwing the mountains into the lakes: On the perils of nomothetic conceptions of the exercise-affect relationship. *Journal of sport and exercise psychology*, 22(3), 208-234.
- Visvanathan, R., & Chapman, I. (2010). Preventing sarcopaenia in older people. *Maturitas*, 66(4), 383-388. doi:<https://doi.org/10.1016/j.maturitas.2010.03.020>
- Vlachopoulos, S. P., & Karageorghis, C. I. (2005). Interaction of external, introjected, and identified regulation with intrinsic motivation in exercise: relationships with exercise enjoyment. *Journal of Applied Biobehavioral Research*, 10(2), 113-132.

- Vogel, T., Brechat, P. H., Leprêtre, P. M., Kaltenbach, G., Berthel, M., & Lonsdorfer, J. (2009). Health benefits of physical activity in older patients: a review. *International journal of clinical practice*, 63(2), 303-320.
- Wagenmakers, A. J., & Pedersen, B. K. (2006). The anti-inflammatory effect of exercise: its role in diabetes and cardiovascular disease control. *Essays in biochemistry*, 42, 105-117.
- Walston, J. D. (2012). Sarcopenia in older adults. *Curr Opin Rheumatol*, 24(6), 623-627. doi:10.1097/BOR.0b013e328358d59b
- Welch, A. S. H., A.; Ferguson, C.; Beauchamp, M.R. (2007). Affective responses of inactive women to a maximal incremental exercise test: A test of the dual-mode model. *Psychology of Sport and Exercise*, 8(4), 401-423.
- Westerterp, K. R. (2018). Changes in physical activity over the lifespan: Impact on body composition and sarcopenic obesity. *Obesity Reviews*, 19(S1).
- Williams, D. M. (2008). Exercise, affect, and adherence: an integrated model and a case for self-paced exercise. *J Sport Exerc Psychol*, 30(5), 471-496. doi:10.1123/jsep.30.5.471
- Williams, D. M., Dunsiger, S., Ciccolo, J. T., Lewis, B. A., Albrecht, A. E., & Marcus, B. H. (2008). Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychology of Sport and Exercise*, 9(3), 231-245.
- Williams, D. M., Dunsiger, S., Jennings, E. G., & Marcus, B. H. (2012). Does Affective Valence During and Immediately Following a 10-Min Walk Predict Concurrent and Future Physical Activity? *Annals of Behavioral Medicine*, 44(1), 43-51. doi:10.1007/s12160-012-9362-9

- Williams, D. M., Rhodes, R. E., & Conner, M. T. (2019). Conceptualizing and intervening on affective determinants of health behaviour. In: Taylor & Francis.
- Win, S. P., K.; Eze-Nliam, C.M.; Gottdiener, J.S.; Kop, W.J.; Ziegelstein, R.C. (2011). Depressive symptoms, physical inactivity and risk of cardiovascular mortality in older adults: the cardiovascular health study. *Heart*, 97, 500-505.
- Wong, A. Y.-Y., Ling, S. K.-K., Louie, L. H.-T., Law, G. Y.-K., So, R. C.-H., Lee, D. C.-W., . . . Yung, P. S.-H. (2020). Impact of the COVID-19 pandemic on sports and exercise. *Asia-Pacific journal of sports medicine, arthroscopy, rehabilitation and technology*, 22, 39-44.
- Yang, J., Weng, W., & Zhang, B. (2014). Experimental and numerical study of physiological responses in hot environments. *Journal of thermal biology*, 45, 54-61.
- Yazdanyar, A. (2009). The burden on cardiovascular disease in the elderly: Morbidity, mortality, and costs. *Clin Geriatr Med*, 24(4).
- Yeung, S. S., Reijnierse, E. M., Pham, V. K., Trappenburg, M. C., Lim, W. K., Meskers, C. G., & Maier, A. B. (2019). Sarcopenia and its association with falls and fractures in older adults: a systematic review and meta-analysis. *Journal of cachexia, sarcopenia and muscle*, 10(3), 485-500.
- Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist*, 35(2), 151.
- Zarit, S. H. Z., J.M. (2007). *Mental Disorders in Older Adults: Fundamentals of Assessment and Treatment*. New York: The Guilford Press.
- Zenko, Z., Ekkekakis, P., & Ariely, D. (2016a). Can You Have Your Vigorous Exercise and Enjoy It Too? Ramping Intensity Down Increases Postexercise, Remembered, and Forecasted Pleasure. 38(2), 149. doi:10.1123/jsep.2015-0286 10.1123/jsep.2015-0286

Zenko, Z., Ekkekakis, P., & Ariely, D. (2016b). Can you have your vigorous exercise and enjoy it too? Ramping intensity down increases postexercise, remembered, and forecasted pleasure. *Journal of sport and exercise psychology*, 38(2), 149-159.

Zuckerman, M., & Lubin, B. (1965). The multiple affect adjective checklist (MAACL).

Appendices

Appendix A

Active Adult (55+) Research Participants Needed!

