TESTING A BRIEF, THEORY-GUIDED VIDEO CHAT INTERVENTION FOR ENHANCING SELF-EFFICACY AND LIFESTYLE PHYSICAL ACTIVITY AMONG LOW ACTIVE WORKING ADULTS

BY

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DISSERTATION

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Abstract

Despite evidence of the many health benefits of engaging in regular physical activity, American adults' physical activity levels are generally low (Centers for Disease Control and Prevention, 2017a). The most common reported barrier for low activity is lack of time (Bellows-Riecken & Rhodes, 2008; Cohen-Mansfield, Marx, & Guralnik, 2003; Manaf, 2013; Welch, McNaughton, Hunter, Hume, & Crawford, 2009). Self-efficacy, defined as one's confidence in his or her ability to successfully complete a task, has been associated with the adoption and maintenance of physical activity behavior (Bandura, 1991). Prior research suggests that self-efficacy is often inflated at the start of a physical activity program and fluctuates (typically declines) as one is exposed to intervention and recognizes what it takes to fully commit to such a program in lieu of omnipresent motivational barriers (McAuley et al., 2011). Therefore, there is a demand for interventions that can effectively enhance or preserve self-efficacy levels at the start of a physical activity program. Such interventions may facilitate adherence to public health guidelines for physical activity. Lifestyle physical activity, an unstructured, but goal-oriented form of physical activity, affords individuals a high degree of flexibility in how they choose to meet public health guidelines. Indeed, lifestyle physical activity interventions have been successful for getting adults to meet the public health guidelines for aerobic activity (Dunn et al., 1998). Moreover, brief interventions (lasting no more than 20 minutes in length; Lamming et al., 2017) and interventions guided by Social Cognitive Theory (SCT; Mailey & McAuley, 2014) have been effective for increasing lifestyle physical activity levels among low-active populations. To date, no studies have tested the efficacy of a brief, theory-guided video chat intervention for enhancing self-efficacy for lifestyle physical activity.

The purpose of this study was to test the feasibility and efficacy of a brief SCT-guided video chat intervention with the aim of enhancing physical activity-related self-efficacy, and in turn, lifestyle physical activity. Results provide support for the feasibility of delivering information remotely through video chats for low-active, working adults. Moreover, this study provides preliminary evidence for the utility of video chat intervention for promoting short-term increases in lifestyle physical activity self-efficacy. Further research is needed to replicate and extend these findings across a larger sample to develop an effective, viable method that can be disseminated and have a longer-lasting impact on full-time working adults' health and quality of life.

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Chapter I: Introduction

Chronic disease is the leading cause of death and disability within the United States with heart disease and cancer accounting for nearly 50% of all deaths (Centers for Disease Control and Prevention [CDC], 2017b). Moreover, 80% of adults over the age of 65 have at least one or more chronic diseases (National Council on Aging, 2018). The most common diseases are cardiovascular-related disease, cancer, type 2 diabetes, and obesity (CDC, 2017b)—all of which are preventable, to some extent, through engagement in regular physical activity (Booth, Roberts, & Laye, 2012). By increasing physical activity levels among low active populations who are not meeting current guidelines (150 minutes of aerobic activity per week), it is also possible to alleviate symptoms for people currently living with these diseases. Altogether, chronic disease accounts for most (90%) of the United States' health care expenditure (CDC, 2017b). The health and financial burdens of chronic disease are severe and current strategies designed to remedy these problems have been met with limited success.

Engagement in physical activity can improve physical functioning, weight control, energy levels (CDC, 2015), and brain health (Colcombe et al., 2006; Hillman et al., 2006). Regular physical activity engagement can prevent the development of chronic disease (Booth et al., 2012), treat anxiety and depression (Martinsen, 2008), and improve one's overall quality of life (American Heart Association, 2015). Despite evidence of the benefits of physical activity, only ~53% are meeting the recommendations for aerobic physical activity (CDC, 2015). Moreover, less than 5% of adults participate in 30 minutes of physical activity each day (US Department of Health and Human Services [USDHSS], 2017), and it is estimated that 30% of American adults are sedentary, meaning they have jobs that require prolonged sitting time and are generally inactive during their leisure time (CDC, 2016; Pate, O'neill, & Lobelo, 2008; Tremblay et al., 2017). Not meeting the recommended physical activity levels can lead to declines in physical and cognitive health, resulting in lower quality of life (Bherer, Erickson, & Liu-Ambrose, 2013; Warburton, Nicol, & Bredin, 2006).

The USDHHS and the *American College of Sports Medicine* (ACSM) have launched multiple initiatives in an effort to increase physical activity levels in the United States and to improve the health and quality of life for both healthy adults and those living with chronic disease. For example, the HHS implemented the *Healthy People 2020* initiative with an aim to educate and provide better environments to promote physical activity and improve the health of Americans (Office of Disease Prevention and Health Promotion, 2017). Likewise, ACSM established the ‘Exercise is Medicine’ (EIM) global health initiative to integrate physical activity into healthcare and to reduce the presence of chronic disease through the support of healthcare providers, exercise professionals, and community engagement (ACSM, 2017). EIM’s strategies to increase physical activity include measuring physical activity as a vital sign when visiting a physician to make patients aware that exercise is an important part of health, creating environments where it is easy to be physically active, and using behavioral interventions to promote behavior change (Tuso, 2015).

Although health initiatives aim to change the current patterns of inactivity, many of the public health strategies have not been fully adopted. To begin, physicians have not consistently incorporated physical activity into primary care. Indeed, Forjuoh et al. (2017) conducted a survey among community-dwelling adults (age 50+) and found only 38.9% of patients reported having received information from their physician about physical activity. Much more difficult is creating environments that promote physical activity (e.g., accessibility, opportunities; Humpel, Owen, & Leslie, 2002), as such changes often require changes in public policy. For example, amendments to zoning laws, among other policies, and reallocation of funding for infrastructure may be needed to facilitate the development of walkable city blocks, neighborhood parks and green spaces, bike lanes and paths, and these efforts are usually cost prohibitive. However, the implementation of well-designed, theory-guided behavioral interventions does appear to be an effective strategy for increasing physical activity (Avery, Flynn, Van Wersch, Sniehotta, & Trenell, 2012; Dishman & Buckworth, 1996; Dunn, Deroo, & Rivara, 2001; Hobbs et al., 2013; Kahn et al., 2002; USDHSS, 1999). The extent such effects can be maintained post-intervention is unclear because physical activity measurement rarely extends beyond the length of the intervention period. Indeed, a review of physical activity and dietary behavior change interventions (157 in total) showed that only 35% of the scoped studies included measures of physical activity maintenance (defined as >3 months post-intervention; Fjeldsoe, Neuhaus, Winkler, & Eakin, 2011). By assessing physical activity post-intervention, interventionists will gain greater insight into their long-term impact.

For most adults, engaging in regular physical activity and adhering to structured physical activity programs is challenging as evidenced by the statistic that approximately 50% of adults who start a structured exercise program tend to discontinue within the first six months (Dishman, 1982). In a more recent observational study of fitness center members, 63% of new gym members abandoned their membership before the third month and 96% abandoned their membership after one year (Sperandei, Vieira, & Reis, 2016). Lack of time is a primary reason given by adults for inactivity (Sonnentag & Jelden, 2009), although a variety of personal factors (e.g., psychological, cognitive, and emotional health) have been found to influence adults' physical activity participation (Trost, Owen, Bauman, Sallis, & Brown, 2002). Furthermore, the increasing number of social roles and commitments that co-occur with aging is believed to deplete one's "self-regulatory capacity" to manage thoughts, behaviors, and feelings to meet the goals necessary for sustained health behavior change (Vohs & Baumeister, 2016). Interventions that provide people with strategies for replenishing self-regulatory resources can boost individuals' confidence during a demanding life transition (e.g., initiating a physical activity program).

Evidence suggests that behavioral interventions guided by theory are more effective than those lacking a theoretical basis (Glanz & Bishop, 2010). Indeed, Albert Bandura's Social Cognitive Theory (SCT) has been effective for understanding and predicting physical activity (Bandura, 1977, 1991). The three core constructs of SCT include self-efficacy, self-regulation, and outcome expectations, all of which are predictive of human behavior (Conner & Norman, 2005) and physical activity (Gourlan et al., 2016; Keller, Fleury, Gregor-Holt, & Thompson, 1999; Young, Plotnikoff, Collins, Callister, & Morgan, 2014), and are sensitive to intervention (Bandura, 2004). Thus, having greater confidence, well-articulated plans, and realistic expectations about one's physical activity participation should increase the likelihood of engaging in physical activity behaviors. One's initial beliefs and motivations can vary at the start of an exercise program (McAuley, Mailey, et al., 2011). Specifically, some people begin with high levels of confidence which decline shortly thereafter. It is theorized that many people over-estimate their abilities to engage in regular exercise, and they recalibrate due to the common challenges people encounter when taking on any new commitments. Others may be more skeptical in their ability to exercise, and after starting, they may feel more confident as they acquire more experience. Either way, exposing individuals to a brief exercise experience prior to the start of an exercise program provides individuals with multiple opportunities to gauge their abilities and assess their exercise self-efficacy. Providing strategies designed to help individuals plan their exercise and develop realistic outcomes of exercise may lead to more favorable psychological profiles, and in turn, increased physical activity engagement. For these reasons, it is important that behavioral interventions account for individual differences in perceptions and expectations and provide information relevant to one's goals.

In an effort to address unhealthy behaviors and improve the science of health promotion, Sorenson and Steckler (2002) have proposed that behavior-change programs are most effective for behavior change when they are designed for the individual and driven by theory. Supporting this idea, Kahn et al. (2002) reviewed intervention approaches (e.g., informational, behavioral and social, and environmental and policy) and found that individually-adapted health behavior change interventions that addressed exercise barriers and negative attitudes, effectively increased physical activity levels. To further understand the components of successful exercise interventions, Knittle et al. (2018) reviewed physical activity programs and found that supervised programs and programs guided by SCT constructs (to enhance self-efficacy and self-regulatory strategies) tend to lead to greater levels of physical activity and positive psychosocial outcomes. However, these programs are typically costly to execute and require a multitude of resources (e.g., trained personnel, exercise equipment, and substantial time).

The setting and targeted population of physical activity programs can also influence physical activity. For example, according to the CDC (2017d), worksite physical activity programs may be best for full-time working, low active adults, as employees spend a large portion of their day at their place of work (on average 7.6 hours a day). To test this, Dishman, Oldenburg, O'Neal, and Shephard (1998) conducted a review of worksite physical activity interventions and concluded that such programs do not lead to increases in physical activity or fitness, noting that the results may be due to the limited number of studies in existence at the time. More recently, Anderson et al. (2009) reviewed 47 worksite nutrition and physical activity programs. Most programs included informational and behavioral strategies to promote changes in activity and diet with few programs modifying the work environment to promote change. Researchers found only modest improvements in employee weight status and decreased BMI at the 6- and 12-month follow-ups, even though most studies utilized evidence-based behavioral strategies from non-worksite physical activity programs. Likewise, Malik, Blake, and Suggs (2014) reviewed 58 workplace interventions for increasing physical activity. The majority of interventions utilized health promotion initiatives (e.g., psychological or behavioral strategies to change participants' exercise behavior), with most of the studies included being randomized controlled trials which relied on a variety of self-reported outcome measures. The results showed 32 of the 58 studies included were successful at increasing physical activity relative to a control group. However, the studies that reported long-term outcomes also reported high rates of attrition, varying considerably from 1% to 65%. Although these reviews offer some evidence of workplace interventions for successfully increasing physical activity, workplace interventions may not be meeting the needs of adults aiming to integrate more physical activity into their daily lives.

Lifestyle physical activity programs that promote walking have been successful for increasing physical activity levels (Dunn, Andersen, & Jakicic, 1998). For example, van der Bij, Laurant, and Wensing (2002) reviewed physical activity interventions for adults (age 50+) and found that unsupervised, home-based physical activity interventions were comparable to supervised, group-based interventions for increasing physical activity levels. In addition, Tully et al. (2007) conducted a 12-week unsupervised walking program (consisting of 3-5 days of 30-

minutes of brisk walking) for sedentary adults (n = 106) and found that the majority (89%) of participants adhered to the program recommendations. Other intervention characteristics important to consider are length of instruction and supervision. There is evidence that brief behavioral interventions can be effective at producing short-term behavior change (Fitzsimons et al., 2013). For example, Fitzsimons et al. utilized a single 30-minute, in-person session to discuss strategies to successfully increase physical activity behavior among older adults. Participants reduced sitting time by 24 min/day and increased time spent walking by 13 min/day over the course of the next two weeks (assessed via activPal). In a similar, SCT-guided brief (45-minute) intervention, participants received one face-to-face goal-setting consultation (guided by SCT and behavioral choice theory) and one individually tailored mailing providing feedback on accelerometer-derived sedentary time. The results revealed decreased sedentary time and increased light-intensity and moderate-intensity physical activity over the course of a six-day period (Gardiner, Eakin, Healy, & Owen, 2011).

Together, findings from these preliminary studies suggest that brief behavioral interventions designed to promote lifestyle physical activity have potential to be effective as a short-term intervention strategy. Given the lack of follow-up assessments in the aforementioned studies and the scant research on the topic of brief physical activity-promotion interventions, in general, it is unclear to what extent they can impact long-term behavior change. Much more research is needed to test the efficacy of brief interventions and the most impactful delivery methods, components and curriculum, especially among targeted populations such as working adults, who have limited time to exercise. By testing the efficacy of a theory-guided, brief behavioral intervention for increasing physical activity levels among low active, working adults, we will be able to gain a greater understanding of the extent to which SCT-based constructs influence adherence to unsupervised physical activity.

Specific Aims and Hypotheses

This dissertation study was designed to test the feasibility and effects of brief (three, 10-minute), theory-guided, interactive video chat sessions on subsequent self-efficacy levels. The interactive video chat sessions were designed to provide tailored information similar to other successful physical activity-promotion programs (Gardiner et al., 2011; Mailey & McAuley, 2014). The specific aims of this project were:

1. To examine the feasibility of a technology-based intervention for enhancing self-efficacy for lifestyle physical activity. It was hypothesized that participants would be highly receptive to the intervention as evidenced by high levels of enjoyment, perceived utility, and low perceived burden on daily life.
2. To determine whether the cumulative effect of the experimental, lifestyle physical activity-focused interactive video chat sessions would yield more positive changes in self-efficacy relative to time-matched chat sessions focused on work-life balance. It was hypothesized that increases in self-efficacy for lifestyle physical activity would be associated with the relevant video chat condition, whereas self-efficacy for work-life balance was included at pre and post intervention to test the specificity of the self-efficacy intervention effects.
3. To understand the potential transfer effects of self-efficacy changes on lifestyle physical activity levels. It was hypothesized that increases in self-efficacy for accumulating lifestyle physical activity would, to some extent, mediate any subsequent changes in lifestyle physical activity.

This study was guided by Social Cognitive Theory and designed to enhance self-efficacy for lifestyle physical activity, and in turn, increase physical activity levels among low-active, working adults. The methodology is novel in that individuals completed a behavioral intervention that was delivered through an interactive video chat smartphone application with the aim of targeting and enhancing self-efficacy after three weeks of exercise engagement, where self-efficacy has been shown to typically decline. This study advances the current understanding of the theoretical components relevant for brief behavioral interventions designed to promote exercise-specific confidence among working adults with little exercise experience. The brevity and tech-based delivery of this intervention reduces the time and personnel typically needed to implement structured, physical activity programs. Moreover, this intervention highlights strategies that could be used to promote engagement in lifestyle physical activity.

Chapter II: Review of Literature

In this chapter, the following will be reviewed: patterns of physical activity among low active, working adults; Social Cognitive Theory as a framework for understanding physical activity engagement; the role of self-perceptions in physical activity; and evidence-based methods for physical activity promotion.

Physical Activity and Working Adults

Lack of time has been reported as a primary barrier for both middle-aged and older adults (Bellows-Riecken & Rhodes, 2008; CDC, 2017c; Cohen-Mansfield, Marx, & Guralnik, 2003; Manaf, 2013; Welch, McNaughton, Hunter, Hume, & Crawford, 2009), men and women of low and high socioeconomic statuses (Sequeira, Cruz, Pinto, Santos, & Marques, 2011), and among low active adults, aged 25 to 64 (Hoare, Stavreski, Jennings, & Kingwell, 2017). Other factors can contribute to the available time working adults' have to participate in physical activity, including occupation-type and hours worked. Specifically, blue-collar occupations were found to have a 50% greater likelihood of being low active compared to white-collar (Burton & Turrell, 2000). Working long hours (e.g. > 40 hours per week) can be detrimental to adults' health by reducing energy levels (Sonnentag & Jelden, 2009) and longer work hours have been associated with worsened sleep quality, anxiety, and depressive states, and increased incidence of coronary heart disease (Bannai & Tamakoshi, 2014). Additionally, high work-related stress, among men and women, is associated with infrequent exercise and low self-efficacy to quit unhealthy behaviors (e.g., poor diet, smoking; Ng & Jeffery, 2003). Indeed, long shifts appear to have a direct negative impact on leisure-time physical activity (Caruso, 2006; Grosch, Caruso, Rosa, & Sauter, 2006; Kirk & Rhodes, 2011). Almost half of all working adults spend the majority of their time at work in a seated position, which can increase obesity risk relative to jobs that require mostly standing (Chau, van der Ploeg, Merom, Chey, & Bauman, 2012). Specifically, adults who reported sitting less than four hours per day during their leisure-time had significantly lower risk for obesity, irrespective of their physical activity levels.

Reducing sedentary behavior may be just as important as increasing physical activity for maintaining healthy weight (Brown, Williams, Ford, Ball, & Dobson, 2005) and reducing chronic disease in middle-aged adults (Owen, Bauman, & Brown, 2009). Sitting time can have negative effects on cardiovascular and metabolic processes, independent of current physical activity levels (Hamilton, Healy, Dunstan, Zderic, & Owen, 2008). Preliminary evidence suggests that breaking up sedentary time throughout the day is associated with reductions in body mass index, waist circumference, triglyceride, and glucose levels (Healy et al., 2008). Given that working adults spend the majority of their work days (76.9%) and non-work days (69.5%) in sedentary activities (Waters et al., 2016), interventions that aim to increase daily activity levels and reduce sedentary behaviors, may offer more health benefits to this population.

The current evidence is mixed regarding the effectiveness of physical activity interventions for working adults. For example, Proper et al. (2003) conducted a systematic reviewed on worksite physical activity programs aimed to promote employees' physical activity or fitness (n=26 studies were included in the review) and found that worksite physical activity programs improved activity levels. However, a quantitative summary was precluded by a large variation in program type and assessment of physical activity. A subsequent meta-analytic review found small, positive effects on physical activity (d = 0.21; Conn, Hafdahl, Cooper, Brown, & Lusk, 2009) yet researchers noted that the interventions within their scope utilized a heterogeneous range of exercise prescriptions (e.g. supervised vs. unsupervised, frequency of prescribed exercise) and mostly subjective physical activity assessments. Likewise, Abraham and

Graham-Rowe (2009) found small effects (*d*=0.23) of worksite physical activity interventions on self-reported physical activity that were substantially smaller when objective measures were used ($d = 0.15$, $p < 0.05$). Moreover, interventions that promoted walking were most effective relative to programs that promoted other forms of physical activity, such as group exercise programs that did not specifically encourage walking ($d = 0.54$ vs. 0.16). The evidence suggests that worksite interventions are somewhat effective at increasing physical activity, but modality matters (e.g. training specificity).

To address the weaknesses of workplace health interventions, Jones, Molitor, and Reif (2018) conducted a study testing the efficacy of a comprehensive workplace wellness program at the University of Illinois at Urbana-Champaign. The study included a control group which received no services upon enrollment and an intervention group that was offered a number of wellness activities (e.g., classes on weight loss, exercise, smoking cessation). The wellness program did not result in any changes in self-reported health status or exercise behaviors relative to the control group. However, the authors used an exploratory observational analysis to compare the completers and non-completers within the intervention group and found greater self-reported exercise behaviors among the program completers. Thus, the results emphasize the need for understanding inter-individual differences that may maximize program success.