If you report being at least 55 years old, you may be eligible to be a participant in this study! You also need to own a computer and a smartphone. We ask that you regularly engage in aerobic exercises such as walking, biking, swimming, etc. We define “regular” as at least 3 days per week of at least 30 minutes per day of moderate intensity exercise for the past 3 months.

We are conducting a virtual research study to better understand why people feel good or feel bad while they are exercising. This study will take place virtually from any safe and private location you want using the video platform Zoom!

Interested individuals should contact Jessica Smith (jsmit580@vols.utk.edu) to set up an initial session where we will determine eligibility and go through a consent form. If you consent to be in this study, we will ask you a series of questions to gather demographic information and setup a one-on-one interview.

The initial session will last about 45 minutes and the interview will last about 30 minutes. We will also ask you to review a typed word-for-word of our conversation and this should take about 1-hour.

Feel free to share this post and reach out to Jessica Smith [jsmit580@vols.utk.edu] or Dr. Kelley Strohacker (faculty advisor) [kstrohac@utk.edu] if you have any questions or to set up your initial screening!

IRB NUMBER: UTK IRB-20-06209-XP
IRB APPROVAL DATE: 03/01/2021

Appendix B

Hello,

Our research team is currently recruiting participants for a master's thesis study entitled Exploring Determinants of Exercise-Related Affect in Older Adults who Regularly Engage in Aerobic Exercise.

Research Study Location. All visits will take place virtually using the Zoom platform.

Study Purpose. To better understand why people feel good or feel bad while they are exercising. Eligibility Criteria. If you are at least 55 years old, own a computer and a smartphone, do not suffer from any cognitive impairments that may limit your memory, and regularly engage in aerobic exercise such as walking, running, swimming, biking, etc., you may be eligible! Regularly is defined as at least 3 days per week of at least 30-minutes per day of moderate intensity exercise.

Study Design. Interested individuals will be emailed a web link to use Zoom, a video conferencing platform, for an initial session. Zoom does not cost you any money. This session will make sure you meet the eligibility criteria, explain the study purpose and study layout including time requirement, benefit, and risks, and collect demographic information from you using a series of questions. People choosing to participate will be asked to attend a virtual interview session where they will be asked questions about their regular exercise, how they feel during exercise, a more unpleasant and pleasant exercise session, and how COVID-19 impacted exercise for them.

Study Duration and Time Commitment. The initial session will last approximately 45 minutes and the interview will last approximately 30 minutes. We will ask you to read a typed word-for-word depiction of our conversation to make sure it accurately represents your thoughts and ideas about the interview, which will take you approximately 1-hour.

Study Contact. For more information, contact Jessica Smith to schedule your initial Zoom session.

Jessica Smith
Master of Science Candidate
Jsmit580@vols.utk.edu

Kelley Strohacker, Ph.D.
Associate Professor of Exercise Physiology
Supervising Faculty Member
kstrohac@utk.edu

IRB NUMBER: UTK IRB-20-06209-XP
IRB APPROVAL DATE: 02/05/2021

Appendix C

Active Adult (55+) Research Participants Needed!

If you regularly (3+ days/week, 30 minutes per day of moderate intensity, for the past 3 months) complete aerobic exercises such as walking, running, biking, swimming, etc. and own a smartphone and a computer, you may be eligible!

Research Study Purpose

To better understand why people feel good or feel bad while they are exercising.



Research Study Design

Interested individuals will be emailed a web link to use Zoom, a video conferencing platform, for an initial session. This session will make sure you meet the eligibility criteria, explain the study purpose and study layout including time requirement, benefit, and risks, and collect demographic information from you using a series of questions. People choosing to participate will be asked to attend a virtual interview session where they will be asked questions about their regular exercise, how they feel during exercise, a more unpleasant and pleasant exercise session, and how COVID-19 impacted exercise for them.

Time Commitment, Location, and Study Contact Information

Initial Screening Video Session- 45 minutes

IRB Number: UTK IRB-20-06209-XP

Interview Video Session- 30 minutes

IRB Approval Date: 03/01/2021

Review Process- 1-hour

All visits will take place virtually from your own home! We will be using a video platform and you can participate from any safe and private location you want. Interested individuals should contact Jessica Smith, a student completing a master's degree at the University of Tennessee, Knoxville (jsmit580@vols.utk.edu) or faculty advisor Dr. Kelley Strohacker, an associate professor at the University of Tennessee, Knoxville (kstrohac@utk.edu), 865-974-7667.

Appendix D

Consent for Research Participation

Research Study Title: *Exploring Determinants of Exercise-Related Affect in Older Adults who Regularly Engage in Aerobic Exercise*

Researcher(s): Jessica Smith, University of Tennessee, Knoxville
Kelley Strohacker, PhD, University of Tennessee, Knoxville

We are asking you to be in this research study because you report being at least 55 years old. You also own a computer and a smartphone capable of downloading an application and you do not suffer from any severe cognitive impairments that limit your memory. You also regularly engage in aerobic exercise (such as walking, running, swimming, biking, etc.). We define “regular” as at least 3 days per week of at least 30 minutes per day of moderate intensity exercise for the past 3 months.

You must be age 18 or older to participate in the study. The information in this consent form is to help you decide if you want to be in this research study. Please take your time reading this form and contact the researcher(s) to ask questions if there is anything you do not understand.

Why is the research being done?

The purpose of the research study is to better understand why people feel good or feel bad while they are exercising.

What will I do in this study?

If you agree to be in this study, we will ask you to attend two Zoom sessions. If you believe that you meet all eligibility criteria and wish to participate in this study, the researcher will schedule an initial meeting with you. Before the meeting, the researcher will email you a web link that will allow you to enter the Zoom session. When you click the link, you will be taken into a waiting room and then be let into the room by the researcher. This waiting room will help ensure that no one else can join your research meeting. We suggest you complete each session in a private and safe environment to protect yourself against being identified.

During this first session, the researcher will ask you to come up with a pseudonym (a made-up name) that can be used in place of your real name before recording the conversation. While the conversation is being recorded, the researcher will ask you questions to confirm that you are eligible to participate. Next, the researcher will send you a web link through your email to open an electronic version of this consent form. The researcher will review this document section by section and allow you to ask questions. If you agree to participate, you will be asked to indicate this decision on the electronic form and then enter your full name and the date to serve as an electronic signature, and then click submit. This form will be kept for our research records. Once we have received this form in our system, the researcher will then ask you a series of questions to better understand your enjoyment of physical activity, your preferences for exercise intensity, and what motivates you to exercise.

We will then talk you through how to download an application on your smartphone. This application is free and will be used to measure your heart rate while seated quietly, which will

help us learn more about your fitness level. Once the application is downloaded, we will ask you to remain seated without moving or talking for five minutes. Then, we will ask you to open the application by tapping on the icon, and then follow the instructions on the screen. This application uses your phone's flashlight to read your pulse through your index finger when it is covering the camera lens. The application will count down how long you should continue holding your finger over the camera and, when finished, will display your heart rate and turn off the flashlight automatically. We will ask you to show the screen to the camera on your computer so we can record the heart rate measurement.

Before you leave this initial meeting, the researcher will schedule your second appointment. Two days before this next appointment, the researcher will email you another web link for the meeting. If you have chosen to complete this second session immediately following the first, the researcher will allow you a 15-minute break before continuing with the interview.

The second session will also be conducted using Zoom. During this meeting, the researcher will lead a four-part interview. For the first part, we will ask you to describe an aerobic exercise session that you complete on a regular basis and can easily remember. We will ask you questions to better understand how you feel while performing that exercise and what makes you feel that way. In the second part, we will ask you about a time when exercising felt more unpleasant than usual and why you think that happened. In the third part, we will ask you to think about a time when exercising felt more pleasant than usual and why you think that happened. In the fourth part, we will ask you how you think COVID-19 impacted your regular exercise and how that made you feel.

After you finish the interview and exit the Zoom session, we will use the video recording to type out the conversation, word-for-word. We will email you a copy of this document and ask that, within the following 7-days, you read it and either confirm that your thoughts are accurately portrayed or provide changes that need to be made.

You can skip any questions that you do not want to answer.

How long will I be in the research study?

If you agree to be in this research study, you will be asked to talk one-on-one with a researcher on two occasions. These sessions will be held using the platform Zoom, which allows us to speak with you using the microphone and camera on your own computer. **The initial session will last about 45 minutes and the interview session will last about 30 minutes.** If you would like, we could conduct both sessions in a single setting or on separate days, depending on your schedule. These interviews will be recorded so that the researcher can type out the conversation, word-for-word. These transcriptions will be read by the research team to achieve the purpose of the study. However, before we analyze these transcriptions, we will ask you to read over the conversation to make sure your thoughts and ideas are portrayed accurately, to the best of your knowledge. **We suggest that you put aside approximately 1-hour to read through this document.** We will ask that you respond to this request within 7-days.

Can I say “No”?

Being in this study is up to you. You can say no now or leave the study later. Either way, your decision won't affect your employment at the University of Tennessee, Knoxville or your relationship with the researchers or with the University of Tennessee, Knoxville.

What happens if I say “Yes” but change my mind later?

Even if you decide to be in the study now, you can change your mind and stop at any time. If you decide to stop before the study is completed,

- You can contact the primary investigator, Jessica Smith, at any time to withdraw your consent.
- All information that has been collected will immediately be destroyed.

Are there any risks to me?

It is possible that someone could find out you were in this study or see your study information, but we believe this risk is small because of the procedures we use to protect your information. These procedures are described later in this form.

Are there any benefits to me?

We do not expect you to benefit from being in this study. Your participation may help us to learn more about what makes people feel more or less pleasant during a commonly performed bout of exercise. We expect that the knowledge gained from this study will benefit others in the future.

What will happen with the information collected for this study?

We will protect the confidentiality of your information by de-identifying all collected information and recordings by implementing pseudonyms. We will also change your name on Zoom so the recording will not show your real name. Lastly, if you or the researcher accidentally mentions your name during the recording, it will not be transcribed by the primary investigator.

If information from this study is published or presented at scientific meetings, your name and other personal information will not be used.