Researchers have also tested the impact of home-based physical activity programs among working adults. For example, McEachan et al. (2011) aimed to test the efficacy of a 3-month theory-guided program (targeting attitudes, norms, self-efficacy, and intention) for meeting the public health guidelines of 150 minutes of aerobic activity per week, by engaging in leisure time physical activity at home. After completion of the 3-month program, the intervention group did not differ in self-reported physical activity (assessed via the *International Physical Activity*

Questionnaire [IPAQ]) relative to the control group. Researchers theorized that participants had difficulty accurately recalling their physical activity. Another study tested the efficacy of a 12-week structured vs. non-structured home-based exercise program in overweight sedentary employees for meeting physical activity guidelines (Pressler et al., 2010). The structured exercise program (three internet-guided exercise sessions per week) and non-structured program (meeting physical activity guidelines through self-selected activities) performed similarly in terms of facilitating physical activity. In contrast, Prestwich et al. (2012) tested the efficacy of a brief behavioral intervention focusing on the provision of social support, where workers and their spouses were partnered together and encouraged to utilize certain self-regulatory strategies (e.g. seeking social assistance, implementation interventions). The partners in the collaborative intervention group were more physically active relative to other participants in the study at one-month, three-month, and six-month follow-ups. Although successful, this study targeted working adults with spouses who were willing to participate in the program. There have been many successful interventions that utilized social support to promote physical activity (Trost et al., 2002). However, a systematic review of social support and physical activity participation among healthy adults found inconsistent relationships between social support and physical activity, with effect sizes ranging from small to large, and negative to positive (Scarapicchia, Amireault, Faulkner, & Sabiston, 2017). Thus, the role of social support as a mechanism for successful behavior change is unclear. To date, the most robust effects have been associated with self-regulatory strategies. Moreover, lifestyle physical activity interventions that promote walking may be as effective as highly supervised group classes for facilitating short-term activity levels among working adults.

Social Cognitive Theory

Evidence suggests health behavior interventions guided by theoretical frameworks are more effective for changing behaviors than interventions that do not explicitly include theory (Fishbein & Yzer, 2003; Painter, Borba, Hynes, Mays, & Glanz, 2008). Albert Bandura's (1986) Social Cognitive Theory (SCT) has been widely adopted by physical activity researchers. SCT describes and explains how people regulate their behavior through three sets of factors: cognitive, behavioral, and environmental (Bandura, 1991). These factors operate through reciprocal determinism, defined as a dynamic and mutual interaction among the three factors. Individuals' behaviors are believed to be motivated and regulated by these three factors. There are three core psychological constructs that predict behavior within SCT: self-efficacy, self-regulation, and outcome expectations. Self-efficacy is the strength of individuals' beliefs in their abilities to successfully perform a specific action. Self-efficacy plays perhaps the largest role in the execution of behavior as it influences one's thoughts, plans, and efforts to perform a certain behavior (Bandura, 1991). Also influential are the outcome expectations that one has about the costs and benefits of performing a behavior. With these three constructs, SCT offers a useful framework for studying individual behaviors related to health and the psychological mechanisms underlying behavioral choices and engagement.

In the context of physical activity, studies have shown self-efficacy, self-regulation, and outcome expectations to be malleable (Anderson, Wojcik, Winett, & Williams, 2006; Gist & Mitchell, 1992). By providing individuals with opportunities to strengthen their confidence to overcome barriers to physical activity, learn self-regulation strategies (e.g., goal setting, monitoring), and scaffold realistic expectations about one's physical activity engagement, in theory, one should be equipped with the tools needed to be successful. Key SCT constructs and evidence of their malleability are reviewed below.

Self-efficacy

Self-efficacy is one's belief in his or her ability to produce a particular outcome. Self-efficacy has been associated with the adoption and maintenance of physical activity behavior (McAuley & Blissmer, 2000). Also, interventions designed to enhance self-efficacy have been shown to be effective at increasing physical activity (Lee, Arthur, & Avis, 2008). Self-efficacy beliefs are domain-specific and are derived from four main sources of information: *mastery experiences*, *vicarious experiences*, *social persuasion*, and individuals' perceptions of *physiological and affective responses* to behavior (Bandura, 1977).

Mastery experience is the experience gained from attempting a new skill or task. It is theorized that mastery experience has the strongest influence on efficacy levels as it allows an individual to directly assess his or her abilities by attempting to complete a task (Bandura, 2004). In theory, if the individual is successful in his or her attempt, he or she will have a higher efficacy for that task. However, Williams and French (2011) reviewed physical activity-related self-efficacy and behavior and found other sources of information (e.g., vicarious experience and verbal persuasion) to have greater effects on self-efficacy change compared to mastery experience. Gao, Xiang, Lee, and Harrison Jr. (2008) have proposed that the sources of information are not mutually exclusive and may vary in their importance depending on certain time points. For example, within a beginning weightlifting class, Gao et al. found that once individuals mastered the basic movements of weightlifting, other sources of information (e.g., physiological change) became more salient. Interventions designed to enhance mastery experience via graded challenges, where the exercise prescription gradually increases over time, typically disregard one’s actual or perceived skill status. The intent of graded mastery is to promote physiological adaptations; however, such strategies have had negative effects on physical activity self-efficacy (Ashford, Edmunds, & French, 2010). It is important to ensure that one is proficient in their prescribed exercises, or at least feels confident in his or her status, before requiring more challenging exercises, particularly for individuals who are inexperienced with prescribed motor movements, equipment, etc. Rather than fixed prescriptions, it is likely more beneficial to provide low active individuals with more flexible goals (i.e. multiple ways to meet activity recommendations).

Vicarious experience is another important source of efficacy, particularly in the context of physical activity. It involves learning behaviors by imagining oneself successfully completing the behavior (symbolic modeling) or by watching other relatable individuals successfully complete the behavior (live modeling). It is important to note that according to theory, the success of vicarious experience depends upon people having similar lifestyles and having similar characteristics (e.g. age, gender, socioeconomic status) as the individual seeking to start a behavior (Bandura, 1977). Cumming (2008) tested the efficacy of symbolic modeling for promoting exercise-specific self-efficacy and found that individuals who imagined themselves becoming healthier and improving their physical appearance had higher levels of coping self-efficacy (e.g. confidence of ability to exercise when faced with barriers). In addition, higher levels of technique imagery were associated with task self-efficacy (e.g. confidence of ability to perform the exercise correctly). Live modeling as a means to enhance self-efficacy has also been tested in the context of physical activity by providing participants the relative progress of other participants in a similar age and health bracket (Lee et al., 2008). Specifically, Lee et al. (2008) used face-to-face and telephone contacts to encourage hypertensive, older adults to engage in a community-based walking intervention. Allender, Cowburn, and Foster (2006) found that older adults reported the lack of realistic role models (e.g. individuals similar to themselves who were successful exercisers) to be a barrier for exercise participation (Allender, Cowburn, & Foster, 2006). Researchers have also utilized videos for facilitating vicarious experiences among for cardiac rehabilitation patients and parents (Gortner & Jenkins, 1990; Gross, Fogg, & Tucker, 1995) and after viewing these videos, they increased levels of relevant behavior-specific self-efficacy for adhering to rehabilitation procedures and adopting new parenting skills. Thus, observing others similar to one's self successfully engaging in exercise can also facilitate similar increases in behavior-specific self-efficacy (Ashford et al., 2010; Warner, Schüz, Knittle, Ziegelmann, & Wurm, 2011).

Verbal persuasion, a third source of self-efficacy information, is defined as the external appraisal of one's ability to engage in a behavior. Bandura theorized that social persuasion is the least effective of all four sources of information because it does not provide additional learning information (Bandura, 1977). Indeed, both Ashford et al. (2010) and Williams and French (2011) conducted a systematic review of self-efficacy and physical activity and found that interventions which utilized verbal persuasion were associated with lower levels of self-efficacy and physical activity. This supports Bandura's theory that verbal persuasion, alone, may not be enough to enhance self-efficacy, but when used with other sources of information (e.g., mastery experience), more positive effects may be possible (Bandura, 1977). For example, in two studies, Wise and his colleagues tested the effects of verbal persuasion for increasing self-efficacy and found that providing verbal persuasion after mastering a single exercise was associated with enhanced efficacy levels (Wise, Posner, & Walker, 2004; Wise & Trunnell, 2001). Providing feedback on past or others' exercise performance, rather than simply providing verbal encouragement, has been effective at increasing self-efficacy levels (Ashford et al., 2010). The type of feedback provided can influence the relative impact of that the feedback on a person's behavior. For example, positive feedback from a trusted, credible source has been associated with increased physical activity behaviors (Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Gilliss et al., 1993). Moreover, feedback is most effective when it is provided in a timely manner, i.e., during or directly after the activity, and is contingent upon performance (Lee et al., 2008; Michie et al., 2011). It is important to note that the feedback provided must be realistic in order to increase the likelihood that one carries out the desired behavior (Bandura, 1997).

Physiological and affective responses are the fourth efficacy source. In the context of physical activity, perceptions of physiological change are likely to be integral to the development and maintenance of self-efficacy. Individuals starting a new exercise program may have negative interpretations of their body's response to exercise, such as muscle soreness, increased production of sweat, and breathlessness (Kwan & Bryan, 2010), which could result in lower adherence to exercise (Annesi, 2005). Fortunately, one's interpretations of their physiological response to exercise can be changed. Supporting this, Resnick (2002) conducted a study that addressed participants' pain, fear, and fatigue related to exercise before starting a walking program, with the aim to change older adults' physiological perceptions of exercise from negative (e.g., unfit for exercise) to more favorable (e.g., improvements in their health over time). Findings revealed lower levels of perceived stress and negative emotional states that were initially associated with exercise participation. Affective responses during exercise also contribute to exercise self-efficacy (Kwan & Bryan, 2010; McAuley & Courneya, 1992). In one study, McAuley and Courneya (1992) had sedentary, middle-aged adults complete a submaximal cycle ergometer-graded exercise test and report their affective responses throughout the session, as well as self-efficacy pre- and post-test. Individuals who reported a more positive affective response and perceived less energy expenditure, also had higher exercise self-efficacy. In an experimental study, McAuley, Talbot, and Martinez (1999) manipulated exercise self-efficacy by providing participants with bogus feedback to create a high- and a low-efficacy group. The efficacy manipulation influenced affective response, with the high-efficacy group reporting more positive and less negative affect compared to the low-efficacy group. Similarly, Hutchinson, Sherman, Martinovic, and Tenenbaum (2008) conducted a study whereby efficacy scores were manipulated to be high or low and participants were asked to complete an isometric hand-grip task. The high-efficacy group found the task to be more enjoyable than the low-efficacy and control group, demonstrating greater tolerance of the task. Together, these findings suggest self-efficacy is malleable and may be targeted to enhance exercise-related affect. Moreover, having a strong sense of self-efficacy can motivate individuals to be more active. As individuals achieve physical activity-related goals, their efficacy beliefs should increase, and in turn, this should increase the likelihood of sustained physical activity behavior (Bandura, 1997).

Among the most effective efficacy-boosting strategies have been to provide vicarious experience, feedback, and learning opportunities for developing mastery as part of a lifestyle physical activity intervention (Ashford et al., 2010). However, it should be pointed out that persuasion (whereby others express support for an individual's capabilities) and graded mastery (where the target behavior becomes increasingly difficult) have been associated with lower levels of self-efficacy. If an individual has not yet "mastered" the initial behavior, this graded mastery, or constant increase in difficulty, may become problematic as the individual's skills may be insufficient and impair progress. Williams and French (2011) reviewed the most effective intervention techniques for changing physical activity self-efficacy and found similar results.

Specifically, they found that *planning* (specific detailed planning of when, where, and how to exercise), *feedback* (on past performance or compared to others' performance), and provision of *instruction* (how to perform the behavior and providing local places accessible for exercise) were associated with significantly higher levels of self-efficacy and physical activity. Indeed, graded tasks, where targeted behavior became incrementally more difficult, were associated with significantly lower levels of self-efficacy and physical activity. Together, these findings support the use of psychological strategies for increasing physical activity self-efficacy.

Structured physical activity interventions that integrate multiple sources of information have also been successful for enhancing exercise-specific self-efficacy and physical activity. For example, McAuley, Courneya, Rudolph, and Lox (1994) implemented an efficacy-promoting intervention for increasing physical activity among low-active, middle-aged adults via a 5-month supervised walking program. The primary focus of the program was to provide participants with self-efficacy information based upon the four primary sources. The results showed individuals who completed the program exercised more frequently, for longer durations, and for greater distances over the course of the program. Moreover, self-efficacy was a significant predictor of exercise behavior throughout the program. Designing an intervention to enhance self-efficacy by implementing methods that target all four sources of information (as opposed to targeting a singular source), appears to be an effective framework for enhancement of self-efficacy and physical activity.

When considering strategies for increasing self-efficacy it is important to understand the distinction between self-efficacy and perceived behavioral control. Specifically, self-efficacy refers to beliefs about one's ability to successfully complete a task, whereas perceived behavioral control refers to one's perceived degree of control over their personal ability to complete a task (e.g., external resources; Ajzen, 2002). Although both terms are attributed to the perceived control of behavior, it is possible to differentiate by identifying that control comes in two forms: internal control (e.g., personal ability and motivation level to complete a task) and external control (e.g., resources and factors available for completion of a task; Manstead & van Eekelen, 1998). To ensure that a study design is indeed assessing and enhancing self-efficacy, it is important that internal constructs (e.g., motivation, personal goals) rather than external constructs (e.g., resources available) are assessed for change. Likewise, when measuring self-efficacy, Williams and Rhodes (2016) argue that standard self-efficacy questionnaires reflect motivation rather than perceived confidence in one's abilities and suggest modifying efficacy measures themselves or including measures beyond self-efficacy, as there may be other contributors of motivation for health-related behaviors besides self-efficacy. By assessing one's motives and goals alongside self-efficacy measures, we are able to construct a more complete understanding of individual's exercise motives. Encouraging individuals to approach tasks as challenges to be mastered and to set personal goals, greater efficacy should be achieved. Facilitating the development and efficient use of self-regulatory skills and strategies should, in turn, increase the likelihood that an individual will carry out the intended behavior.

Self-Regulation

Self-regulation is the process of managing one's own thoughts, behaviors, and feelings in order to complete a desired behavior or task (Hofmann, Schmeichel, & Baddeley, 2012). Self-regulatory strategies are associated with sustained physical activity participation and several neural networks (Buckley, Cohen, Kramer, McAuley, & Mullen, 2014). Indeed, self-regulation is the behavioral manifestation of executive function, which has a reciprocal relationship with physical activity (Hall & Fong, 2007; Kaplan & Berman, 2010). Executive function, according to

Hofmann et al. (2012), consists of three main cognitive processes: working memory (maintenance and updating of relevant information), inhibition (controlling impulses), and multi-tasking (task-switching). These processes are important mechanisms for proper goal setting and processing of information and can influence high or low levels of self-regulatory behavior. It is thought that self-regulation is a limited resource (Nes, Roach, & Segerstrom, 2009) and with its limitations, self-regulation can be temporarily impaired at times due to factors such as cognitive load, environmental stressors, or alcohol and drug intoxication (Hofmann et al., 2012). Self-regulation and executive function are influential of one another and typically follow the same functional pattern (Kaplan & Berman, 2010). If too much strain from external stressors is placed on an individual, self-regulatory capacity can be hindered.

The relationship between executive function, utilization of self-regulatory strategies, self-efficacy, and physical activity participation has been previously studied (McAuley, Mullen, et al., 2011). Specifically, within a year-long exercise program, higher levels of executive function (e.g. task coordination and inhibition) and greater use of self-regulatory strategies at baseline were associated with higher levels of self-efficacy at week 3 of the exercise program, which in turn, was positively associated with adherence for the remaining 11 months of the study. More specifically, structural equation modeling showed that executive function and self-regulatory strategy use had indirect effects on physical activity participation through self-efficacy. It is possible there are also direct effects, given that engagement in health behaviors requires the ability to multi-task, inhibit habitual unhealthy behaviors, and set and achieve goals (Hall, Fong, Epp, & Elias, 2008). Goal-setting can facilitate behavior change by operationalizing short- and long-term actions, objectives, and plans. Self-regulatory strategies can aid in the success of meeting one’s goals and overcoming barriers. Bandura suggested that utilizing self-monitoring and goal-setting strategies and evaluating exercise behaviors are essential for maintaining a physically active lifestyle (Bandura, 1997, 2004). In order for these self-regulatory strategies to be effective for sustained behavior, individuals must be confident and motivated to exercise.

Outcome Expectations

Outcome expectations are the anticipated physical, social, and self-evaluated outcomes of a behavior (Bandura, 1997). Physical outcome expectations are the expected pleasant and unpleasant perceptions associated with physical activity engagement. Movements and exercises that are expected to be more pleasurable and painless will preside over unpleasant, painful behaviors. For example, an inexperienced exerciser is likely to choose a leisure bike ride over completing a submaximal graded bike test. Social outcome expectations include the anticipated degree of support for the behavior from the individuals' personal relationships. Accordingly, if an individual's family or friends explicitly approve of the exercise behavior (by showing interest and support), then the individual is more likely to continue to engage in exercise. Social outcome expectations also include the potential rewards, acknowledgements, and status associated with exercising. Finally, self-evaluated outcome expectancies are one's expected positive and negative reactions to physical activity based upon self-set standards. In this instance, individuals who have higher self-worth and satisfaction from being physically active will be more likely to continue exercising. Not surprisingly, the formation of positive expectations that outweigh any negative expectations, in theory, should facilitate physical activity motivation.

Inflated outcome expectations at the start of an exercise program can have detrimental effects on initiation and maintenance of physical activity. Specifically, the expectancy-value theory suggests that perceived satisfaction of actual outcomes may be predictive of maintaining behaviors long-term (Williams, Anderson, & Winett, 2005). The expectancy-value theory states that individuals form attitudes towards various actions or choices and ultimately choose the action associated with the most positive (or least negative) attitude (Abelson & Levi, 1983). An individual's choice is also based upon his or her perceived value of the outcome, as well as the subjective probability that the outcome will occur (Edwards, 1954). When one's expectations fail to match one's interpretation of the experience, this is known as expectancy violation (Sears & Stanton, 2001) or false hope syndrome (Polivy & Herman, 2002). In one study, Desharnais, Bouillon, and Godin (1986) examined whether expectancy violation and self-efficacy serve as predictors of adults' adherence to an exercise program. Outcome expectation was assessed by asking participants to what extent they expected that attending the program regularly would lead to a variety of outcomes (via a list of 16 commonly listed benefits of regular exercise), as well as to what extent the participant valued each outcome. Self-efficacy expectation was assessed by asking participants to what extent they expected to be able to attend the program regularly until its completion. Results showed that adherence was predicted by self-efficacy and outcome expectations and study dropouts had lower self-efficacy expectations at the start of the program and expected greater benefits from participating in the program.

To further study the relationship between expectancy violation and physical activity, Sears and Stanton (2001) conducted a prospective study examining expectancy-value constructs (predictions about future behavior) and expectancy violation (predictions about future behavior and actual past behavior) as they related to exercise adherence in a sample of low active women. The researchers identified expectancy violations to be predictive of program dropout and termination of exercise over time. Specifically, women who had high initial expectations at the start of the exercise program were more likely to have violated expectations and discontinue the exercise program. Designing interventions that aim to help participants form higher self-efficacy beliefs and realistic outcome expectations, at the start of an exercise program, may be one strategy to promote greater adherence.

Testing the Social Cognitive Theory Model

Interventions designed to enhance multiple SCT constructs, rather than targeting one construct, may be more effective for increasing physical activity behavior (Williams Anderson, & Winett, 2005). In order to test this, we must first understand how SCT constructs influence one another. Researchers have tested the SCT model to gain a more comprehensive understanding of the interrelationships among SCT constructs. Specifically, White, Wójcicki, and McAuley (2011) conducted a longitudinal study examining SCT influences on physical activity behavior in middle-aged and older adults over the course of 18 months. The results of the study revealed that physical activity was both directly and indirectly influenced by self-efficacy via outcome expectations. Gothe (2018) also conducted a longitudinal study among Urban African American adults and older adults to examine how SCT constructs predict physical activity behavior over the course of seven days. Again, the results showed physical activity to be directly and indirectly influenced by self-efficacy through outcome expectations. As evidence by these data, perhaps short-term change is just as impactful as a longer-term design. In a church-based program, Anderson et al. (2006) found similar results, indicating higher self-reported self-efficacy, self-regulation, and social support were related to increased physical activity (self-reported), with self-regulation showing the greatest association with self-efficacy and physical activity. Although it is important to note that these studies did not assess how changes in these constructs may influence exercise behavior. To test this, Anderson, Winett, Wojcik, and Williams (2010) conducted a 12-month online, module-based, SCT-guided randomized controlled trial for increasing physical activity levels (via pedometer step counts) and promoting proper nutrition. The modules aimed to enhance constructs of SCT (self-efficacy, self-regulation) needed for behavior change (eat healthier foods and increase physical activity levels throughout their daily lives). They found that changes in nutrition and physical activity levels were mediated by changes in self-efficacy, self-regulation, and social support were associated with increased physical activity levels.