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information or what information came from you. Although it is unlikely, there are times when others may need to see the information we collect about you. These include:

- People at the University of Tennessee, Knoxville who oversee research to make sure it is conducted properly.
- Government agencies (such as the Office for Human Research Protections in the U.S. Department of Health and Human Services), and others responsible for watching over the safety, effectiveness, and conduct of the research.
- If a law or court requires us to share the information, we would have to follow that law or final court ruling.

What will happen to my information after this study is over?

We will NOT keep your information to use for future research. Your name and other information that can directly identify you will be deleted from your research data collected as part of the study. We may share your research data with other researchers without asking for your consent again, but it will not contain information that could directly identify you.

Will I be paid for being in this research study?

You will not be paid for being in this study.

What else do I need to know?

About 30 people will take part in this study. This is important because, due to the small sample size, it is possibly more likely that you could be re-identified.

If we learn about any new information that may change your mind about being in the study, we will tell you. If that happens, you may be asked to sign a new consent form.

Who can answer my questions about this research study?

If you have questions or concerns about this study, or have experienced a research related problem or injury, contact the researchers: If you have questions or concerns about this study, or have experienced a research related problem or injury, contact the researchers, [Jessica Smith](#), jsmit580@vols.utk.edu, OR [Kelley Strohacker](#), kstrohac@utk.edu, 865-974-7667.

For questions or concerns about your rights or to speak with someone other than the research team about the study, please contact:

Institutional Review Board
The University of Tennessee, Knoxville
1534 White Avenue
Blount Hall, Room 408
Knoxville, TN 37996-1529
Phone: 865-974-7697
Email: utkirb@utk.edu

Statement of Consent

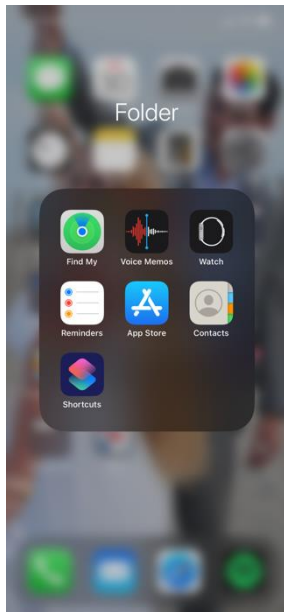
I have read this form, been given the chance to ask questions and have my questions answered. If I have more questions, I have been told who to contact. I understand that I am agreeing to be in this study. I can keep a copy of this consent information for future reference. If I do not want to be in this study, I do not need to do anything else.

Consent for use of images

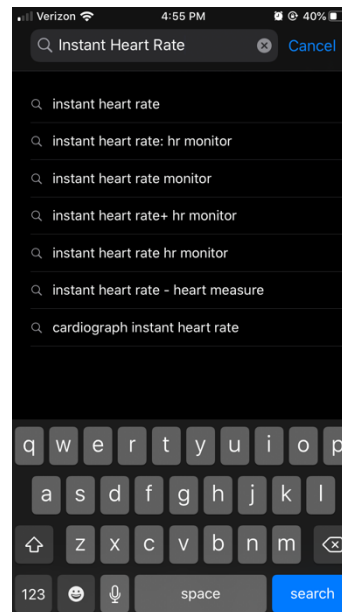
I agree that video recordings of me from this research may be analyzed for research purposes.

Appendix E

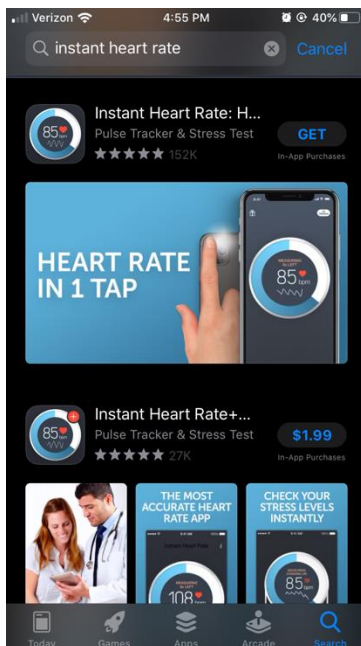
Step 1: Locate the “App Store” Icon



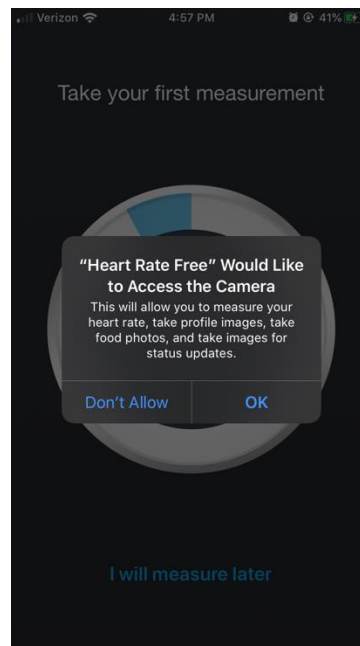
Step 2: Search for “Instant heart Rate”



Step 3: Choose “Instant Heart Rate.” Press Get.



Step 4: Open the application. Allow camera access.



2020 PAR-Q+

The Physical Activity Readiness Questionnaire for Everyone

The health benefits of regular physical activity are clear; more people should engage in physical activity every day of the week. Participating in physical activity is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

GENERAL HEALTH QUESTIONS

Please read the 7 questions below carefully and answer each one honestly: check YES or NO.	YES	NO
1) Has your doctor ever said that you have a heart condition ☐ OR high blood pressure ☐ ?	☐	☐
2) Do you feel pain in your chest at rest, during your daily activities of living, OR when you do physical activity?	☐	☐
3) Do you lose balance because of dizziness OR have you lost consciousness in the last 12 months? Please answer NO if your dizziness was associated with over-breathing (including during vigorous exercise).	☐	☐
4) Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? PLEASE LIST CONDITION(S) HERE: _____	☐	☐
5) Are you currently taking prescribed medications for a chronic medical condition? PLEASE LIST CONDITION(S) AND MEDICATIONS HERE: _____	☐	☐
6) Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active? Please answer NO if you had a problem in the past, but it does not limit your current ability to be physically active. PLEASE LIST CONDITION(S) HERE: _____	☐	☐
7) Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐



If you answered NO to all of the questions above, you are cleared for physical activity. Please sign the PARTICIPANT DECLARATION. You do not need to complete Pages 2 and 3.

- Start becoming much more physically active – start slowly and build up gradually.
- Follow Global Physical Activity Guidelines for your age (<https://apps.who.int/iris/handle/10665/44399>).
- You may take part in a health and fitness appraisal.
- If you are over the age of 45 yr and NOT accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.
- If you have any further questions, contact a qualified exercise professional.

PARTICIPANT DECLARATION

If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that the community/fitness center may retain a copy of this form for its records. In these instances, it will maintain the confidentiality of the same, complying with applicable law.

NAME _____ DATE _____

SIGNATURE _____ WITNESS _____

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER _____



If you answered YES to one or more of the questions above, COMPLETE PAGES 2 AND 3.



Delay becoming more active if:

- You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ at www.eparmedx.com before becoming more physically active.
- Your health changes - answer the questions on Pages 2 and 3 of this document and/or talk to your doctor or a qualified exercise professional before continuing with any physical activity program.

2020 PAR-Q+

FOLLOW-UP QUESTIONS ABOUT YOUR MEDICAL CONDITION(S)

1. Do you have Arthritis, Osteoporosis, or Back Problems?		
If the above condition(s) is/are present, answer questions 1a-1c		If NO ☐ go to question 2
1a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	YES ☐ NO ☐
1b.	Do you have joint problems causing pain, a recent fracture or fracture caused by osteoporosis or cancer, displaced vertebra (e.g., spondylolisthesis), and/or spondylolysis/pars defect (a crack in the bony ring on the back of the spinal column)?	YES ☐ NO ☐
1c.	Have you had steroid injections or taken steroid tablets regularly for more than 3 months?	YES ☐ NO ☐
2. Do you currently have Cancer of any kind?		
If the above condition(s) is/are present, answer questions 2a-2b		If NO ☐ go to question 3
2a.	Does your cancer diagnosis include any of the following types: lung/bronchogenic, multiple myeloma (cancer of plasma cells), head, and/or neck?	YES ☐ NO ☐
2b.	Are you currently receiving cancer therapy (such as chemotherapy or radiotherapy)?	YES ☐ NO ☐
3. Do you have a Heart or Cardiovascular Condition? This includes Coronary Artery Disease, Heart Failure, Diagnosed Abnormality of Heart Rhythm		
If the above condition(s) is/are present, answer questions 3a-3d		If NO ☐ go to question 4
3a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	YES ☐ NO ☐
3b.	Do you have an irregular heart beat that requires medical management? (e.g., atrial fibrillation, premature ventricular contraction)	YES ☐ NO ☐
3c.	Do you have chronic heart failure?	YES ☐ NO ☐
3d.	Do you have diagnosed coronary artery (cardiovascular) disease and have not participated in regular physical activity in the last 2 months?	YES ☐ NO ☐
4. Do you currently have High Blood Pressure?		
If the above condition(s) is/are present, answer questions 4a-4b		If NO ☐ go to question 5
4a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	YES ☐ NO ☐
4b.	Do you have a resting blood pressure equal to or greater than 160/90 mmHg with or without medication? (Answer YES if you do not know your resting blood pressure)	YES ☐ NO ☐
5. Do you have any Metabolic Conditions? This includes Type 1 Diabetes, Type 2 Diabetes, Pre-Diabetes		
If the above condition(s) is/are present, answer questions 5a-5e		If NO ☐ go to question 6
5a.	Do you often have difficulty controlling your blood sugar levels with foods, medications, or other physician-prescribed therapies?	YES ☐ NO ☐
5b.	Do you often suffer from signs and symptoms of low blood sugar (hypoglycemia) following exercise and/or during activities of daily living? Signs of hypoglycemia may include shakiness, nervousness, unusual irritability, abnormal sweating, dizziness or light-headedness, mental confusion, difficulty speaking, weakness, or sleepiness.	YES ☐ NO ☐
5c.	Do you have any signs or symptoms of diabetes complications such as heart or vascular disease and/or complications affecting your eyes, kidneys, OR the sensation in your toes and feet?	YES ☐ NO ☐
5d.	Do you have other metabolic conditions (such as current pregnancy-related diabetes, chronic kidney disease, or liver problems)?	YES ☐ NO ☐
5e.	Are you planning to engage in what for you is unusually high (or vigorous) intensity exercise in the near future?	YES ☐ NO ☐