Behavioral interventions that have utilized motivational and behavioral strategies to enhance self-efficacy, self-regulatory skills, and outcome expectations have been successful for increasing physical activity levels among both healthy adults and adults living with chronic diseases (Knittle et al., 2018; Teixeira, Carraça, Markland, Silva, & Ryan, 2012). Self-efficacy can serve as a mediator, driving the effects between other SCT constructs and exercise behavior. Specifically, interventions that aim to enhance self-regulatory strategy-use have been successful for increasing physical activity, but only among individuals with high self-efficacy levels (Luszczynska & Haynes, 2009; Luszczynska, Schwarzer, Lippke, & Mazurkiewicz, 2011). Implementing planning exercises for behavior change alone may not be enough to achieve self-initiated goals long-term. For example, Koestner et al. (2006) tested whether a combination of goal implementation plans with a self-efficacy-promoting exercise (where participants reflected on their past mastery experiences, vicarious experiences, and social support) might facilitate goal progress. They found that when goal implementation plans include autonomy support and strategies for increasing self-efficacy, undergraduate students acquired more progress towards their goals than when self-efficacy-promoting strategies were absent from their plans. Although the influence of self-efficacy is thought to be strongest at the start of an exercise program, McAuley and Mihalko (1998) have suggested that low active adults' inexperience with exercise does not provide an appropriate frame of reference for evaluating their confidence, resulting in inaccurate estimations of their self-efficacy at baseline. Upon initiating a new exercise program and acquiring additional experience, research suggests that adults adjust their beliefs (McAuley, Mailey, et al., 2011). Specifically, McAuley and his colleagues (2011) tested this theory by assessing physical activity-related self-efficacy at various time points across a year-long, structured, supervised walking program. Among the self-efficacy beliefs assessed, lifestyle physical activity was included and was assessed at baseline (prior to the start of the exercise program), three-weeks after starting the exercise program, and again at the 6- and 12-month follow-up points. Consistent with McAuley's hypothesis, efficacy scores declined from baseline to the three-week point, when participants had more experience to inform their beliefs. Interestingly, the three-week efficacy score was either maintained or increased at the 6-month mark, suggesting self-efficacy enhancement through exercise participation. Although the mechanisms for enhancing and sustaining self-efficacy levels throughout the length of an exercise program are not fully understood, it appears that efficacy declines occur within the first three weeks of starting an exercise program. Thus, in order to enhance self-efficacy, and in turn, increase physical activity levels, it may be most beneficial to provide an intervention that aims to enhance self-efficacy at or before this crucial point in time.

Individual Factors that Influence Physical Activity

When designing physical activity interventions, it is important to consider individual differences. For example, prior exercise experience and general health knowledge (Dishman, Sallis, & Orenstein, 1985; Lee & Laffrey, 2006; Sallis et al., 1986; Sallis & Hovell, 1990; Williams et al., 2008), social support (e.g., spousal, friend, or participant support; Bauman et al., 2012; Dishman et al., 1985; Lorentzen, Ommundsen, & Holme, 2007; McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003), and health status (e.g. obesity, high BMI, or presence of chronic disease; Dishman, 1982; Dishman et al., 1985; Sallis & Hovell, 1990; Schutzer & Graves, 2004) have been predictive of physical activity participation. Indeed, age can influence the effectiveness of intervention techniques for increasing physical activity levels. Behavior change techniques that are typically successful among young and middle-aged adults (e.g. goal setting, self-monitoring, performance feedback), can be ineffective among older adults (French & Sutton, 2010). Additionally, intervention characteristics (e.g. longer duration, face-to-face contact, and multiple intervention strategies used) may influence the effectiveness of an intervention (Fjeldsoe et al., 2011). Intensities that are too strenuous can increase perceived exertion levels among those who are overweight, less fit, or less experienced, and may cause one to appraise their physical activity experiences as negative (Dishman et al., 1985). When a negative experience occurs (e.g. discomfort), participants are more likely to discontinue participation (Oldridge et al., 1983) whereas positive experiences have been shown to increase individuals' attention to cues which guide their daily decisions to continue their engagement (Van Cappellen, Rice, Catalino, & Fredrickson, 2018). Thus, providing individuals with a treadmill assessment that is informative (to offer self-awareness and experience) and optimally challenging (to ensure neutral or positive perceptions and avoid negative perceptions) may facilitate future physical activity participation. There are hundreds of studies on acute exercise-induced affect and therefore, plenty of evidence-based protocols for maximizing affect during a brief, moderately-paced treadmill exercise. Indeed, positive post-exercise perceptions have been attained even among low active, overweight populations (Focht, 2013). The key is to monitor the session and listen to the needs of the participant. That said, it should be noted that initial attitudes towards physical activity may also influence one's physical activity experiences (Wang, 2011; Zenko, Ekkekakis, & Ariely, 2016). Therefore, attitudinal measures (e.g., anticipated negative affect, forecasted pleasure) should be administered and used to adjust for any baseline differences that could limit the impact of such an intervention.

Effective Intervention Methods for Behavior Change

Exercise interventions rooted in SCT have been successful for increasing physical activity (Keller et al., 1999; Young et al., 2014). Still, it is important to consider the most effective intervention methods for promoting exercise participation and delivering the theory-guided content of the intervention for working adults. Among working adults, lifestyle physical activity offers greater flexibility and opportunities to engage in exercise compared to more structured programs. Providing programs and promoting exercise that is focused on the needs of the individual can increase the likelihood of sustained behavior change (Marcus, Bock, et al., 1998), such as reducing the amount of time it takes to complete the behavior change program for working adults with limited free time. Providing a brief, individualized behavioral program that can be completed remotely, followed by a flexible physical activity prescription, may help adults in overcoming the time barrier that is preventing them from reaching their exercise goals.

Lifestyle Physical Activity

Lifestyle physical activity, defined as the daily accumulation of at least 30 minutes of moderate to vigorous intensity of self-selected activities, have been successful for increasing physical activity among low active adults (Dunn et al., 1998). Unlike structured, supervised programs, lifestyle physical activity takes into account individual and environmental differences and facilitates flexibility in leisure-time physical activity engagement. Specifically, interventions that include lifestyle physical activity offer more options and opportunities to individualize their physical activity programs to fit their own lives. Dunn et al. (1998) reviewed lifestyle physical activity studies ranging from 2 weeks to 18-months in length and found that lifestyle physical activity seems to be effective at getting adults to meet the public health guidelines. Moreover, studies that utilized behavior change theories were most effective for increasing physical activity. In another lifestyle physical activity study, Opdenacker, Delecluse, and Boen (2011) examined the effects of lifestyle physical activity versus a structured exercise intervention in older adults and found that at 23 months, participants in both groups showed improvements in cardiorespiratory fitness and the lifestyle activity group showed long-term improvements in functional performance (assessed via arm curl test, chair stand test, and blood pressure). The results of these studies suggest that interventions that promote lifestyle physical activity may provide similar health benefits as structured aerobic exercise programs.

Lifestyle physical activity interventions that specifically promote walking have also been successful for increasing physical activity. For example, Opdenacker, Boen, De Bourdeaudhuij, and Auweele (2008) tested the efficacy of a 6-month lifestyle physical activity intervention for rural women. The intervention included one 90-minute group meeting that provided the recommendations for moderate and vigorous physical activity, goal setting and self-monitoring exercises, and discussions of barriers to exercise followed by a 6-month home-based program with minimal contact from research staff. Physical activity was measured at baseline and at 6-month follow-up with the intervention group showing greater use of the behavioral strategies provided during the group meeting as well as increases in objectively measured physical activity. In addition, Bravata and colleagues (2007) conducted a systematic review measuring the use of pedometers at-home for promoting physical activity among adults receiving disease treatment but not currently admitted to a hospital, and found that the use of pedometers is associated with increases in physical activity levels, as well as decreases in BMI and blood pressure. Bock, Jarczok, and Litaker (2014) conducted a more recent review of programs that promote lifestyle physical activity and found that of the 55 studies included, half of the studies reported positive physical activity outcomes (net percent change: 16.4%; p=0.159). Moreover, interventions that utilized face-to-face or in-person group sessions (net percent change: 35.0%; p=0.014) or were tailored to specific populations, like women (net percent change: 27.7%; p=0.005) or specific ethnic groups (net percent change: 38.9%; p=0.034), were most effective, suggesting that interventions that utilize tailored approaches are most promising. Together, these findings suggest that lifestyle physical activity, specifically walking, appears to be adequate and attainable form of exercise for individuals with little exercise experience.

Tailored Interventions

Tailoring can be defined as implementing theory-based strategies in order to meet the needs of one individual, using characteristics of the individual that are related to a particular behavior (Kreuter, Farrell, Olevitch, & Brennan, 2013). Unlike traditional, problem-focused interventions developed to enhance a group's physical activity levels, tailored interventions are data-driven and dependent upon participants' responses which inform intervention approaches and strategies. Lustria, Cortese, Noar, and Glueckauf (2009) conducted a review of tailoring methods for promoting health behavior and indicated that tailored messages were most commonly generated through the assessment of individuals' daily health behaviors and stages of change. Lustria et al. also found that behavior change techniques which enhance self-regulation, engagement, and psychosocial processes seem to be most effective for health behavior change. Additional reviews of tailored interventions found that both web-based (g = 0.17; Krebs, Prochaska, & Rossi, 2010) and printed messages (d = 0.12; Noar, Benac, & Harris, 2007) are effective for a variety of health behaviors, including physical activity.

The most common tailored physical activity interventions have been guided by the Transtheoretical Model (TTM)'s stages of change (Bock, Marcus, Pinto, & Forsyth, 2001; Kroeze, Werkman, & Brug, 2006; Marcus, Owen, Forsyth, Cavill, & Fridinger, 1998), whereby individuals move through six stages of change and each stage requires different intervention strategies for promoting behavior change. These interventions are most commonly delivered via informational pamphlets by mail (Bock et al., 2001; Marcus, Bock, et al., 1998; Marcus, Owen, et al., 1998; Pekmezi et al., 2016) or through internet (Alley, Jennings, Plotnikoff, & Vandelanotte, 2016; Friederichs, Oenema, Bolman, & Lechner, 2016; Krebs et al., 2010; Rebar et al., 2016; Spittaels, De Bourdeaudhuij, Brug, & Vandelanotte, 2006; Spittaels, De Bourdeaudhuij, & Vandelanotte, 2007; Vandelanotte, Spathonis, Eakin, & Owen, 2007). In short, researchers survey a population, determine the individual's current stage of change, and then provide tailored, stage-matched exercise information to the individual. Although less common, tailored physical activity interventions that implement strategies to improve self-regulatory skills (self-monitoring and goal-setting; Bull, Kreuter, & Scharff, 1999; Keele-Smith & Leon, 2003) and motivation levels (Marcus, Bock, et al., 1998), rather than solely providing stage-matched advice, have been successful for behavior change. The results from these studies have identified individual factors that are predictive of sustained physical activity. For example, both Bock et al. (2001) and Pekmezi et al. (2016) conducted tailored physical activity randomized controlled trials, guided by SCT and TTM. For both studies, participants randomized to the intervention group received tailored messages that targeted deficiencies based upon participants responses to theory-based constructs (e.g. self-efficacy, barriers to physical activity). Individuals randomized to the control group received a standard, print-based intervention. Physical activity was assessed at 6-months and 12-months post-intervention, respectively. Bock et al. found that participants in the tailored group met or exceeded exercise participation goals (meeting the physical activity recommendations of 150 minutes of aerobic activity per week) at the end of the intervention and at 6-months post-intervention relative to the non-tailored group. Pekmezi et al. (2016) found social support, enjoyment, and outcome expectations to be predictive of physical activity at 12-months post-intervention, regardless of group. Another study by Keele-Smith and Leon (2003) tested the efficacy of a much shorter 5-week tailored education plus monitoring physical activity intervention for increasing adherence to the public health guidelines for adults (age 18-59). Individuals randomized to the education plus monitoring program (which included self-regulatory strategies intended to increase adherence) had higher levels of motivation and greater adherence to the physical activity recommendations compared to the individuals who were randomized to the monitoring only program. Additionally, a systematic review of interventions designed to promote walking found that interventions that tailored to peoples' needs (e.g., individualized counseling, integrating theory-guided measures) and programs delivered at the individual level (e.g., brief, individual advice) resulted in greater time spent walking per week (with average increases of 30-60 minutes per week), with studies ranging from 4 weeks to 12-months in length (Ogilvie et al., 2007). Taken together, it appears that tailored behavioral interventions are, at least to some extent, successful, when messages are framed to target the individual and psychological constructs associated with SCT are the focal point.

Researchers have begun to test the efficacy of using psychological "phenotypes" (Burgermaster, Contento, Koch, & Mamykina, 2018) and "exercise referral schemes" (Wade, Mann, Copeland, & Steele, 2019) for improving the tailoring of behavior change interventions. For example, one study assessed high school students' psychosocial characteristics related to behavior change as well as their responses to participating in a childhood obesity prevention intervention. Four psychosocial phenotypes emerged: “activated” (successful behavior changers with strong internal supports), “inspired” (motivated, but not fully successful behavior changers with some internal supports), “reinforced” (already engaging in the behavior and had strong family support), and “indifferent” (not interested in the behavior change and only did the behavior if family insisted). Each subgroup appeared to respond differently to the behavior change intervention (Burgermaster et al., 2018). Another study by Mullen et al. (2013) utilized multi-assessment profiling for predicting attrition among older adults in a 12-month exercise program. Based upon baseline assessments of functional performance and psychosocial measures, a latent profile analysis revealed two distinct groups relative to memory complaints, self-efficacy to overcome barriers to exercise, balance performance, and stair performance. The profiles were predictive of dropouts and completers of the program.

Assessing psychological determinants of physical activity prior to the start of an intervention can permit the classification of theoretically and empirically based “phenotypes,” depicting strengths and weaknesses. These profiles may be used to inform the development of tailored interventions. For example, assessing SCT-guided constructs (e.g. self-efficacy, self-regulation, and outcome expectations), with the aim of enhancing adults’ confidence, self-regulatory skills, and expectations prior to the start of a physical activity program, should result in greater physical activity engagement.

Technology-based Behavioral Interventions

Given the increasing number of health technologies available (e.g., wearable devices, health-tracking phone applications), technology-based interventions can provide instructional and motivational information to support physical activity behavior change programs, while utilizing a minimal number of resources (Boudreaux et al., 2014; Kaplan & Stone, 2013; Shah, Weinborn, Verdile, Sohrabi, & Martins, 2017; Sullivan & Lachman, 2017; Yang, Maher, & Conroy, 2015). Telehealth interventions, in which health-related services and information are distributed via telecommunication technologies (e.g. computers and mobile devices), have become increasingly popular for improving care in chronic disease prevention and management (Mayo Clinic, 2017). Although face-to-face health care may be preferred by some patients for chronic disease self-management, psychotherapy, education, and group support, committing to such treatment can also present barriers to compliance and success. Specifically, distance and transportation issues can prevent individuals from scheduling and keeping appointments. Travel simply adds the burden of time, a limited resource in high demand among working adults. Thus, telehealth may be used to provide services remotely and reduce these barriers. Indeed, the scientific literature supporting telemedicine, and specifically videoconferencing, has mainly focused on clinical patients with pain and mobility issues, as these are burdens that make it difficult to attend in-person appointments (Bennell et al., 2017; Klaren, Hubbard, & Motl, 2014; Tsai et al., 2017). For example, among patients with mental health issues, Backhaus et al. (2012) found that videoconferencing is generally associated with user-satisfaction and has comparable effects on clinical outcomes relative to traditional face-to-face psychotherapy. Similarly, Banbury, Nancarrow, Dart, Gray, and Parkinson (2018) found that health professional-led videoconferencing (group education or social support) was feasible for individuals with a wide range of digital literacy who expressed little concern for privacy issues. Moreover, the authors found that this delivery format can provide sufficient information for the development of health knowledge, insight, and skills compared to face-to-face delivery. Together, these reviews support the use of videoconferencing among populations with chronic disease and mental health issues.

Although limited, some evidence exists for the use of videoconferencing in promoting physical activity. For example, Klaren, Hubbard, and Motl (2014) tested the efficacy of a 6-month behavioral intervention for reducing sedentary behavior (by increasing physical activity) in people with multiple sclerosis (MS). Participants in the intervention group received one-on-one Skype video chats that provided SCT-based skills and strategies for engaging in physical activity and reducing sedentary behavior. The Skype sessions were semi-scripted and consisted of SCT-based information including goal setting and planning (e.g., identifying opportunities to move more throughout the day). Those who received the Skype-based behavioral intervention successfully reduced sedentary behaviors by more than 1.5 hours compared to the waitlist control group. These results support the delivery of SCT-guided video conferencing for promoting health behavior change. It is important to note that videoconferencing has typically been implemented via computer-based programs and additional flexibility in hardware/software (e.g. apps) and information technology (IT) training may result in more favorable outcomes. Indeed, telemedicine could benefit healthy populations too, who may find it difficult to attend appointments due to work or family commitments.

In addition to videoconferencing, telehealth interventions that are delivered through other connected mobile devices have been effective for managing chronic disease (Neubeck et al., 2009) and promoting physical activity (Stephens & Allen, 2013), although, it is important to note that most of these studies have utilized short message services (SMS or text messaging) and this is likely responsible for their success. Bort-Roig, Gilson, Puig-Ribera, Contreras, and Trost, (2014) reviewed the effects of smartphone technology and found that smartphone apps that included SCT-based features, such as self-monitoring (e.g. providing physical activity profiles and real-time feedback) and goal-setting were successful for promoting physical activity.

Specifically, Tsai et al. (2007) provided graphical feedback of user's daily physical activity and developed profiles through a Patient-Centered Assessment and Counseling mobile phone application. Participants in the study reported that being able to self-monitor their activities and goals in real-time served as a form of motivation throughout the study. Indeed, goal-setting is another way to promote physical activity. For example, studies that utilize smartphone applications that either provide opportunities to set personal goals (e.g. meet a certain number of steps; Årsand, Tatara, Østengen, & Hartvigsen, 2010) or are provided with automated goals (e.g. increase step count per week; Fukuoka, Lindgren, & Jong, 2012), were reported by participants to be useful engaging in physical activity. To further explore smartphone technology for promoting physical activity, Rabin and Bock (2011) recruited 15 low-active adults to test three publicly-available smartphone physical activity apps (SPAAs) and to provide their feedback and user preferences. The results showed that the low-active adults prefer apps that provide features consistent with constructs of the social cognitive theory: promoting goal setting, overcoming barriers to physical activity, and providing behavioral reinforcement. Similar to typical, face-to-face health behavior interventions, technology-delivered interventions that utilize theory-based strategies appear to have some success for promoting physical activity. Indeed, Fanning, Mullen, and McAuley (2012) found that mobile devices are an effective platform for influencing physical activity behavior but emphasized the need for theoretically grounded behavior change interventions to optimize efficacy and leverage the full potential of technology.

Although telehealth interventions appear to be an effective method for promoting physical activity, it is important to consider factors that may hinder the success of tech-delivered interventions, including the technological preferences and beliefs of the participants. For example, Downs et al. (2018) interviewed overweight and obese rural women who reported advantages and disadvantages to using smartphones for health behavior change. Participants identified advantages to be that smartphones are convenient, useful, and can provide social support, whereas disadvantages include annoyances and needed IT support when technological issues arise. Moreover, upon completing the interview, improvements were found in participants' willingness to use a smartphone in health behavior change interventions. In a related study, targeting people with chronic obstructive pulmonary disease, Tsai et al. (2016) found that aside from some difficulties with internet connection, overall, the participants had high user satisfaction with the home-based videoconferencing exercise program coupled with health benefits from program engagement. Although there are some barriers that may arise when utilizing smartphones in health behavior interventions, it appears that these barriers can be addressed by providing information to successfully use the app (e.g. in-person instructions for downloading the app) and by providing IT support when needed.

Altogether, there seems to be sufficient evidence that the use of smartphones and videoconferencing for delivering health behavior interventions are generally accepted by those who partake. Given the high prevalence of smartphones in the United States and the emergence of free video smartphone apps with intuitive interfaces (e.g. Skype, Google Duo), videoconferencing is becoming a ubiquitous form of communication. In theory, utilizing videoconferencing via smartphones should minimize the barriers typically associated with physical activity interventions, while still providing face-to-face, personalized instruction and guidance.

Brief Interventions

Brief interventions have been successful for increasing physical activity behaviors. For example, Godin, Bélanger-Gravel, Amireault, Vohl, and Pérusse (2011) conducted a brief, 20-

minute intervention, involving only the completion of a theory-guided questionnaire. The experimental group received questions which assessed self-perceptions (beliefs, attitudes, norms, perceptions of control, and intentions) and participation in leisure-time physical activity. The control group was asked to complete the same number of questions but they were related to fruit and vegetable consumption. Both participants and interviewers were blind to the purpose of the study and the study was presented as a study on motivation. At the three-month follow-up, those who completed the leisure-time physical activity-focused questionnaire reported greater engagement in physical activity compared to the control group. The results of this study support the "mere-measurement effect," where completion of a self-evaluative questionnaire can enhance awareness, promote self-reflection, and actually change behavior. Self-evaluation is believed to enhance awareness of one's behaviors and increase the likelihood of a favorable response (French & Sutton, 2010; van Sluijs, van Poppel, Twisk, & van Mechelen, 2006). Although the exact mechanism behind mere-measurement is not fully understood, it is possible that providing individuals with physical activity intention or efficacy questions can result in feelings of regret about not being physically active, energizing efforts to be more physically active. Although the mere measurement effect for physical activity is small (d = 0.20), the results of this study suggest that it may be possible to facilitate self-reflection for promoting physical activity behaviors in a short period of time. Providing individuals with information about SCT constructs through an individualized, home-based, video chat session may result in greater participant awareness, and thus, greater behavior change.