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- 6. Do you have any Mental Health Problems or Learning Difficulties?** This includes Alzheimer's, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome
If the above condition(s) is/are present, answer questions 6a-6b If **NO** ☐ go to question 7
- 6a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments) YES ☐ NO ☐
- 6b. Do you have Down Syndrome **AND** back problems affecting nerves or muscles? YES ☐ NO ☐
-
- 7. Do you have a Respiratory Disease?** This includes Chronic Obstructive Pulmonary Disease, Asthma, Pulmonary High Blood Pressure
If the above condition(s) is/are present, answer questions 7a-7d If **NO** ☐ go to question 8
- 7a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments) YES ☐ NO ☐
- 7b. Has your doctor ever said your blood oxygen level is low at rest or during exercise and/or that you require supplemental oxygen therapy? YES ☐ NO ☐
- 7c. If asthmatic, do you currently have symptoms of chest tightness, wheezing, laboured breathing, consistent cough (more than 2 days/week), or have you used your rescue medication more than twice in the last week? YES ☐ NO ☐
- 7d. Has your doctor ever said you have high blood pressure in the blood vessels of your lungs? YES ☐ NO ☐
-
- 8. Do you have a Spinal Cord Injury?** This includes Tetraplegia and Paraplegia
If the above condition(s) is/are present, answer questions 8a-8c If **NO** ☐ go to question 9
- 8a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments) YES ☐ NO ☐
- 8b. Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light-headedness, and/or fainting? YES ☐ NO ☐
- 8c. Has your physician indicated that you exhibit sudden bouts of high blood pressure (known as Autonomic Dysreflexia)? YES ☐ NO ☐
-
- 9. Have you had a Stroke?** This includes Transient Ischemic Attack (TIA) or Cerebrovascular Event
If the above condition(s) is/are present, answer questions 9a-9c If **NO** ☐ go to question 10
- 9a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments) YES ☐ NO ☐
- 9b. Do you have any impairment in walking or mobility? YES ☐ NO ☐
- 9c. Have you experienced a stroke or impairment in nerves or muscles in the past 6 months? YES ☐ NO ☐
-
- 10. Do you have any other medical condition not listed above or do you have two or more medical conditions?**
If you have other medical conditions, answer questions 10a-10c If **NO** ☐ read the Page 4 recommendations
- 10a. Have you experienced a blackout, fainted, or lost consciousness as a result of a head injury within the last 12 months **OR** have you had a diagnosed concussion within the last 12 months? YES ☐ NO ☐
- 10b. Do you have a medical condition that is not listed (such as epilepsy, neurological conditions, kidney problems)? YES ☐ NO ☐
- 10c. Do you currently live with two or more medical conditions? YES ☐ NO ☐
- PLEASE LIST YOUR MEDICAL CONDITION(S) AND ANY RELATED MEDICATIONS HERE:** _____

GO to Page 4 for recommendations about your current medical condition(s) and sign the PARTICIPANT DECLARATION.

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If you answered NO to all of the FOLLOW-UP questions (pgs. 2-3) about your medical condition, you are ready to become more physically active - sign the PARTICIPANT DECLARATION below:

- ▶ It is advised that you consult a qualified exercise professional to help you develop a safe and effective physical activity plan to meet your health needs.
- ▶ You are encouraged to start slowly and build up gradually - 20 to 60 minutes of low to moderate intensity exercise, 3-5 days per week including aerobic and muscle strengthening exercises.
- ▶ As you progress, you should aim to accumulate 150 minutes or more of moderate intensity physical activity per week.
- ▶ If you are over the age of 45 yr and **NOT** accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.



If you answered YES to one or more of the follow-up questions about your medical condition:

You should seek further information before becoming more physically active or engaging in a fitness appraisal. You should complete the specially designed online screening and exercise recommendations program - the **ePARmed-X+** at www.eparmedx.com and/or visit a qualified exercise professional to work through the ePARmed-X+ and for further information.



Delay becoming more active if:

- ▶ You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- ▶ You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ at www.eparmedx.com before becoming more physically active.
- ▶ Your health changes - talk to your doctor or qualified exercise professional before continuing with any physical activity program.

- You are encouraged to photocopy the PAR-Q+. You must use the entire questionnaire and NO changes are permitted.
- The authors, the PAR-Q+ Collaboration, partner organizations, and their agents assume no liability for persons who undertake physical activity and/or make use of the PAR-Q+ or ePARmed-X+. If in doubt after completing the questionnaire, consult your doctor prior to physical activity.

PARTICIPANT DECLARATION

- All persons who have completed the PAR-Q+ please read and sign the declaration below.
- If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that the community/fitness center may retain a copy of this form for records. In these instances, it will maintain the confidentiality of the same, complying with applicable law.