The social-cognitive framework has been used for developing brief physical activity interventions for individuals who feel they cannot dedicate a lot of time to being physically active. For example, Mailey and McAuley (2014) implemented a brief physical activity intervention for working mothers using programs guided by SCT. The program included two, 2-hour group meetings that taught behavior modification strategies to increase activity levels. The meetings aimed to enhance self-efficacy via the four sources of SE, outcome expectations via group discussion of exercise benefits, and self-regulation strategies via goal setting. The intervention included two workshops and one personal training session and physical activity was tracked via accelerometers for six months. Participants who received the intervention exhibited short-term increases in physical activity ($d = 0.44$; $p < 0.05$), but few participants exhibited sustained activity after six months ($d = 0.08$; $p < 0.05$).

The workshop methods used by Mailey and McAuley can be modified and condensed. For example, their program focused solely on working mothers who have a significant number of perceived barriers to exercise. However, this brief form of intervention may be useful for all working adults who do not perceive themselves as having enough time to incorporate exercise into their lives due to a multitude of barriers. Social support was a key factor in Mailey and McAuley's intervention design and the researchers heavily relied on group workshops to deliver information to the participants. However, social support may not always be available or warranted for working individuals who want to get involved with a physical activity program.

Brief interventions designed to enhance exercise-specific psychological skills and motivations may "free up" more time to exercise, resulting in greater adherence. To test this idea, Gardiner, Eakin, Healy, and Owen (2011) conducted a brief, 45-minute SCT-guided intervention consisting of face-to-face goal-setting consultation among older adults. The brief intervention resulted in reduced sedentary time and increased physical activity levels over the course of six days for previously low active older adults. However, Gardiner et al. did not include any additional follow-ups to assess sustained impacts of this brief behavioral program. Indeed, many physical activity interventions have been successful at increasing activity levels, but sustained behavior change post-intervention is rarely examined.

In an attempt to understand whether brief interventions can increase physical activity, Lamming et al. (2017) conducted a systematic review of reviews examining the effectiveness of brief interventions (30 minutes of less) for promoting physical activity within primary care consultations. Overall, it appears that brief interventions can increase physical activity over short durations (4 to 12 weeks); however, this is based upon studies that include inconsistent measures of self-reported physical activity. The review showed insufficient evidence about the long-term effects of brief interventions, and limited evidence is available about the factors that influence intervention effectiveness, feasibility, or acceptability. Of the studies reviewed, the most common method was a brief (5-minute) session that provided advice or encouragement from a physician and it is important to note that these sessions were not based on theory. Moreover, there was insufficient evidence to determine the impact of brief interventions on objectively measured physical activity, as these primary care consultations rely on self-reported activity levels. Indeed, it appears that exercise programs may not be as effective for promoting changes in health outcomes when prescribed during a primary care consultation. For example, Wade, Mann, Copeland, and Steele (2019) tested whether exercise referral schemes (ERSs) were associated with changes in health and wellbeing among 23,731 participants in the United Kingdom. An ERS occurs when a primary care professional refers a patient with a chronic disease into an exercise intervention. After assessing health and wellbeing outcomes (e.g. body mass index, blood pressure, resting heart rate, and wellbeing, exercise related quality of life, and exercise self-efficacy questions), the results showed no change in these outcomes for patients who have undergone an ERS for more than six weeks.

Together, these findings show uncertainty about the effectiveness of brief interventions, due to the heterogeneity in study methods and lack of reliable activity measures. Implementing brief intervention designs that are guided by theory and use objective measures for tracking activity levels is necessary for understanding the effectiveness of brief interventions for increasing physical activity. Before we can begin to test the efficacy of brief interventions for longer periods of activity, we must first understand the extent to which a brief, theory-guided intervention works for shorter periods, with objectively measured exercise.

The Present Study

Physical activity is associated with a reduced risk of mortality and morbidity. However, approximately 50% of American adults are insufficiently active to receive the benefits of regular aerobic physical activity. Long work hours and a preference for sedentary leisure-time activities has resulted in a highly low active, aging adult population, with 60% of older adults living with two or more chronic conditions (Office of Disease Prevention and Health Promotion, 2017). To prevent the development of chronic disease among healthy individuals and reduce the number of symptoms that exist for those living with chronic disease, low active adults need to adopt and maintain physical activity behaviors. The present study aimed to test the feasibility and efficacy of a brief, technology-delivered behavioral intervention that provides individuals with the opportunities to enhance their confidence for engagement in lifestyle physical activity.

This study intended to extend the existing physical activity literature and interventions that have been framed by SCT. Time-intensive, highly supervised randomized controlled trials guided by SCT have been successful in promoting short-term changes in physical activity, but less is known about the extent to which these changes can occur in the context of a less time-intensive technology-delivered intervention involving less supervision. This brief, SCT-guided study examined the feasibility and acceptance of such an approach, in addition to testing effects on social cognitive outcomes and lifestyle physical activity engagement, upon completion of interactive video chats delivered via smartphone. In addition, this study was designed to test the extent to which objectively-measured physical activity levels are explained by changes in these social cognitive factors. According to theory, self-efficacy should increase with repeated exposure to a behavior, like physical activity, but this is not typically the case, as evident by McAuley and colleagues (2011). Indeed, McAuley and Mihalko (1998) have suggested that individuals may not have sufficient experience or exposure to accurately form efficacy beliefs at the start of an exercise program. Given that most low active adults report time as a primary barrier to engaging in healthy behaviors, this study utilized brief, interactive video chat communications to circumvent this issue with a population of low active, working adults.

Chapter III: Methods

Low active, full-time working adults (n=72; 25-64 years of age) were recruited from the Champaign-Urbana community to participate in a 6-week intervention consisting of baseline assessments, brief technology-delivered interactive video chats (at the conclusion of week one, two, and three), and engagement in lifestyle physical activity. Full-time employed adults (defined as working at least 35 hours or more per week) were targeted. Recruitment was conducted through listserv announcements through the local university, individuals who requested to be contacted after completing a brief survey about physical activity engagement, and word of mouth throughout the community. Recruitment began in April 2019 and concluded mid-July, with the last data collection occurring on September 15, 2019. Individuals interested in participating contacted research staff through an online survey and/or through the provided phone number or email address. Interested individuals then completed a telephone screening to assess eligibility and those who qualified were asked to sign a consent form and complete in-person baseline assessments. During this appointment, all participants completed a 30-minute treadmill assessment where they were asked to walk at a moderate-intensity (assessed via heart rate). Participants were also asked to complete a brief battery of psychosocial assessments and wear a Fitbit device (temporarily provided by the lab) for seven days. Participants were then provided with information for engaging in lifestyle physical activity (e.g. meeting the current 2018 aerobic physical activity guidelines of a minimum of 150 minutes of moderate intensity per week). At the end of the session, participants were instructed on how to install and use a video chat application (app) on their smartphone called, “Google Duo.” The app is available as a free download on both the Android and iOS systems. Participants were asked to engage in lifestyle physical activity for the next six weeks, with the video chat intervention occurring at weeks one, two, and three.

During the first three weeks of the study, participants randomized to the intervention group completed three, 10-minute interactive video chats (one each week) that aimed to provide SCT-guided information for engaging in physical activity. Participants randomized to the control group used the app to engage in three interactive video chats with research staff. Although the topics were of similar length and framed by SCT (focusing on outcome expectancies, sources of self-efficacy, and self-regulatory strategies in weeks 1, 2, and 3, respectively), the topics of conversation were centered around balancing work, family, and hobbies—all topics unrelated to physical activity engagement. Before and after each video chat, all participants, regardless of group, were asked to complete a brief survey that was texted to their smartphone. Participants were also asked to wear the Fitbit device continuously while engaging in lifestyle physical activity for six weeks (weeks 2-7). During week eight, participants were asked to complete an online follow-up survey and return their Fitbit to the laboratory at which time they were asked to complete questions assessing feasibility and acceptability of the study.

Inclusion and Exclusion Criteria

Adults who met the inclusion criteria were between the age of 25-64, low active (defined as not participating in exercise for 2 or more days per week for >30 minutes over the past 3-months), willing to be randomized to any condition, willing to complete the in-person and home-based program, and must have owned an iOS or Android smartphone (to assess physical activity via the Fitbit app). Exclusionary criteria included being unable to speak or read English, having a cognitive impairment (assessed via the modified Telephone Interview for Cognitive Status (TICS) task (Knopman et al., 2010); TICS score less than 21 resulted in exclusion from the study, or self-reported depressive symptoms (assessed via the Geriatric Depression Scale [GDS]; Hoyl et al., 1999); GDS score greater than 2 resulted in exclusion from the study. Finally, participants were excluded if they were unable to exercise at a moderate intensity level without causing or exacerbating a pre-existing condition (e.g. prior injury, surgical procedure, diagnosed health condition) which would have prevented participation in the exercise program. For an overview of the study, including the timeline and flow, refer to Figure 1.

Physical Activity Prescription

Each participant was instructed to engage in lifestyle physical activity upon completion of baseline testing. Lifestyle physical activity consists of accumulating at least 30 minutes of moderate intensity of self-selected activities per day. Within this study, participants were asked to increase their physical activity behavior with the goal of reaching a minimum of 150-minutes of moderate-intensity aerobic physical activity per week, per the ACSM Physical Activity Guidelines (CDC, 2017c). Participants were provided with a Fitbit device that was worn for seven consecutive days prior to the start of the study and throughout the course of the following six weeks.

Participants were asked to complete interactive video chats at week one, two, and three and complete a brief online survey prior to and upon completion of each video chat. The survey consisted of questionnaires that assess changes in self-efficacy for lifestyle physical activity and work-life balance.

Experimental Design

General Overview

All participants, regardless of group, completed baseline assessments that took place at a location on the University of Illinois at Urbana-Champaign campus and three brief, interactive video chat sessions, were completed remotely, at a location of their choosing. Both the baseline assessments and the video chats were one-on-one with a research assistant and a participant. During the baseline appointment, the participant completed a 30-minute treadmill assessment and were provided with the information and smartphone applications needed to complete the study, including suggested goals to reach each week (150 minutes of aerobic activity per week; 30 active minutes, 5 days per week).

The aim of the treadmill assessment was to provide individuals with a standardized experience of engaging in 30 minutes of moderate-intensity aerobic physical activity prior to the start of the study. This was intended to make the physical activity prescription self-relevant and to harmonize participants' beliefs and goals with study objectives.

Randomization Procedures

Participants who signed the consent form, completed the baseline assessments, and wore the provided Fitbit device for seven consecutive days were randomly assigned to one of two groups: a group that received three, 10-minute SCT-guided interactive video chats related to physical activity, or a group that received three, 10-minute time-matched interactive video chats. A block-order random number generator was used to randomize participants into one of two groups.

Intervention Conditions

The intervention consisted of three brief SCT-guided interactive video chats to provide participants with skills and strategies needed to engage in six weeks of lifestyle physical activity (experimental group) or for having work-life balance (control group). The participants in both groups received different information during each video chat. The interactive video chats provided information relative to realistic outcome expectations (week 1), the four sources of self-efficacy (week 2), and specific strategies (e.g. goal-setting, planning and monitoring, and overcoming barriers). The information within each chat was developed based on previous studies guided by SCT. Specifically, content from Mailey and McAuley's study with full-time working mothers was adapted for this study. They utilized in-person, SCT-framed workshops designed to teach behavior modification strategies. The message was modified to target full-time working men and women, more broadly. Research assistants were trained to lead the interactive video chats and use scripts (> 5 hours each) for each theme using "mock phone calls" and extensive practice to ensured consistency and that research assistants knew how to adequately respond to participants who may have been more or less engaged, distracted, or reserved, to ensure conversations stayed within the allotted 10 minutes.

Experimental Group

Information was provided by a research assistant about what outcomes can be expected from participating in lifestyle physical activity and becoming more active. Physical, social, and self-evaluative outcome expectancies were discussed briefly, based upon Bandura's three major forms of outcome expectations (Bandura, 1997) and realistic, positive benefits of exercise were provided in order to identify more intrinsic motives for increasing activity levels (e.g. to feel better, to improve health), rather than extrinsic motives (e.g. to look better, to lose weight). During the second interactive video chat, the four sources of self-efficacy were discussed including: mastery experiences, vicarious experiences, social persuasion, and perceptions of physiological and affective responses to behavior. In order to discuss mastery experience, the research assistant reminded the participant of their prior experience engaging in 30-minutes of moderate-intensity physical activity via the treadmill assessment and asked the participant to assess whether they felt they could continue to engage in that amount of physical activity. The research assistant promoted vicarious experience by asking the participant to think about someone who is similar to themselves who is currently active and to envision themselves being sufficiently active (e.g. the treadmill assessment at baseline). The participant received social persuasion through positive feedback directly from the research assistant. Providing specific, positive feedback about the participant's behavior was implemented to encourage the participant to believe that he or she had the capability to continue to engage in the physical activity. Perceptions of physiological and affective responses to exercise were addressed by having the research assistant ask how the participant feels (both physically and emotionally) while exercising and working together to ensure that they had positive physiological and affective perceptions. During the third video chat, the research assistant and the participant discussed specific strategies (e.g. goal-setting, planning and monitoring, and overcoming barriers) for engaging in lifestyle physical activity. The research assistant provided brief explanations of goal setting and SMART goals (Bovend'Eerdt, Botell, & Wade, 2009), strategies for planning and monitor activity (e.g. adding exercise to daily calendar, keeping a journal), and methods to help participants overcome barriers to their activity-related goals. Each of the three interactive video chats were restricted to 10 minutes in length. The research assistant followed a semi-structured script to ensure participants received the same types of information in the same, thematically-arranged format.

Control Condition

The participants who were randomized into the control group were also asked to engage in three, 10-minute interactive video chats, but they did not receive any information relative to physical activity. Instead, the video chats provided information about realistic outcome expectations (week 1), four sources of self-efficacy (week 2), and specific strategies (week 3) relative to work-life balance. The control group received the same attention, time, social interaction, and theoretical components as the experimental group. Similar to the intervention group, the control group's interactive video chats were guided by a semi-structured script. The script provided the research assistant with questions and statements that were read to the participant and served as an aid to keep the conversation topics relevant (while avoiding discussions about physical activity). Regardless of group, participants were asked to complete pre- and post-assessments of self-efficacy for lifestyle physical activity and work-life balance via short surveys administered through participants' smartphones at the beginning and end of each video chat call.

Measures

Demographics

During the initial telephone screening, participants were asked to answer a series of demographic questions that included age, gender, income, race, ethnicity, employment status, marital status, and a brief health history questionnaire. Participants were told that they did not have to disclose any demographic information that they found to be too personal.

Physical activity: Fitbit Charge 3

Physical activity was objectively measured using the Fitbit Charge 3 activity and sleep tracker (Fitbit, San Francisco, California, USA). The Fitbit Charge 3 is a small device that measures all-day activity, distance, floors climbed, and sleep. The device is worn on the wrist and is attached with a wristband. The validity and reliability of Fitbit devices among healthy adults has been tested through treadmill walking and the Fitbit activity monitors appear to be valid and reliable devices for measuring step counts (Case, Burwick, Volpp, & Patel, 2015; Takacs et al., 2014). The participants were asked to wear the device for seven consecutive days

(24 hours/day) prior to the brief in-person session and upon completion of the in-person session, all participants were asked to wear the device for the entirety of the 7-week study. Participants were instructed to download the Fitbit app and were asked to regularly sync their device to their app. Each participant was provided a Fitbit account and data was collected via the app. Daily activity levels were assessed via the provided steps through the app. Fitbit data was collected for seven consecutive days prior to the start of the intervention program and for the entirety of the 7-week study. To account for missing Fitbit data, from noncompliance to the study protocol and equipment wear requirements, a minimum of three days per week of complete data was necessary to accurately estimate daily physical activity in adults (Hart, Swartz, Cashin, & Strath, 2011; Tudor-Locke et al., 2005). If three days were available for one complete week, the three days were averaged and imputed into the missing days for that particular week. In line with intention-to-treat analysis, if any participant had substantial missing Fitbit data (one week or more), established EM imputation procedures were used to allow for total and average computations (see data analytic procedures section).

Leisure-time Physical Activity

Self-reported physical activity was assessed via the *Godin Leisure-Time Exercise Questionnaire* (GLTEQ; Godin & Shephard, 1985). The GLTEQ is a brief, 4-item measure of physical activity that asks individuals to assess their current frequencies of engaging in strenuous, moderate, and light activities for at least 15 minutes per session during a typical week. Total weekly leisure activity is calculated by the equation: (9*strenuous) + (5*moderate) + (3*light). The second question assesses the frequency of weekly leisure-time activities that are done long enough for the individual to “work up a sweat”. The GLTEQ was assessed at baseline and post-intervention.

Sedentary Behavior

The *Sedentary Behavior Questionnaire* (SBQ; Rosenberg et al., 2010) was used to assess individual's self-reported sedentary behavior. The SBQ assesses the amount of time spent doing nine sedentary behaviors (watching television, playing computer/video games, sitting while listening to music, sitting and talking on the phone, doing paperwork or office work, sitting and reading, playing a musical instrument, doing arts and crafts, sitting and driving/riding in a car, bus, or train). The SBQ assesses sedentary time on a typical weekday and weekend day. Total sedentary behavior is calculated by recoding time reported into hours, then summing the total hours for all nine measures, for the weekday and weekend day. Weekly estimates are calculated by multiplying the weekday hours by (5) and the weekend day hours by (2), then summing together for total sedentary hours per week. Sedentary behavior was assessed in order to compare self-reported activity levels and was used as a comparison to the subjective activity measures.

Self-efficacy

The *Lifestyle Efficacy Scale* (LSE; McAuley et al., 2009) and the *Barriers-specific Self-efficacy Scale* (BARSE; McAuley, 1992) were used to assess self-efficacy. The LSE is a 6-item questionnaire that assesses an individual's belief in his or her ability to be physically active five or more times per week at a moderate intensity, for at least 30 minutes, for six months. The first item asks about their ability to do this for the next month, followed by 2-, 3-, 4-, 5-months, and finally, asking about their ability to do this for the next 6-months. A modified version of the LSE was used to reflect the length of the current study (e.g. six weeks). Each question is based on a confidence scale ranging from 0% (not confident at all) to 100% (highly confident). The LSE composite score is calculated by summing and averaging the 6-items, with higher scores meaning greater self-efficacy for lifestyle physical activity. The BARSE is a 13-item questionnaire, also modified to reflect current physical activity recommendations, that assesses an individual's belief in his or her ability to exercise five times per week at a moderate intensity for at least 30 minutes, for the next 6-weeks, when faced with common barriers to exercise participation. Each question is based on a confidence scale ranging from 0% (not confident at all) to 100% (highly confident). The BARSE composite score is calculated by summing and averaging the 13-items, with higher scores meaning greater confidence in overcoming exercise barriers. In recent studies, an abbreviated, 4-item version of the BARSE has been developed (see Mullen et al., 2011) had a high correlation with the original 13-item measure (r =.90).

Self-efficacy to regulate work and life (SRWL; Chan et al., 2016) was assessed via a 5-item scale that assesses how confident individuals are in regulating their work and non-work domains. The five items include: "How confident are you in changing your lifestyle to achieve a good work–life balance?" "How confident are you in finding out how to balance work and life?"; 3) "How confident are you in achieving your ideal work–life balance?" "How confident are you in implementing strategies to achieve work–life balance?" and "How confident are you in inventing ways to balance your work and life?" Responses to all items are based on a scale ranging from 0 (cannot do at all) to 100 (highly certain can do). The composite score is calculated by summing and averaging the five items, with higher scores indicating that individuals are more confident in their abilities to cope with work–life challenges.

Self-regulation

The *Exercise Planning and Schedule Scale* (EPSS; Rovniak, Anderson, Winett, & Stephens, 2002) was used to assess self-regulation. The EPSS is a 10-item questionnaire that assesses exercise scheduling and planning. Each question is based on a 5-point Likert scale, ranging from 1 (does not describe me) to 5 (describes me completely). The EPSS composite score is calculated by reverse-scoring items 2, 3, and 7 then summing and averaging the 10-items. Higher scores indicate more scheduling and planning done for exercise.

The *Physical Activity Self-Regulation Scale* (PASR-12; Umstattd, Motl, Wilcox, Saunders, & Watford, 2009) was used to assess the degree to which self-regulation strategies are used to support physical activity behavior. The PASR-12 is a 12-item questionnaire and each question is based on a 5-point Likert scale, ranging from 1 (never) to 5 (very often). The PASR-12 composite score is calculated by summing the 12-items. There are six subscales within the PASR-12 (calculated by summing the designated items): self-monitoring, goal-setting, social support, reinforcement, time management, and relapse prevention. Higher scores indicate greater strategy-use.

Measures of Expectations

The *Multidimensional Outcome Expectancies for Exercise Scale* (MOEES; Wójcicki, White, & McAuley, 2009) was used to assess outcome expectancies. The MOEES is a 15-item questionnaire that has three subscales: physical outcome expectancies, social outcome expectancies, and self-evaluative outcome expectancies. The MOEES assesses an individual's beliefs or expectations about the benefits of regular exercise. Each question is based on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Each subscale is scored by summing the total items, with higher scores being indicative of higher outcome expectations for exercise.

Affect

Affect was assessed via the *Feeling Scale* (FS; Hardy & Rejeski, 1989). The FS is internally consistent and stable, and consists of a single-item 11-point scale assessing feelings of pleasure-displeasure, ranging from -5 (very bad) to +5 (very good). Participants are asked how the exercise makes them feel (e.g. for this study, participants were asked about how they felt during their treadmill assessment). Participants responded by selecting from an 11-point scale. The FS is scored by based upon the number provided by the participant, with a possible range of -5 to +5, with higher scores indicating greater feelings experienced.

Anticipated negative emotions was assessed via the *Anticipated Negative Affect Questionnaire* (ANAQ; Wang, 2011). The ANAQ is a reliable measure with high internal consistency (α=.89) and asks participants to anticipate how they may feel not regularly participating in physical activity. The ANAQ consists of five bi-polar items including "relaxed/tense," "not guilty/guilty," "no regret/regret," "not angry/angry," and "displeased/pleased." The ANAQ scale ranges from 1 to 7, with higher scores indicating more negative emotions.

Forecasted pleasure was assessed via a single question "If you repeated the exercise session again, how do you think it would make you feel?" (Zenko et al., 2016). Responses are recorded using the *Empirical Valence Scale* (EVS; Lishner, Cooter, & Zald, 2008), where participants select from 15 empirically spaced anchors, ranging from -100 (most unpleasant imaginable) to +100 (most pleasant imaginable), with higher scores indicating more pleasant, imaginable feelings.

Stress

Job stress was assessed via the *Brief Job Stress Questionnaire* (BJSQ; Kawada & Otsuka, 2011). The BJSQ is a 15-item scale that has 4 subscales: evaluation of job demand, job control, support, and degree of job satisfaction. Each question is based on a 4-point Likert scale, ranging from 1 (disagree) to 4 (agree). Each subscale is scored by summing the total items (reverse scoring the job demand subscale), with higher scores being indicative of lower job stress.

General stress was assessed via the *Perceived Stress Scale* (PSS; Cohen, Kamarck, & Mermelstein, 1983). The PSS is a 10-item questionnaire and scores are obtained by reverse scoring on four positive items and then summing across all items. Each question is based on a 5-point Likert scale, ranging from 0 (never) to 4 (very often).

Work-life Balance

To assess work-life balance, the *Work-Life Balance scale* (WLB-6; Gröpel & Kuhl, 2009) was used. The WLB-6 is a 6-item questionnaire that measures perceived sufficiency of time available for work and social life. Each question is based on a 6-point Likert scale, ranging from 1 (completely disagree) to 6 (completely agree). The WLB-6 is scored by reverse coding select items and summing the total items, with higher scores being indicative of high work-life balance.

Perceived satisfaction

Physical activity enjoyment was assessed via the *Physical Activity Enjoyment Scale* (PACES; Kendzierski & DeCarlo, 1991). The PACES is an 18-item questionnaire and items are based on a 7-point Likert scale, ranging from 1 (e.g. it makes me depressed) to 7 (e.g. it makes me happy). The PACES is scored by reverse coding items 1, 4, 5, 7, 9-11, 13, 14, 16, and 17 and then summing all of the items, with scores ranging from 7 to 126. Higher scores indicate greater physical activity enjoyment. For a complete list of measures and a timeline of assessments, see Table 1.

Data Analysis

A priori Power Analysis

To our knowledge, no brief, SCT-guided behavioral interventions for promoting physical activity among low active, working adults exist. However, two brief theory-guided interventions can be used as a point of reference for the expected effect size. Mailey and McAuley (2014) conducted a physical activity study for working mothers and reported a moderate effect size (d = 0.44) for total physical activity (measured via accelerometer) post-intervention but a much smaller effect size (d = 0.08) at follow-up. A second study consisting of a 45-minute SCT-guided program for reducing sedentary time and increasing physical activity over the course of six days for older adults targeted n=60 participants to provide 90% power (two-tailed, $p<0.05$) for a moderate effect size and accounting for 15% attrition (Gardiner et al., 2011). Other studies with similar measures (e.g. SCT-guided constructs), samples (e.g. working adults), and time periods (e.g. brief, <60-minute program) have yielded moderate effect sizes, suggesting a moderate effect size (d = 0.3) was achievable for this study.

An a priori power analysis was conducted to identify the necessary sample size using *G*Power version 3.0.10*. A 2 (Group) x 2 (Time) interaction with 80% power and a moderate effect size (d = 0.3) resulted in n=60 participants. Accounting for 20% attrition, a total of n=72 participants were needed, with n=36 in each group. Note that the study was not powered for multiple comparisons.

Data Analytic Procedures

Once questionnaire data was submitted online, it was checked for completeness. All data collected was exported from *Qualtrics* (Qualtrics, L.L.C., 2014) and saved to a secure, password-protected computer located within the lab. Data was exported into *SPSS Statistics, Version 25* (IBM Corp., 2017) where frequencies and descriptives were run to identify any outliers within the data. Outliers were then Windsorized (e.g., replaced by a ±2.5 standard deviation calculated value). Composite files were created for all questionnaire data based upon the scoring instructions for each questionnaire. There weren't any missing data points for the baseline and follow-up survey, with the exception of one participant who did not complete the study at follow-up. Daily Fitbit wear was examined via the Fitbit app, with a “valid day” consisting of wearing the device for a minimum of ten hours (Cadmus-Bertram, Marcus, Patterson, Parker, & Morey, 2015). Expectation-maximization (EM) imputations were used to impute missing Fitbit data when a three day-minimum average could not be computed, which only occurred for the one drop out. EM imputations were selected as this process preserves the relationship with other variables and produces unbiased estimates (Von Hippel, 2004). When imputation procedures were required, analyses were conducted with and without missing data to assess any meaningful differences. Baseline group comparisons for demographic variables were conducted using t-tests.

Primary and Secondary Outcome Analyses

To test the first hypothesis, 2 (group) x 1 (measure) ANCOVAs were used to assess potential group differences in changes in physical activity enjoyment after completing the intervention. Self-report questions related to study enjoyment, video chat effectiveness, and recommendation to others, as well as additional metrics describing video chat success (video lag, etc.) were examined to determine study feasibility. To understand the feasibility of this brief intervention, a cost analysis was conducted. Specifically, the cost of staff and equipment needed to implement the study herein were reported. To further explore this idea, a cost analysis of conducting this study for an extended time period (one year) to reach a larger number of participants (1000+) was conducted. Finally, questions from a feasibility checklist for pilot studies from the *National Center for Complementary and Integrative Health* (NCCIH) were addressed. Although few published standards and guides exist to assess feasibility of interventions, using evaluations to guide judgments of feasibility for pilot interventions are needed to implement evidence-based interventions (Bowen et al., 2009).

To test the second hypothesis, a 2 (Group) x 2 (Time) repeated measures analysis of covariance (ANCOVA) was used to identify differences in self-efficacy levels between the intervention and control groups from the beginning (week 1 pre-chat) to the end of the third video chat (week 3 post-chat). The target outcome was self-efficacy for lifestyle physical activity (assessed via the Lifestyle Efficacy Scale composite score). A measure of self-efficacy to regulate work and life also served as a manipulation check against the control condition. We hypothesized that, at the end of week 3, intervention groups would have higher self-efficacy types which are reflective of the core content covered within their video chats. To adjust for potential impact of known determinants of self-efficacy, baseline levels of objectively-recorded physical activity (7-day average steps), age, gender, education, and baseline scores for the respective outcome were used as covariates.

To test the third hypothesis that self-efficacy changes influence subsequent behavior, a mediation analysis was conducted. Specifically, we hypothesized that changes in activity-related self-efficacy would at least partially mediate any positive increases in physical activity behavior at week four (post-intervention point) and week six (maintenance of activity levels). Furthermore, we hypothesized that self-efficacy to regulate work and life would, at least, partially mediate changes in perceptions of work-life balance. Both types of self-efficacy were assessed before and after each video chat and intra-session change across groups was examined for exploratory purposes. Efficacy change across the length of the intervention period was therefore examined in a multitude of ways.

Chapter IV: Results

Participant Characteristics

In total, 112 contacts expressed interest in the study by completing the online initial interest survey. Upon screening 101 contacts, 22 did not meet the inclusion criteria, with reasons including being too active (n=11), living outside of the Urbana-Champaign community (n=3), having depressive symptoms (n=3), not working full-time (n=2), unwilling to wear the Fitbit device (n=2), and being outside of the target age range (n=1). Five individuals who were screened ultimately declined participation prior to signing the consent form. Overall, 72 individuals were completed the informed consent document, baseline testing, and were randomized to one of the two groups (see CONSORT in Figure 2). All but one individual completed the study in its entirety.

No statistically significant differences were found between groups for any demographic variables and baseline activity levels using independent-sample t-tests (see Table 2). Participants were low-active, full-time working adults between the age of 29-64 (M=46.57±9.24). The majority of participants were women (73.60%) who obtained a college degree (90.30%). Moreover, the majority of individuals were Caucasian (75.00%) and were not Hispanic or Latino (94.40%). Participants enrolled in the study reported being low-active (not engaging in regular exercise more than two days per week for ≥ 30-minute sessions during the past three months) and at baseline, averaged 8372.78 ± 4037.72 Fitbit-derived steps.

Few participants reported having been diagnosed with a chronic disease. Specifically, 2.80% reported ever having coronary artery disease or heart disease, 4.20% reported ever having cancer, and 8.30% reported ever being diagnosed with diabetes. Moreover, this sample did not appear to have difficulty completing physical tasks, with 90.30% reporting having no degree of difficulty with walking or using stairs and 94.40% having no difficulty lifting or carrying up to ten pounds of weight. It is important to indicate that 40.30% had slight-to-moderate difficulty concentrating, remembering, or making decisions.

All participants were full-time workers, working at least 35 hours per week. The majority of participants (76.40%) were government employees, with 70.80% working for state government, including state colleges and universities, and 5.60% working for the local government, including city or county school districts. Moreover, 22.50% worked for a private sector employee, with 12.50% working for a for-profit company or organization and 9.70% working for a non-profit company or organization. Finally, just 1.40% of participants reported being self-employed, which included being an owner of a non-incorporated business, professional practice, or farm.

Study Feasibility and Cost Analysis

Among the 72 participants enrolled in the study, n=71 completed the study in its entirety. Of the 36 participants randomized to the intervention group, 36 participants completed all aspects of the study, including the baseline and follow-up appointment, three video chats, and wearing the Fitbit for the entire study. All but one participant randomized to the control group completed all aspects of the study. This participant completed the baseline appointment and first video chat but did not continue any further due to a family emergency. In total, 71 out of 72 (98.61%) participants completed the study, and 214 out of 216 (99.07%) video chats were completed. Video chats were scheduled based on the participants' availability, with almost all chats occurring during the work week, with a majority of the 10-minute chats taking place over the lunch hour or at the end of the work day (between 5-7pm).

The feasibility of the study design was examined via self-report questions at follow-up related to study enjoyment, video chat effectiveness, and recommendation to others. Seventy-one of the possible seventy-two participants completed the follow-up survey. The study appeared to be an enjoyable experience, as 93.06% of participants reported that they enjoyed participating in the seven-week study. More individuals in the intervention group reported that they enjoyed participating (100%) compared to the control group (91.43%), and three participants (8.57%) randomized to the control group reported they did not enjoy participating in the study at all. Participants were asked if they found the study to be a burden on their life, with most (82.60%) not finding the study to be a burden, while 13.00% found the study to be a burden sometimes, and 4.30% reported the study to be an overall burden.

In regard to the interactive video chat sessions, overall 71.00% of participants enjoyed all of the video chats, 23.20% enjoyed some of the chats, and 5.80% did not enjoy the chats at all. Participants randomized to the intervention group enjoyed all (77.80%) or some (19.40%) of the video chats, more so when compared to the control group (58.30% enjoyed all, 25.00% enjoyed some, and 11.10% did not enjoy the chats at all). Based upon the participants' free-response comments, some individuals in the control group did not enjoy the video chat sessions. They felt they already had a sufficient level of work-life balance and they did not find the chats to be useful. Among participants in the experimental group, 40.0% indicated "yes" the video chats were helpful for increasing physical activity levels, 40.00% replied "maybe" and 20.00% reported they were not useful. Interestingly, the same question was asked to individuals randomized to the control condition, and although the topics of their video chats were not focused on physical activity at all, 20.60% still found the chats to be helpful for increasing physical activity (47.10% replied "maybe" and 32.40% replied "no").

Of the total sample, 84.10% reported that they would recommend this study to a friend or family member (13.00% reported they would "maybe" recommend the study). The intervention and control groups were not statistically different (85.70% vs. 82.40%, respectively) Just two participants (2.90%) would not recommend the study and both of these individuals were randomized to the control group. The experience of the control group was comparable to the intervention's experience, given that 82.4% reporting they would recommend the study to a friend or family member (compared to 85.70% in the intervention group).

To examine group differences in physical activity enjoyment, a univariate ANCOVA controlling for age, gender, education, baseline steps, and scores from the Feeling Scale revealed no significant group differences on the modified 8-item PACES (Mullen et al., 2011) at follow-up, $F(1, 64) = 1.72$, $p = 0.194$, $d = 0.33$. Data are adjusted mean ± standard error.

The cost analysis for replicating this study included estimates of staff, equipment and participant incentives. Specifically, a research assistant is needed for a total of 144 hours (72 participants * (1-hour baseline appointment + 0.5 hour video chat + 0.5 hour follow-up appointment). Assuming a minimum wage of $15 per hour, the cost to pay a research assistant is $2,160. The equipment including the free *Google Duo* application, as well as 50 Fitbit Charge 3 devices, yields $7,500 ($150 * 50 devices). In this study, Fitbits were returned and reused whereas future studies may want to provide each participant with their own device (adding an extra cost of $150 per device). Compensation was provided to participants who completed all aspects of the study, and a three-hour time-valuation was assessed for the baseline and follow-up appointments and 30-minute video-chat time at $15 per hour (or $45 in cash totaling $3,240 (72 participants). Thus, the potential total cost to conduct this study, is $12,900 ($2,160 salary + $7,500 devices + $3,240 cash payments). This was not the total cost incurred by the investigators for the study, as the Fitbit devices were already available as a resource, and one research assistant running this study received credit hours towards their degree and did not require payment. The second student research assistant was paid $2,000 to assist with data collection and study execution. Thus, the actual cost to implement this study for seventy-two participants was $5,240. If this study were to be replicated over the course of an entire year, it would cost $31,200 to fund a research assistant (52 weeks * 40-hour work week * $15 per hour) to reach a maximum of 1,040 participants (52 weeks * 40-hour work week/2 total hours per participant). The total cost of equipment is fairly low, provided that the Google Duo video chat app is free on both iOS and Android devices and new Fitbit devices cost ~$150 per unit (1,040 devices * $150 = $156,000). Thus, the total cost to run this study for 1,040 participants over the course of a year would be $187,200 (salary + Fitbit devices). Feasibility questions for pilot studies from the NCCIH were also examined to further assess study feasibility (see Table 3).

Intervention Effects on Self-Efficacy

To assess the effect of completion of three interactive video chats on self-efficacy levels from pre to post intervention, a 2 (group) X 2 (time) mixed ANCOVA with repeated measures was conducted. Self-efficacy was assessed prior to the first video chat (week 1-pre) and at the end of the third (final) chat (week 3-post). Covariates assessed at baseline included age, gender, education, self-efficacy and PA (steps via seven-day period of wrist-worn Fitbit Charge 3). No significant differences on the LSE were observed across groups at baseline. Results revealed a significant interaction between group and time (pre/post completion of three weekly video chats) on the LSE $F(1, 65) = 4.57$, $p = 0.04$, $d = 0.55$, demonstrating a medium effect size. Upon completion of three video chats, participants in the lifestyle physical activity-targeted intervention groups' self-efficacy was greater compared to the control group (*M*s = 84.35±2.07 vs. 77.17±2.08; see Figure 3).

A second RM-ANCOVA was conducted to examine between-group differences in intra-session change for LSE scores. No statistically significant group differences were found with the 2 (group) x 6 (time) RM-ANCOVA $F(2.96, 192.12) = 2.16$, $p = 0.10$, $d = 0.35$, see Figure 4.

A 2 (group) X 2 (time) RM-ANCOVA was conducted for self-efficacy to regulate work-life and although no such interaction was found ($p > 0.05$), both the intervention and control group showed improvements in this measure from week 1-pre (*Ms* = 72.10±3.39 vs. 68.61±2.83) to week 3-post (*Ms* = 77.76±3.85 vs. 77.21±2.36), see Figure 5.

A 2 (group) X 6 (time) RM-ANCOVA was conducted to examine between-group differences in intra-session change for SRWL scores. No between-group differences were found, $F(2.76, 179.57) = 0.36$, $p = 0.77$, $d = 0.00$.

Mean change scores of LSE and SRWL for pre-post completion of three video chats are shown in Figures 6 and 7, respectively. As hypothesized, individuals in the intervention group showed greater change in LSE scores compared to the control group and individuals in the control group showed greater change in SRWL scores compared to the intervention. Table 4 shows correlations of pre and post LSE and SRWL scores for the three video chats completed and physical activity levels for weeks 1-6.

Compliance to Study Fitbit Wear-time Instruction

Participants were instructed to wear the Fitbit Charge 3 throughout the entire 7-week study. "Valid wear days" were defined as wearing the Fitbit for at least 10 hours which was verified via activity graphs provided through each online Fitbit account. During the 7-week study, the majority of participants appeared to comply with the full Fitbit-related instructions. All participants (with the exception of the one participant, lost to follow-up) wore the device for at least three days each week, allowing for an average weekly computation when needed. Out of the 72 participants, all but n = 16 (22.22% of sample) participants had 7 valid days for every week of the study. These 16 participants had on average 1.14 days missing per week that required imputation. Of the 3,024 possible days of wear (six full weeks for 72 participants), a total of 65 days (2.15%) required imputation (for having some missing days throughout a single week). When this occurred, the average of the remaining week's days was computed and inserted into the missing day(s). This procedure was similar to what other researchers have used. Specifically, both Hart (2011) and Tudor-Locke (2005) showed that a minimum of three days of accelerometer data are needed to accurately predict physical activity levels. The accelerometer data from this study support the aforementioned studies, as there were no significant differences in activity levels with and without imputation (see Table 5). Accelerometer data was available through week three for the participant who dropped from the study (50% of this participants' data was missing and needed imputation); therefore, 21 total days out of 3,024 needed to be imputed via EM imputation.

Intervention Effects on Physical Activity Participation

Statistically significant group differences were observed at week four, $F(1, 66) = 4.43$, $p = 0.039$, $d = 0.52$, but not at week six, $F(1, 66) = 0.028$, $p = 0.867$, $d = 0.00$. Moreover, there was not a significant difference in activity levels during (weeks 1-3) versus after video chat completion (weeks 4-6), although individuals were more active during the first three weeks ($M \pm SD = 9381.53 \pm 3640.60$) vs. 8655.91 ± 3083.65 steps, respectively).

To test the hypothesis that changes in activity-related self-efficacy would at least partially mediate any positive increases in physical activity behavior, a mediation analysis was conducted using the PROCESS macro for SPSS (Hayes, 2012), a four-step model (see Figure 8). Average step-count for week four was used for the physical activity behavior variable for this mediation, as this was the only week post-intervention where statistically significant group differences were observed (see Figure 9). Results are reported as unstandardized/standardized, standard error, p-value. In step one of the mediation model, the regression of physical activity levels at week four on group was compatible with hypotheses, $\beta = 1152.03/0.32$, S.E. = 579.80, $p = 0.05$. Step two revealed that the regression of the mediator, change in LSE, on group was also significant, $\beta = 9.35/0.51$, S.E. = 4.33, $p = 0.03$, suggesting group predicted higher LSE scores, with the intervention group having higher scores compared to the control. The third step of the mediation process showed the regression of physical activity levels on change in LSE, when controlling for group, was significant, $\beta = 46.40/0.24$, S.E. = 15.72, $p < 0.01$. Finally, when controlling for change in LSE, group was still a significant predictor of physical activity, suggesting a partial mediation. The bootstrapped unstandardized indirect effect was 433.64, and the 95% confidence interval ranged from 20.52 to 932.18. Thus, the indirect effect was statistically significant. The Sobel test ($z = 1.74$, $p = 0.08$) indicated full-mediation did not occur. Thus, the results show that LSE partially mediates the relationship between group and physical activity levels at week four.

A second mediation analysis could not be conducted to examine whether self-efficacy to regulate work and life mediates changes in perceptions of work-life balance was unnecessary, given the lack of relationships among these data, ($p > 0.05$ for group, work life balance score, and change in self-efficacy to regulate work and life [SRWL]).