NAME _____ DATE _____

SIGNATURE _____ WITNESS _____

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER _____

For more information, please contact

www.eparmedx.com
Email: eparmedx@gmail.com

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Key References

1. Jamnik VK, Warburton DER, Makarski J, McKenzie DC, Shephard RJ, Stone J, and Gledhill N. Enhancing the effectiveness of clearance for physical activity participation; background and overall process. *APNM* 36(S1):S3-S13, 2011.
2. Warburton DER, Gledhill N, Jamnik VK, Bredin SSD, McKenzie DC, Stone J, Charlesworth S, and Shephard RJ. Evidence-based risk assessment and recommendations for physical activity clearance; Consensus Document. *APNM* 36(S1):S266-S298, 2011.
3. Chisholm DM, Collis ML, Kulak LL, Davenport W, and Gruber N. Physical activity readiness. *British Columbia Medical Journal*. 1975;17:375-378.
4. Thomas S, Reading J, and Shephard RJ. Revision of the Physical Activity Readiness Questionnaire (PAR-Q). *Canadian Journal of Sport Science* 1992;17:4 338-345.

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Appendix G

EXERCISE REGULATIONS QUESTIONNAIRE (BREQ-2)

Age: _____ years

Sex: male female (please circle)

WHY DO YOU ENGAGE IN EXERCISE?

We are interested in the reasons underlying peoples' decisions to engage, or not engage in physical exercise. Using the scale below, please indicate to what extent each of the following items is true for you. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel about exercise. Your responses will be held in confidence and only used for our research purposes.

		Not true for me		Sometimes true for me		Very true for me
1	I exercise because other people say I should	0	1	2	3	4
2	I feel guilty when I don't exercise	0	1	2	3	4
3	I value the benefits of exercise	0	1	2	3	4
4	I exercise because it's fun	0	1	2	3	4
5	I don't see why I should have to exercise	0	1	2	3	4
6	I take part in exercise because my friends/family/partner say I should	0	1	2	3	4
7	I feel ashamed when I miss an exercise session	0	1	2	3	4
8	It's important to me to exercise regularly	0	1	2	3	4

9	I can't see why I should bother exercising	0	1	2	3	4
		Not true for me		Sometimes true for me	Very true for me	
10	I enjoy my exercise sessions	0	1	2	3	4
11	I exercise because others will not be pleased with me if I don't	0	1	2	3	4
12	I don't see the point in exercising	0	1	2	3	4
13	I feel like a failure when I haven't exercised in a while	0	1	2	3	4
14	I think it is important to make the effort to exercise regularly	0	1	2	3	4
15	I find exercise a pleasurable activity	0	1	2	3	4
16	I feel under pressure from my friends/family to exercise	0	1	2	3	4
17	I get restless if I don't exercise regularly	0	1	2	3	4
18	I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
19	I think exercising is a waste of time	0	1	2	3	4

Thank you for taking part in our research

Appendix H

Physical Activity Enjoyment Scale

Please rate how you feel *in general* about the physical activity you have been doing.

*	1	2	3	4	5	6	7
I enjoy it							I hate it
	1	2	3	4	5	6	7
I feel bored							I feel interested
	1	2	3	4	5	6	7
I dislike it							I like it
*	1	2	3	4	5	6	7
I find it pleasurable							I find it unpleasurable
*	1	2	3	4	5	6	7
I am very absorbed in this activity							I am not at all absorbed in this activity
	1	2	3	4	5	6	7
It's no fun at all							It's a lot of fun
*	1	2	3	4	5	6	7
I find it energizing							I find it tiring
	1	2	3	4	5	6	7
It makes me depressed							It makes me happy
*	1	2	3	4	5	6	7
It's very pleasant							It's very unpleasant
*	1	2	3	4	5	6	7
I feel good physically while doing it							I feel bad physically while doing it
*	1	2	3	4	5	6	7
It's very invigorating							It's not at all invigorating
	1	2	3	4	5	6	7
I am very frustrated by it							I am not at all frustrated by it
*	1	2	3	4	5	6	7
It's very gratifying							It's not gratifying at all
*	1	2	3	4	5	6	7
It's very exhilarating							It's not at all exhilarating
	1	2	3	4	5	6	7
It's not at all stimulating							It's very stimulating
*	1	2	3	4	5	6	7
It gives me a strong sense of accomplishment							It does not give me any sense of accomplishment at all

*	1	2	3	4	5	6	7
It's very refreshing						It's not at all refreshing	
	1	2	3	4	5	6	7
I felt as though I would rather be doing something else						I felt as though there was nothing else I would rather be doing	

*** Item is reverse scored (i.e., 1=7, 2=6.....6=2, 7=1)**

Appendix I

Inventory of Exercise Habits

Please, read each of the following statements and then use the response scale on the right to indicate whether you agree or disagree with it. There are no right or wrong answers. Work quickly and mark the answer that best describes what you believe and how you feel. Make sure that you respond to all the questions.