Secondary and Exploratory Outcomes

Psychosocial Measures. Table 6 provides baseline and follow-up scores reported via self-report questionnaires. There were no significant differences across groups at baseline. Table 7 provides correlations between psychosocial questionnaires at baseline and physical activity levels for weeks 1-6. Statistically significant correlations were observed among self-reported physical activity levels (assessed via the GLTEQ) and average weekly steps during weeks 1 through 6. Lifestyle physical activity self-efficacy was correlated with average weekly steps during weeks 1 through 4, during the supervised portion of the study and during the first week of the unsupervised portion. Self-regulation (assessed via the EPSS) was correlated with physical activity levels at weeks 1, 3, and 6 and physical activity enjoyment was correlated with physical activity at all weeks except week 5.

Prior to implementation of the interactive video chat intervention and six weeks of lifestyle physical activity, a series of psychosocial questionnaires, a cognitive assessment, and a thirty-minute treadmill task were completed. A series of questions related to affect were assessed immediately after completion of the thirty minute treadmill task. Table 8 provides correlations of affect and Stroop scores at baseline and physical activity levels at weeks 1-6.

Affect

Prior to the start of the six-week intervention, participants completed questions related to affect at the end of the thirty-minute treadmill assessment. A univariate ANCOVA revealed no statistically significant differences between groups on the *Feeling Scale* (FS), $F(1, 70) = 1.345$, $p = 0.50$, *Anticipated Negative Affect Questionnaire* (ANAQ), $F(1,70) = 0.61$, $p = 0.50$, or the *Forecasted Pleasure* question, $F(1, 70) = 3.31$, $p = 0.07$.

Irrespective of group, a linear regression analysis was conducted to determine if *Forecasted Pleasure* predicted physical activity levels (weekly step averages) for weeks 4-6, $F(1, 70) = 7.67$, $b = 23.76$, $p = 0.01$ and the *Forecasted Pleasure* score accounted for 10.00% of the explained variability in physical activity levels, with adjusted $R_2 = 8.60\%$. A second linear regression established that the *Feeling Scale* question statistically significantly predicted physical activity levels for weeks 4-6, $F(1, 70) = 6.46$, b = 463.23, $p = 0.01$ and the *Feeling Scale* score accounted for 8.50% of the explained variability in physical activity levels, with adjusted $R^2 =$ 7.10%.

To test whether *Forecasted Pleasure* moderates the relationship between group and physical activity levels at week four, a hierarchical multiple regression analysis was conducted using the PROCESS macro for SPSS. The overall model using the *Forecasted Pleasure* question was significant, $F(7, 64) = 15.14$, $p = < 0.001$, $R^2 = 0.62$. To avoid multicollinearity with the interaction term, the variables were centered and an interaction term between group and *Forecasted Pleasure* score was created. The interaction between group and *Forecasted Pleasure* score was statistically significant, suggesting that the interaction term accounts for a significant proportion of the variance in physical activity levels at week four, $F\Delta\ (1, 64) = 6.46$, $p = 0.01$, $\Delta R^2 = 0.04$, b = -37.82, t(64) = -2.54. Examination of the interaction plot showed group was significantly related to physical activity levels at week four when the *Forecasted Pleasure* score was at the mean (b = -1389.46, t(64) = -2.34, $p = 0.02$) or one standard deviation above the mean (b = -2902.29, t(64) = -3.14, $p < 0.01$), but not when scores were one standard deviation below the mean (b = 879.80, t(64) = 0.91, $p = 0.36$). Therefore, individuals in the intervention group who had a *Forecasted Pleasure* score at, or one standard deviation above, the mean had significantly greater levels of physical activity levels at week four.

A second hierarchical multiple regression analysis was conducted to test whether the *Feeling Scale* moderates the relationship between group and physical activity levels at week four, again using the PROCESS macro for SPSS. The overall model using the *Feeling Scale* was significant, $F(7, 64) = 13.97$, $p = 0.00$, $R^2 = 0.60$, but the interaction between group and Feeling

Scale score was not statistically significant, suggesting that the Feeling Scale does not moderate the relationship between group and physical activity levels at week four, $F\Delta(1, 64) = 3.73$, $p = 0.06$.

Sedentary Behavior

At follow-up, a univariate ANCOVA controlling for age, gender, education, baseline 7-day average of Fitbit steps, and baseline SBQ score revealed no statistically significant group differences on the SBQ at follow-up, $F(1, 64) = 0.627$, $p = 0.431$, $d = 0.20$.

Self-reported Physical activity

No statistically significant group differences were observed at follow-up on the GLTEQ according to a univariate ANCOVA controlling for the same covariates, $F(1, 64) = 2.43$, $p = 0.12$, $d = 0.41$.

Self-efficacy

A univariate ANCOVA controlling for the same covariate model revealed no statistically significant group differences on the LSE at follow-up, $F(1, 64) = 0.19$, $p = 0.67$, $d = 0.00$, on the BARSE, $F(1, 64) = 1.26$, $p = 0.27$, $d = 0.29$, or on the SRWL, $F(1, 64) = 0.59$, $p = 0.44$, $d = 0.20$.

Self-regulation

No statistically significant group differences were observed at follow-up on the EPSS, $F(1, 64) = 0.16$, $p = 0.69$, $d = 0.00$ or the PASR-12, $F(1, 64) = 1.43$, $p = 0.24$, $d = 0.29$. No significant group differences were observed on the following PASR-12 subscales: self-monitoring, goal-setting, social support, reinforcement, time management, or relapse prevention.

Measures of Expectations

No statistically significant group differences were observed at follow-up on the MOEES self-evaluative outcome expectancies subscale, $F(1, 64) = 1.77$, $p = 0.19$, $d = 0.35$ or the physical outcome expectancies subscale, $F(1, 64) = 2.26$, $p = 0.14$, $d = 0.35$. Significant group differences were revealed for the social outcome expectancies subscale, $F(1, 64) = 4.70$, $p = 0.03$, $d = 0.55$. Post hoc comparisons using a Bonferroni adjustment revealed that social outcome expectancies were statistically significantly greater in the control group ($M \pm SE$; 12.35 ± 0.36) compared to the intervention group (11.25 ± 0.35), a mean difference of 1.10 (95% CI, 0.09 to 2.11), $p = 0.03$.

Exercise Schema

To examine differences in the proportion of exerciser and non-exerciser schematics from baseline to follow-up, an exact McNemar's test was run. Regardless of group, the number of exerciser schematics increased from baseline (n = 3; 4.17%) to follow-up (n = 12; 16.67%), a statistically significant difference, $p = 0.02$. The number of non-exerciser schematics decreased from baseline (n = 28; 38.89%) to follow-up (n = 11; 15.28%), a statistically significant difference, p = < 0.001. Specific to group, the difference in proportion of exerciser schematics pre- and post-intervention were statistically significant for the intervention group ($p = 0.02$) but not the control group ($p = 0.69$). Specifically, there were more shifts to exerciser schematic in the intervention group than the control group from baseline to follow-up (7 versus 2, respectively). This same pattern was observed for non-exerciser schematic differences by group, across time, with the intervention group shifting from 14 non-exerciser schematics at baseline to 4 at follow-up ($p = 0.01$), whereas the control group had 14 non-exerciser schematics at baseline and 7 at follow-up ($p = 0.12$).

Stress

No statistically significant group differences were observed at follow-up on the BJSQ, $F(1, 64) = 0.09$, $p = 0.77$, $d = 0.00$ or on the PSS, $F(1, 64) = 1.90$, $p = 0.17$, $d = 0.35$.

Work-life Balance

No statistically significant group differences were observed at follow-up on the WLB-6, $F(1, 64) = 0.52$, $p = 0.48$, $d = 0.20$.

Chapter V: Discussion

General Summary

This pilot feasibility and efficacy trial was the first to test a brief, theory-guided interactive video chat intervention for enhancing lifestyle physical activity self-efficacy during a six-week, home-based program designed for working adults. The interventions were guided by Social Cognitive Theory (SCT) with the aim of improving participants' outcome expectations, self-efficacy, and self-regulatory strategies. Prior SCT-based interventions have had some success increasing physical activity levels but they have often relied upon group sessions and substantial resources (staff, facilities, equipment) to cultivate greater knowledge and psychological skills needed for behavior change (Gardiner et al., 2011; Hallam & Petosa, 2004; Mailey & McAuley, 2014). Given that lack of time is frequently cited as the primary barrier to physical activity engagement among working adults, a 10-minute video-chat, accessible in any environment (impacted only by surrounding noise and reliability of internet connection), including home or work, was theorized to be of great utility to the target population. The study's findings support, in part, the hypothesis that SCT-guided interactive video chats are useful and can enhance targeted self-efficacy beliefs (post-intervention) and lifestyle physical activity levels (immediately, post-intervention).

Study Feasibility

Overall, the evidence gathered from this study support the feasibility of promoting behavior-specific self-efficacy and physical activity behavior among low-active, full-time working adults with interactive video chats using personally-owned mobile devices (in this case, a smartphone app). The high completion rate of this study (98.61%), with participants complying to all aspects of the study, suggests that individuals were willing to engage in this study design, which offered brief guidance to assist with physical activity or parallel tips for acquiring work-life balance. Specifically, participants for the most part, found the interactive video chats to be enjoyable and somewhat effective for increasing activity levels. Participant level of compliance with Fitbit wear-time instructions suggests they either felt it was of little burden or they gained value from it, or some combination thereof. Both the intervention and control group had high scores of physical activity enjoyment at follow-up (Ms (SD) = 94.92 (18.45) and 85.94 (23.95), respectively, out of a maximum score of 100), suggesting that irrespective of group, participants liked the physical activity. Although not statistically significant, group differences for physical activity enjoyment at follow-up trended in the expected direction, with a small-to-medium effect size supporting this trend. Moreover, upon completion of the study, participants in both groups were regularly active, with step counts exceeding 8,000 steps each week. Perhaps the flexibility of a home-based lifestyle physical activity program, combined with the brief, mobile-delivery of the intervention, is an acceptable format for promoting physical activity among this population, but more research is warranted.

Intervention Effects on Self-efficacy

The primary hypothesis that SCT-guided interactive video chats would result in greater levels of lifestyle physical activity self-efficacy (LSE) was supported by these data. Although not statistically significant, the results of the between-group differences in intra session change for LSE scores do support the directional hypothesis that was specified a priori. The evidence of trends compatible with expectations for change in LSE is supported by the small-to-medium effect size found herein. A compatible trend was observed with the control group having greater self-efficacy scores for work-life balance (SRWL) when compared to the intervention (although mean levels were not statistically different). These data provide preliminary support for the efficacy (and the specificity of the efficacy effect) of the brief, three-week interactive video chat intervention. It is not altogether surprising that both groups improved in SRWL, as both groups engaged in three interactive video chats guided by SCT and discussed expectancies, self-efficacy, and self-regulatory strategies helpful in goal acquisition. It is likely that all participants who enrolled in the study had similar study expectations, provided that the study was intended for working adults and the recruitment campaign highlighted the brief, home-based design. Thus, this program aimed to eliminate the time-burden associated with structured exercise programs by providing participants the option to engage in any type of aerobic exercise of their choosing at any location.

During each of the three interactive video chats, participants in the intervention and control group increased their behavior-specific self-efficacy scores from pre to post video chat. Interestingly, individuals in the intervention group had the greatest increase in LSE score pre-post video chat after session two, which focused on sources of efficacy information for physical activity. Individuals in the control group, however, had the greatest increase in SRWL score pre-post video chat after session one that centered on outcome expectations for work-life balance. Certain topics may have been more engaging for one group over the other or for discrete subgroups of participants. For example, there are individual differences in how we maintain our self-perceptions across the lifespan and the ways in which these findings can differ has been researched and theorized. For example, young adults appear to have a tendency to make more upward social comparisons and are more influenced by these social comparisons compared to older adults (Frey and Ruble, 1990), whereas older adults seem to pay more attention to positive cues and have a better memory for positive information compared to younger adults (Carstensen, Fung, & Charles, 2003). It is also theorized that one’s tendency for shifting social and self-comparisons across situations is malleable and can be learned from experience as a means to maintain favorable self-views across the lifespan. Therefore, it is possible that some of the younger or more experienced adults in this study may have interpreted the information provided within the interactive video chats differently than older adults or those with less experience with physical activity. Specifically, some topics may have varied in the extent to which they were able to nudge participants to engage in self-reflection or self-correction, but future research is necessary to untangle the ideal pathways from SCT-guided video communications to sustained behavior change. That said, consistent with previous research (see McAuley et al., 2011), LSE scores decreased for both groups, on both primary targeted (group-specific) measures of self-efficacy, during the last three weeks of the study, when participants were no longer provided weekly chats and were expected to exercise regularly on their own. In fact, both LSE and SRWL scores dropped below their respective baseline levels. It has been theorized and empirically-validated that initial self-efficacy beliefs tend to be overestimations that decline after exposure to a given behavioral intervention. Optimizing one's self-efficacy to inform realistic expectations at the start of an intervention may be an effective strategy for increasing adherence and other outcomes. The initial treadmill assessment at the start of the study was intended to expedite recalibration of participants' self-efficacy levels and LSE scores did show a slight decline after engaging in the 30-minute treadmill walking task (at moderate intensity). Most researchers that have reported early trial recalibration (declines) of physical activity-related self-efficacy have shown the decrease occurring within the first few weeks, whereas this trial was designed to maximize self-efficacy within the first three weeks.

In the context of exercise trials, self-efficacy levels also tend to drop at the very end of interventions. According to McAuley and colleagues (2011), this is because participants' must cope with the prospect of carrying out their exercise prescription alone, minus the guidance of experts and research-assisted social support of any kind. Although not significant, self-efficacy scores ultimately declined by the end of the six-week study period, with the intervention group's LSE scores being higher than the recalibrated (post-treadmill) baseline LSE scores (assessed before the first video chat) at the end of the third video chat (77.93 vs. 84.35, respectively) compared to the control group (77.04 vs. 77.17). The same pattern was found for the control group with SRWL scores. These data are promising and are consistent with a meta-analytic review conducted by Tang, Smith, Mc Sharry, Hann and French (2018) which found moderate effects ($d = 0.26$) of physical activity on post-intervention self-efficacy. Specifically, they found that interventions that targeted social, environmental, and emotional consequences of physical activity were associated with higher effect sizes, whereas social support was associated with lower effect sizes. Similar themes were addressed during the three interactive video chats within this study. Specifically, social outcome expectations and emotional response to physical activity were discussion points, as well as identifying environments and activities (type and duration) that are most enjoyable. The authors concluded that there is no "one-size-fits-all" approach to effectively change self-efficacy beliefs regarding physical activity behavior. However, they did find that behavior change interventions implementing more efficacy-boosting strategies yielded greater effect sizes. Therefore, incorporating a more holistic approach may optimize change and maintenance in physical activity-related self-efficacy beliefs.

Intervention Effects on Physical Activity Engagement

SCT-guided interventions have long been used for increasing physical activity self-efficacy and physical activity behaviors (Ashford et al., 2010; Gourlan et al., 2016; Williams & French, 2011), but generally, these approaches have required what many researchers might now view as intensive and intrusive supervision. This study was aimed at answering the question as to whether a behavioral intervention that provides similar educational and motivational information and resources (e.g. Fitbit tracking device), without the supervision of typical structured programs, is sufficient enough to yield an effect on physical activity engagement. As mentioned previously, brief interventions have been successful for increasing physical activity behaviors (Gardiner et al., 2011; Mailey & McAuley, 2014). However, such interventions have required multiple in-person meetings (Mailey & McAuley, 2014), or did not include follow-up assessements to understand the sustained impact of a brief intervention (Gardiner et al., 2011). More recently, Shcherbina and colleagues conducted a longitudinal smartphone-based study utilizing brief coaching interventions to test the effect of digital interventions for promoting physical activity (Shcherbina et al., 2019). The interventions consisted of daily prompts to complete 10,000 steps, hourly prompts to stand, reading information from the *American Heart Association* website, and individualized e-coaching based upon previous activity patterns. Although small increases in step counts occurred (less than 400 steps from baseline to follow-up two years later), the completely remote intervention was able to maintain and slightly improve individuals' daily physical activity levels. Thus, this study herein aimed to implement a brief intervention design that combines aspects of previously conducted studies: offering a more balanced approach of both (remotely) supervised and unsupervised periods of the intervention, while providing information for promoting physical activity that could potentially be tailored in the future to better meet others' needs.

This brief intervention design did result in post-intervention change in physical activity at week four across groups but did not result in an overall effect on physical activity (defined as the six weeks of lifestyle physical activity, adjusting for the 7-day baseline step assessment, and using EM imputation for missing). Moreover, there was not a significant difference in activity levels during (weeks 1-3) versus after video chat completion (weeks 4-6), although participants' step counts were higher during weeks 1-3 compared to weeks 4-6. This is not surprising as participants were receiving an intervention that provided supervision and support during the first three weeks, which could have led to increased motivation to be active. It is important to note that although we did not find differences in activity levels across the supervised (first three weeks) and unsupervised (last three weeks) phases of the study, the average step count was well above 7,500 steps, for both groups, for the entirety of the study, which is thought to be the equivalent of achieving the public health recommendations for physical activity (Tudor-Locke, 2010; Tudor-Locke, Johnson, & Katzmarzyk, 2009). Indeed, 7,500 steps over 12 months is sufficient to achieve positive cardio-metabolic adaptations (Hajna, Ross, & Dasgupta, 2018). Moreover, at baseline the average step count was already at a relatively high level for "low active" adults, as evidenced by the sample mean and standard deviation of 8372.78 $\pm$ 4037.72 steps. It is possible that participants changed their behavior upon receiving the Fitbit device (measurement effect) or that simply enrolling in the study provided sufficient motivation for initially increasing physical activity levels.

Interestingly, the SBQ was not correlated with physical activity levels at any time point. Studies aiming to reduce sedentary behavior have been associated with lower levels of physical activity in adults, yet inverse associations between sedentary behavior and physical activity tend to be weak (Mansoubi, Pearson, Biddle, & Clemes, 2014). One reason for this may be that when individuals reduce their sedentary time, it may not be because they are engaging in more moderate physical activity, but rather they are standing more. Sedentary behavior may be more likely to be associated with fluctuations in light activity and not one's overall physical activity levels. That said, engagement in physical activity at high intensity can also result in more, compensatory sedentary behavior during refractory (recovery) periods. In this study, sedentary behavior is unlikely to be used for compensatory purposes following lifestyle physical activity engagement, as individuals were only asked to accumulate 30 minutes of moderate-intensity LPA per day that should not have impacted sedentary behaviors. Baseline sedentary behavior was not assessed and therefore it is difficult to determine if the intervention influenced participants' usual sedentary behavior patterns.

Theoretically, changes in SCT constructs including self-regulation, outcome expectations, and self-efficacy should, at least partially, mediate physical activity behaviors. This is not altogether consistent with prior research. An early review of mediators of physical activity behavior change has reported null findings, due to the use of mediators of change analyses in experimental designs being relatively scarce, with changes in self-regulation potentially having the most effect on changes in physical activity (Rhodes & Pfaeffli, 2010). More recently, several meta-analyses have shown SCT constructs to be associated with changes in physical activity, but the variance in methodological quality needs to be considered. For example, Young and colleagues (2014) reviewed the associations between SCT constructs and physical activity and found that self-efficacy and self-regulatory strategies were consistently associated with physical activity but outcome expectations were not. Moreover, SCT constructs accounted for 31% of the variance in physical activity, and higher methodological quality of studies was associated with greater variance explained. More recently, Beauchamp, Crawford, and Jackson (2018) reviewed SCT and physical activity and found that the core tenets of SCT (self-efficacy, outcome expectations, and self-regulatory strategies) are associated with physical activity behavior, but suggest there is a need to differentiate within- and between-individual effects, as it cannot be assumed that these effects are always related. The mediation analysis conducted herein revealed that changes in LSE partially mediated increases in physical activity at week four, supporting the established relationship between self-efficacy and physical activity behavior. It was not possible to further explore this partial mediation with other SCT variables, as they were unrelated to group assignment or physical activity at week four.

Exploratory Findings and Implications

Examining the intervention effects on psychosocial measures typically associated with physical activity behaviors resulted in some expected and unexpected findings. Provided that p-values and effect sizes are context dependent, we can no longer draw scientific conclusions purely on the basis of p-values (Baker, 2016). In a pilot feasibility trial that was not powered to detect differences across multiple outcomes, but that was designed to facilitate positive change in most of these secondary outcomes, it is promising to note there are small-to-medium effect sizes and patterns of change that are compatible with theory and expected trends. For example, although not statistically significant according to a p-value score >0.05, small-to-medium effect sizes were observed in both primary and secondary outcomes. Specifically, between-group differences in intra-session change for LSE scores showed a small-to-medium effect size, lending support for the a priori hypothesis of between-group differences in LSE scores over the course of the three interactive video chats. These trends were also present in secondary outcomes, supporting expected patterns predicted a priori, with a small-to-medium effect size observed for physical activity enjoyment, self-report physical activity levels (via GLTEQ), physical and self-evaluative outcome expectations, and general stress levels at follow-up. Thus, it is important to interpret the outcomes of this pilot feasibility trial beyond p-value significance.

Over the past two decades, researchers have begun to examine the relationship between affective response to exercise and future exercise participation and the results have been mixed (Rhodes & Kates, 2015; Williams et al., 2008). Specifically, Rhodes and Kates' review revealed positive affective change during moderate-intensity exercise was associated with subsequent physical activity, but affect immediately post-exercise was unrelated to exercise intentions. Moreover, Williams et al. (2008, 2012) explored this relationship and found that affective responses during exercise showed significant inter-individual variability, and suggest assessing affect before and after moderate-intensity exercise, as low-active participants who reported more positive affect responses after a single bout of exercise at baseline reported more minutes of physical activity both six and 12 months later. Together, the literature implies that individuals are more likely to exercise in the future if they experience positive feelings while exercising, but this may also be true for positive affect post-exercise among individuals who were previously inactive.

To further explore this relationship, affect was assessed immediately after the baseline treadmill assessment (via the Forecasted Pleasure question, the Feeling Scale, and the ANAQ). Interestingly, both the Forecasted Pleasure and the Feeling Scale assessments were predictive of physical activity levels at weeks 4-6, irrespective of group. Moreover, the Forecasted Pleasure question moderated the relationship between group and physical activity levels at the mean and one standard deviation above the mean. Thus, it appears that having an average or above average rating of pleasant feelings toward repeating the thirty-minute exercise session can influence an individual's future physical activity levels, with the intervention group having greater levels of activity compared to the control. In support of this, Kim, Conroy, and Smyth (2019) and colleagues found bidirectional associations of affect with physical activity and sedentary behaviors among working adults, suggesting that positive affect prior to physical activity engagement may lead to higher levels of activity and lower levels of sedentary behavior. Williams and colleagues used an unsupervised, home-based study, providing self-paced exercise prescription versus a moderate intensity exercise prescription for overweight adults, with the aim of promoting positive affect towards physical activity to encourage greater subsequent physical activity (Williams et al., 2014). The self-paced condition reported more minutes of walking (26 more minutes per week) compared to the moderate intensity prescribed group. However, this study had a very high dropout rate, possibly due to the fact that the study was completely unsupervised. Together, the current and past work suggests that providing individuals with an opportunity to have a pleasant exercise experience prior to the start of a physical activity intervention may influence future activity levels. Ensuring participants perceive exercise as enjoyable and not a daunting task, may promote increases in self-efficacy, and aid in long-term physical activity engagement.

Group differences were not found for the social cognitive variables, including self-regulatory outcomes, outcome expectations, and self-efficacy, at follow-up. Specifically, no group differences were observed for self-regulatory outcomes, including the EPSS, PASR-12, and BARSE. Although not statistically significant, there were trends towards increased use of self-regulatory strategies. Specifically, greater increases on the PASR-12 (assessing self-regulatory skills used in relation to physical activity) from baseline to follow-up were observed in the intervention group, compared to the control, with the intervention group reporting higher use of self-regulatory strategies at follow-up. Moreover, the intervention group did report higher scores on the PASR-12's subscales, including self-monitoring, goal-setting, social support, and relapse prevention, suggesting that the intervention group may have started to utilize the strategies discussed during the interactive video chats. While the intervention did target self-regulatory strategies, these strategies were only discussed during a brief portion of one, 10-minute video chat. It is possible that this was not sufficient to spark substantive change. Scores on the BARSE declined from baseline to follow-up for both groups, indicating less confidence in their ability to overcome exercise-specific barriers. This is not uncommon as participants experience more barriers as they integrate physical activity into their lives, especially without a structured on-site program (Olson & McAuley, 2015). Moreover, group differences were only observed for social outcome expectancies, favoring the control group. Perhaps the information provided to the control group had an impact on their social relationships, given that these participants were encouraged to work towards a good work-life balance, spending more quality time with family and friends.

Even though individuals in the control group received information to work toward and maintain a work-life balance, no significant group differences were observed at follow-up for questions related to work-life balance. Moreover, we hypothesized that engaging in physical activity would reduce stress levels, yet no group differences were observed for both general and work-related stress among participants in this study. The general stress levels of the participants were relatively low for both the intervention and control group at baseline (15.47 vs. 16.94, respectively, out of a maximum possible score of 40). This same pattern was observed for the *Brief Job Stress Questionnaire*, with average scores for both groups being low at baseline and follow-up. It is possible that participants were not overly stressed at the onset of the intervention and that the dose or overall approach was insufficient for reducing the impact of any remaining stressors. It is important to note that group differences for the *Perceived Stress* Scale were trending towards the expected pattern of reduce stress levels at the end of a physical activity intervention, with small-to-medium effect sizes supporting this trend. Indeed, a similar study conducted by Cook, Billings, Hersch, Back, and Hendrickson (2007) tested the efficacy of a workplace health promotion program to improve diet, reduce stress, and increase physical activity. The intervention provided web-based information to full-time workers and although retention rates were good for both groups, no significant differences were found between the two groups on measures of stress or physical activity. After reviewing technology-delivered interventions for behavioral change outcomes, Wantland, Portillo, Holzemer, Slaughter, and McGhee (2004) found few studies in existence examining this relationship between remote interventions aimed at stress management and physical activity. Rather, this format has been more successful for promoting healthy diets and changes in nutrition. More recently, Heber et al. (2017) reviewed web- and computer-based interventions for stress and found that guided interventions that were of medium duration (5-8 weeks) were most effective. It is important to note that these interventions did not include physical activity. Another review by Rathbone and Prescott (2017) examining the use of mobile apps and SMS messaging for physical and mental health interventions revealed that mobile interventions may improve physical health and significantly reduce stress levels. However, again, the studies reviewed did not focus primarily on physical activity, but rather used weight loss as a measure of physical health. Thus, it is still unclear whether lifestyle physical activity walking programs are enough to elicit changes in stress levels among working adults.

Significant group differences were observed for the proportion of exerciser and non-exerciser schematics from baseline to follow-up. Specifically, there were more shifts to exerciser schematic in the intervention group than the control group from baseline to follow-up. Moreover, the intervention group had more individuals that shifted out of the non-exerciser schematic classification compared to the control group at follow-up. The change in classification is noteworthy as exerciser schematics tend to exercise more frequently for longer durations, have higher levels of self-efficacy and positive outcome expectancies for exercise, and report fewer lapses relative to those without such schemas (Beacham et al., 2011; Kendzierski, 1988; Rhodes, Kaushal, & Quinlan, 2016). This dissertation study is just one of a handful of studies (Rhodes et al., 2016) that have assessed change, in the context of an RCT, in any physical activity-related self-schema or self-identity—a highly related, yet conceptually distinct construct (see Berry, Strachan, & Verkooijen, 2014). To date, evidence is unavailable to confirm the theoretical mechanisms proposed by researchers on the antecedent factors of physical activity self-definition (PASD) and the degree to which they are malleable. Kendzierski and Morganstein (2009) tested a theoretical model in two large samples (runners, cyclists) and found that *perceived commitment* and *perceived ability* had direct effects on PASD, and that *enjoyment*, *perceived wanting to* and *perceived trying to* had indirect effects (via perceptions of commitment and ability) on PASD. Therefore, intervention strategies designed to encourage self-awareness, self-evaluation, and self-reflection may lead to the self-inference "I am an exerciser" (Kendzierski & Morganstein, 2009). That said, this theoretical model also underscores the importance of perceived ability which is likely to be influenced by daily fluctuations in self-efficacy and the informational sources through which it is received and replenished. Thus, it is not surprising that participants began to identity as an exerciser as they engaged in the intervention and gained confidence through the SCT-guided interactive video chats. It is also possible that the flexibility and freedom to choose any form of physical activity, and to accumulate 30 minutes throughout the day—which is equally effective for improving health compared to engaging in a single continuous bout of exercise according to a recent meta-analytic review (Murphy, Lahart, Carlin,

& Murtagh, 2019)—provided non-exerciser schematics the opportunity to have a more open mind about physical activity.

At baseline, the majority of participants, on average, were already exceeding 7,500 steps, which is thought to be sufficient to achieve positive cardio-metabolic adaptations (Hajna, Ross, & Dasgupta, 2018). Although baseline 7-day average steps were included as a covariate in the primary and secondary analyses, exploratory analyses were conducted to examine potential effects for participants within the bottom third (33.33th percentile (n=23) = 6484.52 steps) and top third (66.66th percentile (n=23) = 9056.24 steps) for step counts at baseline. The results showed different patterns relative to the primary (LSE and SRWL) and secondary outcomes (physical activity levels at week six) demonstrated by the entire sample. Specifically, immediately upon post-intervention (after completion of three video chats), participants in the bottom third percentile for steps at baseline had lower LSE scores compared to the entire sample's average (77.43 versus 80.14, respectively). Moreover, participants in top third percentile for baseline steps had higher LSE scores compared to the entire sample's average (85.57 versus 80.14, respectively). Similar patterns were observed for LSE and SRWL at follow-up, as well as physical activity levels at week six. Given that the entire sample's average step count at week six (M = 8717.26), participants in the bottom third percentile at baseline had a lower average step count at week six (M = 6575.86) and participants in the top third percentile had a higher average step count at week six (M = 11663.83). A second exploratory analysis was conducted, examining LSE scores immediately post-intervention (after completion of three video chats), excluding n = 2 participants who scored >2.5 standard deviations from the mean at baseline (>18,467 steps). The results did not reveal differences in scores in comparison to the entire sample for LSE scores (79.70 versus 80.14, respectively) or average step count at week six

(M = 8540.66 versus 8717.26, respectively). As such, it appears the effects of this intervention may have been dependent on initial low activity levels, with individuals who are already active having greater levels of self-efficacy and activity throughout the study length and those with the least activity at baseline having lower confidence after completing the intervention and lower activity levels at the end of the study.

At baseline, 40.3% of the sample reported having slight-to-moderate difficulty concentrating, remembering, or making decisions due to physical, mental, or emotional conditions. Provided that this was a large portion of the sample, exploratory analyses were conducted to examine whether there was overlap in relation to low self-efficacy scores and physical activity levels. The results did not change for primary (LSE and SRWL) or secondary (physical activity) outcomes, after accounting for cognitive complaints. Furthermore, this subgroup of individuals who reported having slight-to-moderate memory complaints, exceeded 7,500 steps across the duration of the six-week study. Perhaps individuals who perceived themselves as having memory problems at the start of the study became more confident in their ability to engage in lifestyle physical activity. It may not be challenging to remember just one goal (engage in 30-minutes of activity each day), and on average, this subsample successfully met this weekly goal. It is possible that this subgroup over-estimated the degree to which they had cognitive difficulty. Every participant in the sample scored ≥ 21 on TICS at screening and perceived cognitive difficulties did not correlate with the cognitive performance measure (Stroop) assessed at baseline ($p = 0.479$) or physical activity levels at any point in the study ($p > 0.05$).

Strengths and Limitations

This study has a number of strengths. First, this study was pre-registered, conducted using a randomized controlled trial (arguably the most rigorous scientific research design), theory-based, and the study-protocols, scripts, and data are fully available to anyone interested in replication and re-analysis. Second, this study targeted full-time working adults, provided a home-based intervention rather than the typical worksite intervention for this population, and encouraged more avenues to acquire physical activity beyond the workplace setting. This was the first study to explore the efficacy of a brief, video-chat delivered SCT-guided intervention for promoting lifestyle physical activity self-efficacy and physical activity levels. Prior research has identified successful SCT-guided interventions, but these methods typically require a substantial commitment and personal travel time to a group-based setting. The Google Duo video chat application provided a mobile, scalable, easy-to-use platform that a few participants had already been using prior to the study commencement. Although this was a novel app for most participants, the brief orientation provided to participants at baseline appeared to eliminate user-questions and errors, as no technological issues were reported. The intervention herein was delivered via mobile technology, required only one staff member, and the cost to scale this up would be minimal. As reported in the results section, the cost of replicating this study over the course of an entire year would be $187,200 (salary + Fitbit devices). Additionally, given that participants were low-active adults working 35+ hours per week, the retention rate was very high (98.61% completed all study requirements), with all but one dropout, for reasons unknown (lost to follow-up).

Use of an objective measure of physical activity over the entire six-week study was also a strength of this study, providing greater insight into individuals' study engagement. Finally, this study design used a tailored approach, implementing theory-based strategies to meet the needs of the individual and providing targeted, personalized information to promote self-efficacy and physical activity. Specifically, a brief design was selected as full-time working adults were the target of the investigation, and lack of time is the primary reason for physical inactivity. Although scripted, the interactive video chats utilized prompts and questions to elicit personalized responses from the participant, with the aim of participants relating the information to their own lives and incorporating the information and strategies provided to overcome their personal barriers and schedules.

There are limitations of this study that must be addressed. First, although recruitment efforts aimed to enlist a diverse sample, the study sample was homogenous in terms of career-type and demographics. Specifically, most participants (76.4%) were government employees, including working for state colleges and universities. Considering that the University of Illinois at Urbana-Champaign was targeted via recruitment efforts, it is not surprising that UIUC employees were overrepresented in our sample. Intervention effectiveness may vary according to the type or nature of one's employment. Similarly, results may vary according to residence (urban vs. rural) and other geographic factors affecting work-related stress and time for physical activity (e.g., long commutes). Moreover, it is possible that demand characteristics, or subtle cues that make participants aware of experimenters' expectations of the study (Nichols & Maner, 2008), may be present within this study. Demand characteristics can result in social desirability bias, where participants provide survey responses that they believe will be viewed favorably by the researcher (Fisher, 1993). Specifically, the video chat topics may have resulted in participants altering their survey responses to conform to what they believe to be the experimenter's expectations. To minimize demand characteristics and social desirability bias, researchers will often choose to provide participants information about a secondary aim rather than disclosing the true purpose of the study. Within this dissertation study, participants believed the primary aim was to increase physical activity levels, rather than the true purpose of enhancing behavior-specific self-efficacy. Taking such precautions can minimize the impact of demand characteristics and social desirability bias. Finally, the sample size in this study was sufficient for conducting the planned primary data analyses but having a larger sample would have improved power and reduced the potential for Type I and II error in multiple group comparisons.

Directions for Future Research

Results from this study support the feasibility of a remote, video chat-delivered intervention for promoting lifestyle physical activity self-efficacy and subsequent physical activity levels, to an extent. Compliance was high for video chat completion and Fitbit wear, and participants enjoyed both the intervention and physical activity portion of the study. It is advised that future studies assess self-efficacy levels each week during the unsupervised portion of the study to better understand the relationship between the decline in activity levels and self-efficacy scores after completion of the intervention. Moreover, the inclusion of follow-up questions regarding the participants' preference of the video chat topics can inform the effects of the intervention. Although not statistically significant, trends in efficacy change scores (pre to post chat) varied by group and efficacy measure and were consistent with theory and hypotheses. It is also important to note that the majority of participants in this study were physically active at baseline (with average step count exceeding 7,500 steps). Future studies should consider using the Fitbit device to facilitate individualized activity goals based on each participant's baseline activity levels. For example, researchers could use baseline levels and facilitate realistic goal-setting by encouraging 5-10% increases on a weekly or monthly basis.

It would be of interest to consult experts in motivational interviewing (MI) to potentially improve the content of the discussions and feedback provided. Although this study did not utilize formal MIs, there is a lot of overlap in the content and goals provided herein, including motivational strategies such as giving advice, removing barriers, and providing choices to the individual, and promoting self-efficacy. Specifically, the aim of MI is to use a therapy-approach to resolve discrepancies between desired behaviors and actual behaviors, while increasing motivation to facilitate behavior change (Miller & Rollnick, 2009). MI typically consists of two phases: enhancing intrinsic motivation and strengthening one's commitment to change. Incorporating additional video chats focusing on strengthening the commitment to behavior change, after the participant has been engaging in the behavior, may help to maintain self-efficacy levels and further enhance physical activity levels. For example, from an MI perspective, the three chats used in this study can be used to enhance motivation for starting the new behavior of engaging in regular physical activity. Once the participant engages in the behavior and feels confident, the interventionist can "check in" with the participant through additional chats, providing information previously related to commitment. Such strategies can include asking individuals to agree to an additional task or goal related to the behavior and implementing active decisions (verbally opting in to committing to a new goal). These strategies can serve as self-signals that inform self-perceptions and guide subsequent behavior to align with previously established commitments (Baca-Motes, Brown, Gneezy, Keenan, & Nelson, 2012). This strategy would also be aligned with theorized antecedents of physical activity self-definition processes, requiring one to reflect upon his or her commitment indirectly via 'wanting to' and 'trying to' (Kendzierski & Morganstein, 2009). Reviews of MI have found that group-delivered MIs are less effective than one-on-one (Lundahl & Burke, 2009). Moreover, MIs can be administered using technology (Shingleton & Palfai, 2016) and MIs have been shown to be effective in brief, 15-minute sessions, with multiple sessions being more effective than one session for behavior change (Rubak, Sandbæk, Lauritzen, & Christensen, 2005).

When implementing a psychological intervention, it is important to address cultural differences, as researchers have found that failing to do so can lead to disengagement (Oh & Lee, 2016). For example, minority communities which are often socialized through interdependent value systems (e.g., having a greater value of family and community over oneself) may not benefit from conventional psychosocial interventions that tend to promote individualistic value systems. Moreover, ethnic minority groups that experience poverty and limited access to resources may respond differently to an intervention compared to other majority groups (Bernal & Sáez-Santiago, 2006). To decrease disparities in intervention delivery, cultural values, community resources, and socioeconomic status (SES) must be considered. Given that 81% of Americans own smartphones (Pew Research Center, 2019), interventions that deliver information via smartphone apps or SMS messaging can potentially be scaled and disseminated amongst different ethnic and SES groups. Moreover, cultural adaptations including language, people, metaphors, content, concepts, goals, methods, and context, can be used to culturally adapt evidence-based interventions (Hall, Ibaraki, Huang, Marti, & Stice, 2016). Utilizing a tailored approach may provide an opportunity to overcome potential cultural biases, as the discussions that occur during the video chats can be adapted to include the considerations listed above. Specifically, the language used and person delivering the intervention can be adapted to match the language and ethnicity of the participant. Moreover, the content of the chats, including goals, examples provided, and intervention method can be modified in order to cultivate interpretations of the information that are relevant to the specific culture, values, or ethnicity of the individual.

Understanding the perceived quality of the content provided can inform future interventions. Specific to this study, participants at the start of the study received the intervention from a different staff member than those at the end of the study. Research assistants completed a thorough training of administering the interactive video chats and a script was provided to ensure the staff members were delivering the information in the same fashion. Still, it is possible that slight discrepancies in their delivery could have caused differences in participant response. Both of the staff members were young, physically fit, Caucasian females. Attributes such as age, appearance, and other similarities across demographics (i.e., model similarity and self-to-prototype match) could potentially build a closer bond between participants and interventionists. Theoretically, self-efficacy can be enhanced through observational learning, the observation of someone similar succeeding at a specific task or behavior (Bandura, 1998). Although observational learning, or vicarious experience, has been shown to be the second most-powerful efficacy source of information (following mastery experience), to increase self-efficacy, it has been given cursory attention in the physical activity domain (Ashford, Edmunds, & French, 2010). Recently, Rowland and colleagues (2018) tested the efficacy of a peer modeling workplace intervention for promoting physical activity levels among female employees. They found that female employees who interacted with peer models (female employees who were similar in gender, age and family demands and were meeting the 2008 Physical Activity Guidelines for moderate intensity exercise) had increased physical activity levels and greater improvements in fitness and cardiovascular risk over the course of 12-weeks compared to the attentional control group (Rowland et al., 2018).

Although group differences were not found in self-efficacy scores or physical activity levels at follow-up (week six), this should not be interpreted as an unsuccessful attempt for promoting self-efficacy and physical activity. Indeed, such results complement previous research showing that exercise self-efficacy scores decline during initial behavior change interventions, and again, at the conclusion of such programs; for a brief review, see McAuley, Mailey, et al. (2011). Perhaps the completion of brief SCT-guided chats during the first three weeks of an exercise program can prolong the expected period when efficacy levels drop, as demonstrated in this study. The continuation of interaction and delivery of SCT-based information through interactive video chats could improve maintenance over longer periods of time, while still reducing participant burden. Moreover, it is possible that results were constrained by a ceiling or floor effect, as the study sample consisted of relatively active, low-stressed, highly educated full-time working adults. Although prospective participants were screened for regular physical activity participation over the prior three months, it is possible that the definition of two or more days per week for at least 30-minutes allowed for the possibility of participants who engaged in shorter durations of activity equivalent to or in excess of this definition, to be eligible for this study. To further promote efficacy levels across time, providing an online platform for participants to serve as a social support outlet for discussing expectations and strategies for participating in physical activity could be a useful addition to this study. Provided that there is evidence that social support can promote engagement in health behaviors like physical activity, enlisting support from other participants or encouraging participants to seek support from family members or friends could make the intervention more effective once the video chats are completed.