		totally disagree	disagree	Neither agree or disagree	agree	totally agree
1	Feeling tired during exercise is my signal to slow down or stop.	①	□	□	□	□
2	I would rather work out at low intensity levels for a long duration rather than at high-intensity levels for a short duration.	①	□	□	□	□
3	During exercise, if my muscles begin to burn excessively or if I find myself breathing very hard, it is time for me to ease off.	①	□	□	□	□
4	I'd rather go slow during my workout, even if that means taking more time.	①	□	□	□	□
5	While exercising, I try to keep going even after I feel exhausted.	①	□	□	□	□
6	I would rather have a short, intense workout than a long, low - intensity workout.	①	□	□	□	□
7	I block out the feeling of fatigue when exercising.	①	□	□	□	□
8	When I exercise, I usually prefer a slow, steady pace.	①	□	□	□	□
9	I'd rather slow down or stop when a workout starts to get too tough.	①	□	□	□	□
10	Exercising at a low intensity does not appeal to me at all.	①	□	□	□	□
11	Fatigue is the last thing that affects when I stop a workout; I have a goal and stop only when I reach it.	①	□	□	□	□
12	While exercising, I prefer activities that are slow -paced and do not require much exertion.	①	□	□	□	□
13	When my muscles start burning during exercise, I usually ease off some.	①	□	□	□	□
14	The faster and harder the workout, the more pleasant I feel.	①	□	□	□	□
15	I always push through muscle soreness and fatigue when working out.	①	□	□	□	□
16	Low-intensity exercise is boring.	①	□	□	□	□

Appendix J

Interview Guide

The purpose of this research is to explore and understand determinants of exercise-related affect in older adults who complete regular aerobic exercise.

Section I

We would like to know how you remember feeling during a regular aerobic (e.g., walking, swimming, cycling) exercise session. I want you to think about an exercise session you regularly complete. (PAUSE- give time to think).

1. Picture yourself wherever you usually complete exercise- whether that be at home, outside, a gym, etc. (PAUSE- give time to think). Please describe where you are.
2. Describe for me the type of exercise you are doing. (Probe for the mode)
 - a. How long does it normally take you to complete (EXERCISE)?
 - b. How many times do you complete this activity in a given week?
 - c. Please describe how intense this activity is for you. (Clarify by giving examples of intensity).

We are interested in exploring how you normally remember feeling during this exercise session. Please remember that there is no right way to answer these questions and no right way to feel, we are interested in your individual experience.

3. Please describe how this exercise session makes you feel in the moment while you are completing it. (Gather more information)

Section II

Now I would like you to think back to a specific time where this same exercise session felt more unpleasant than normal. (PAUSE- give time to think).

4. How much more unpleasant did this exercise session feel than normal?
5. What specifically made this session unpleasant for you?
6. How did the unpleasantness that you felt affect the quality of this exercise session?
(Clarify quality if need be)

OR

If they've never had a more unpleasant session:

7. So, you can't think of a more unpleasant exercise session that occurred recently. What do you think would cause you to feel more unpleasant during exercise?
8. How would this affect the quality of your exercise session?

Section III

Now I would like you to think back to a specific time where this same exercise session felt more pleasant than normal. (PAUSE-give time to think).

9. How much more pleasant did this exercise session feel than normal?
10. What specifically made this session pleasant for you?
11. How did the increased pleasantness that you felt affect the quality of this exercise session?

OR

If they've never had a pleasant session:

12. So, you can't think of a more pleasant exercise session than normal that occurred recently. What do you think would cause you to feel more pleasant during exercise?
13. How would this affect the quality of your exercise session?

Section IV

COVID-19 has drastically changed our world in the last year, including how we exercise.

14. How would you say the pandemic has changed your exercise behavior?
15. Would you say exercise has been more pleasant or unpleasant since the start of the pandemic?
 - a. More pleasant- Why has exercise been more pleasant for you?
 - b. More unpleasant- Why has exercise been more unpleasant for you?
 - c. No change (**Reflect back to them if necessary**)- Why do you think your experience of exercise has not changed?

Is there anything else you would like to add, or you think we have missed in our discussion today?

Vita

Jessica Smith is a second-year master's student at the University of Tennessee, Knoxville in the Exercise Physiology Department. She earned her Bachelor of Science from Longwood University in 2019 with a degree in Exercise Science. Jessica graduated from Longwood University Magna Cum Laude and was the recipient of the Joan of Arc medallion, an award presented to citizen leaders. While attending Longwood, Jessica received four scholar-athlete awards, two Big South All-Academic Team recognitions, and one Longwood University All-Academic Team recognition. Jessica was a member of the Cormier Honors College and graduated with honors.

Jessica has presented at two Southeast American College of Sport Medicine (ACSM) conferences and two National ACSM conferences. She is a current professional member of both the Southeast ACSM and the National ACSM. Jessica has been an ACSM certified exercise physiologist since April 2019 and has earned the Associate Certification through the Center for the Integration of Research, Teaching, and Learning. Jessica is also a student reviewer for the International Journal of Exercise Science. She will be pursuing her Doctor of Philosophy in Exercise Physiology at Kent State University in the fall.