Furthermore, future studies may also want to consider the various formats of full-time employment. Teleworkers, or individuals who work remotely, have become increasingly more popular with new mobile online technologies and the accessibility of smart devices, leading to work being completed outside of the office. Working off-site can potentially alleviate the time burden by lowering commute times and allowing more flexibility for when individuals work throughout the day. However, a survey of 456 government-employed teleworkers in Sweden examining how home-based telework affects employees' perceived time pressure and time use control in everyday life revealed that teleworking appears to contribute to the perception of feeling "time-pressed" by expanding and intruding on free time (Thulin, Vilhelmson, & Johansson, 2019). Thus, the brief intervention used in this study, and the flexibility of the lifestyle physical activity program, may also benefit full-time teleworkers who may be working longer hours from home and perceived themselves as having less free time.

Finally, a recent cross-sectional study examining free time and physical activity showed that American adults believe they do not have enough time to engage in regular physical activity. Such perceptions are consistent across age, gender, and socioeconomic status for individuals who do not engage in regular physical activity (Bellows-Riecken & Rhodes, 2008; Borodulin et al., 2016; CDC, 2017c; Cohen-Mansfield, Marx, & Guralnik, 2003; Manaf, 2013; Welch, McNaughton, Hunter, Hume, & Crawford, 2009). However, American adults tend to have on average five hours of free time each day, with most of this time being spent on smartphones, computers, or television screens (Sturm & Cohen, 2019). Therefore, future research should aim to change individuals' perception of time, whether that is through training cognition such as processing speed and attention or by addressing these perceptions at the start of a physical activity program. The mediation analysis in this study did show that improvements in self-efficacy was responsible for some of the subsequent physical levels, but self-efficacy is not the only factor contributing to physical activity behaviors. There are other reasons for the high levels of inactivity among this population that should be considered, including workers with irregular schedules (e.g., police, firefighters, medical workers). Barriers for engaging in physical activity vary based on the individual and their occupation and personal obligations. The aim of this study was to provide individuals with the information and strategies needed to integrate physical activity into their daily lives. Therefore, helping individuals realize that they do have enough time to be physically active, and increasing their confidence in their ability to do so, should facilitate healthier mindsets towards physical activity for the average working adult.

Conclusion

Findings from this study support the feasibility of delivering information remotely through interactive video chats appears to be feasible for individuals across the working adult lifespan (age 25-64). Moreover, the results support the use of a brief, 10-minute interactive video chat for promoting lifestyle physical activity self-efficacy. Findings from this trial may be useful for individuals needing a boost in confidence in their ability to be physically active or to health coaches, clinicians and researchers interested in efficacious behavior change strategies. Further research is needed to replicate and extend these findings across a larger sample to develop an effective, viable method that can be disseminated and have an impact on full-time working adults' health and quality of life.

Chapter VI: Figures

Figure 1

SIMPLEX Study Flow Chart

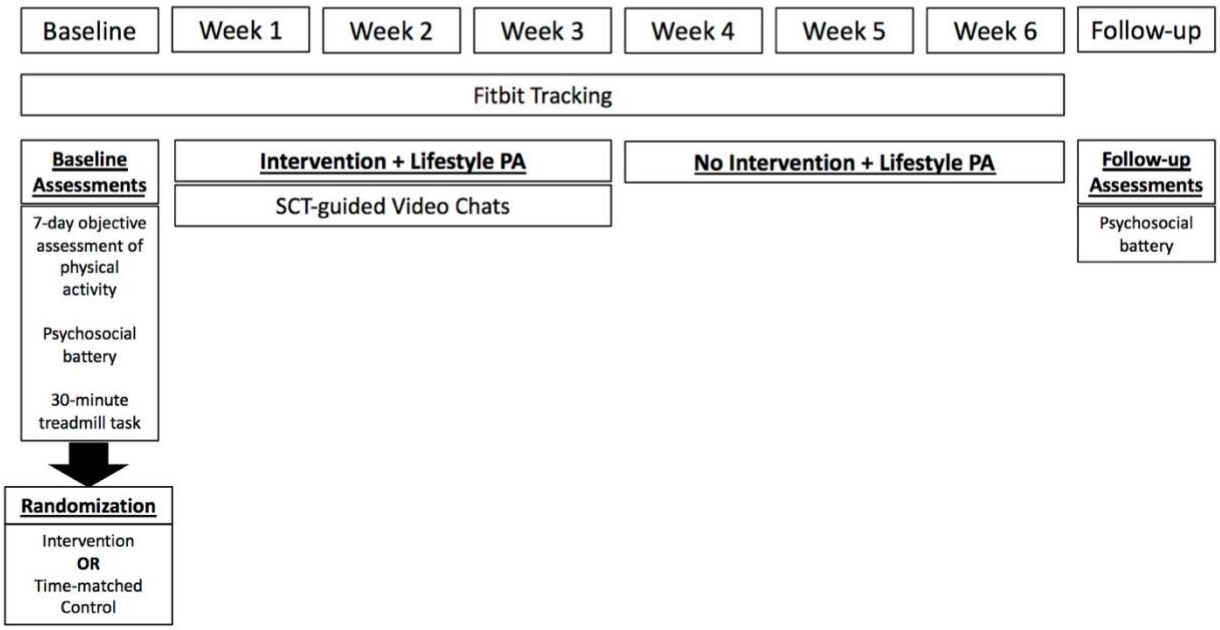


Figure 2

Study Consort

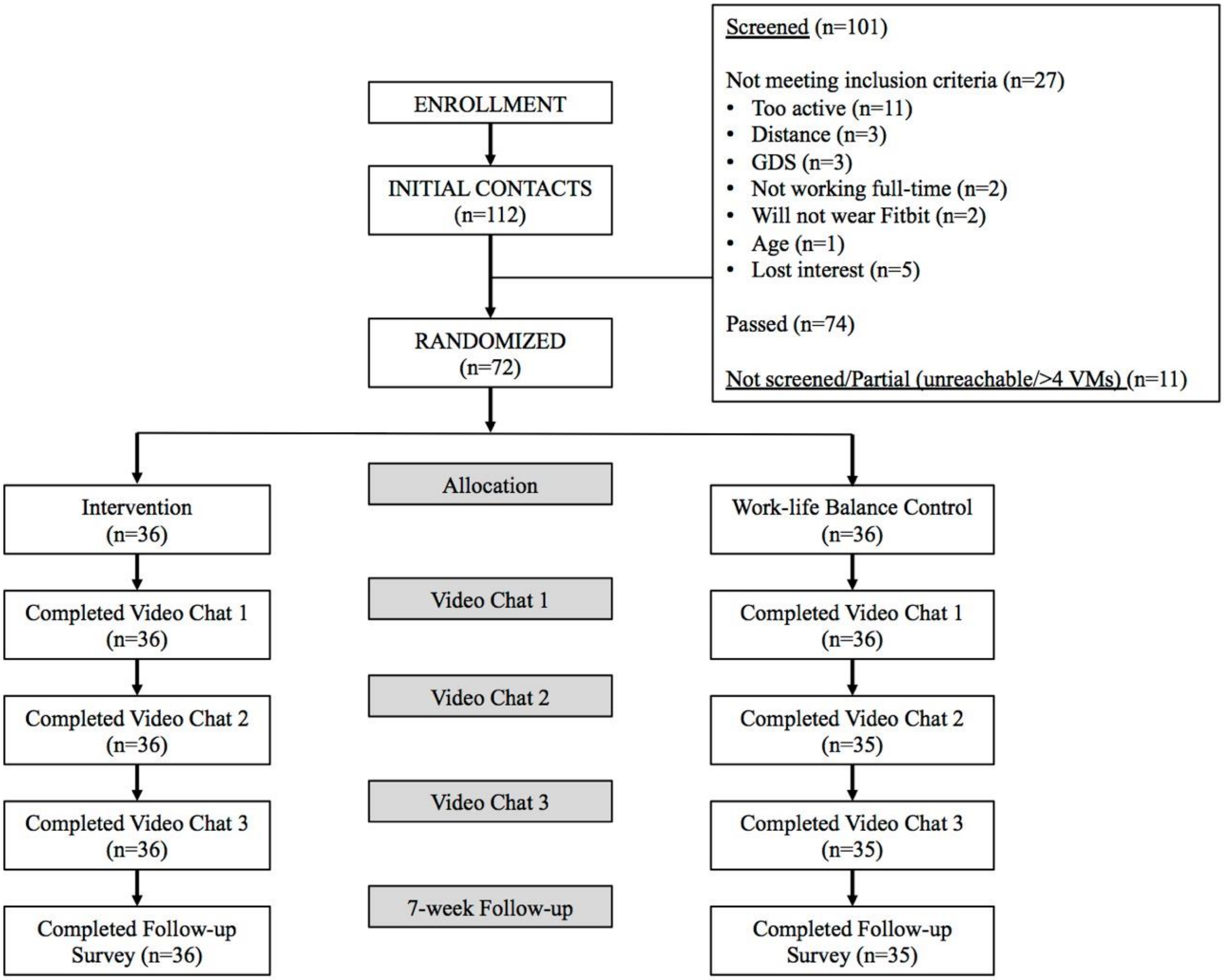
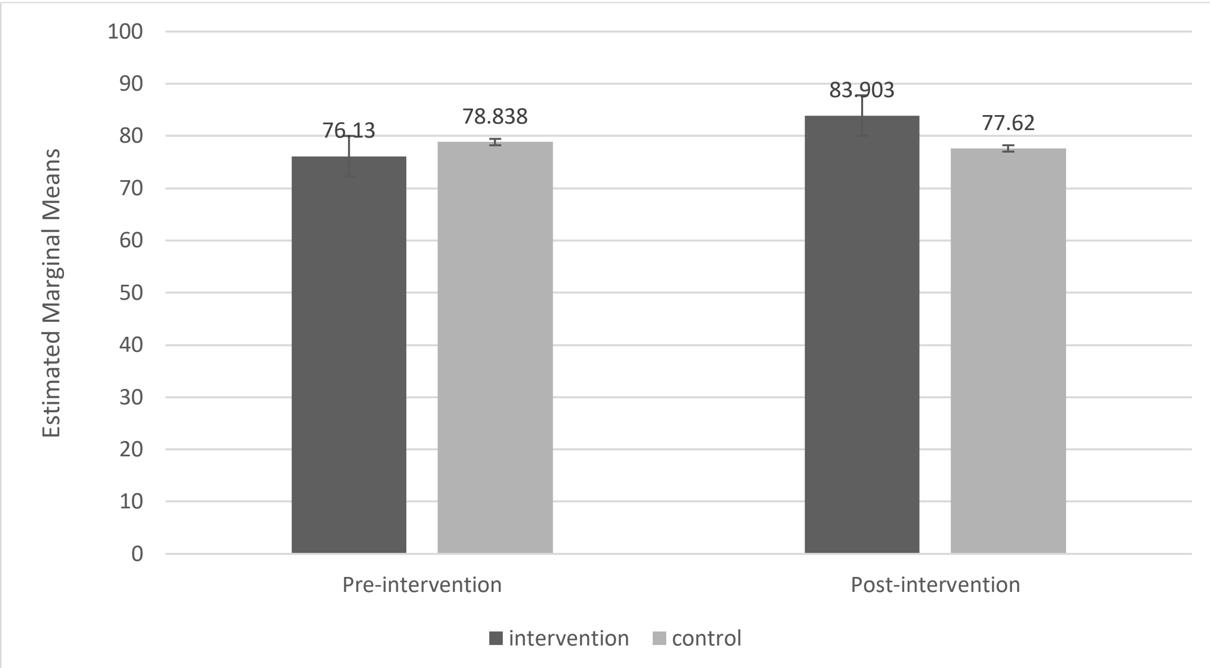


Figure 3

Estimated Marginal Means for LSE (Pre-post Completion of Three Video Chats)



Note. Covariates appears in the model are evaluated at the following values: Age = 46.57, Gender = 0.76, Education = 4.42, Baseline steps = 8527.7821, LSE Baseline Score = 79.5602.

Figure 4

Lifestyle Physical Activity Self-Efficacy Scores by Group

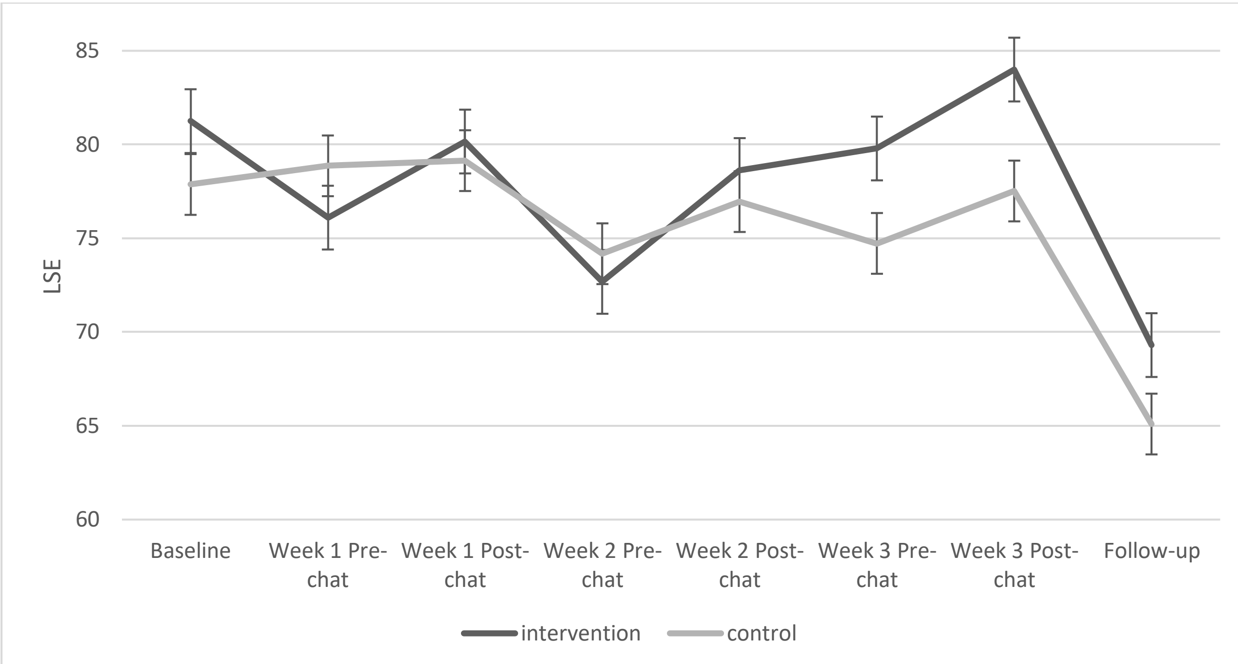


Figure 5

Self-Efficacy to Regulate Work and Life Scores by Group

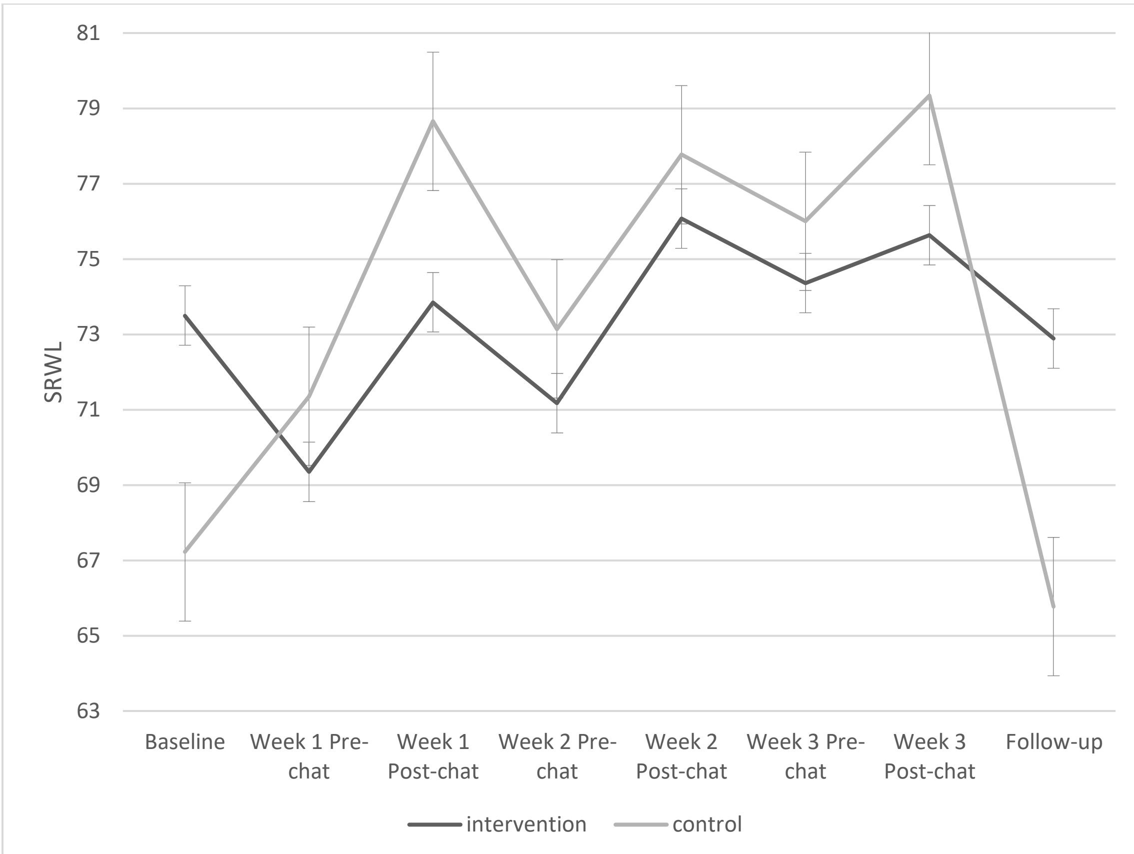
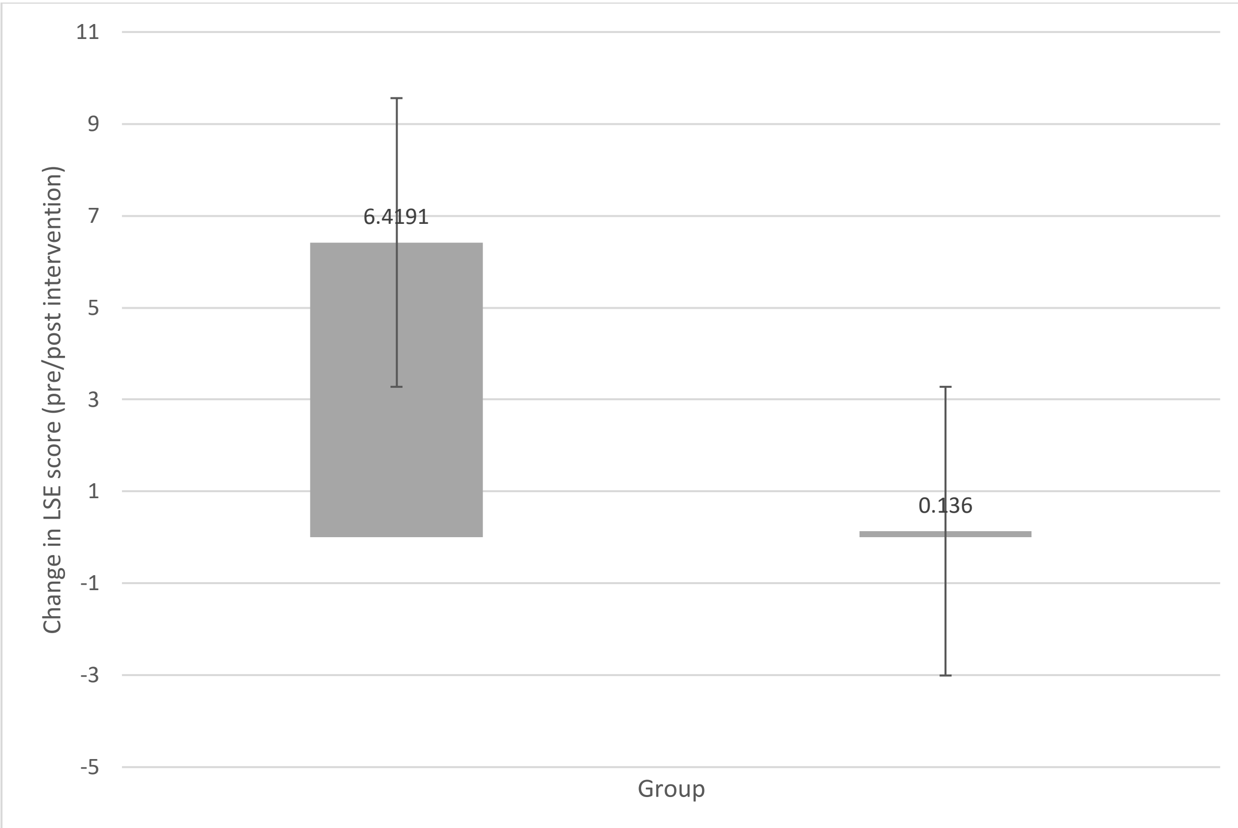


Figure 6

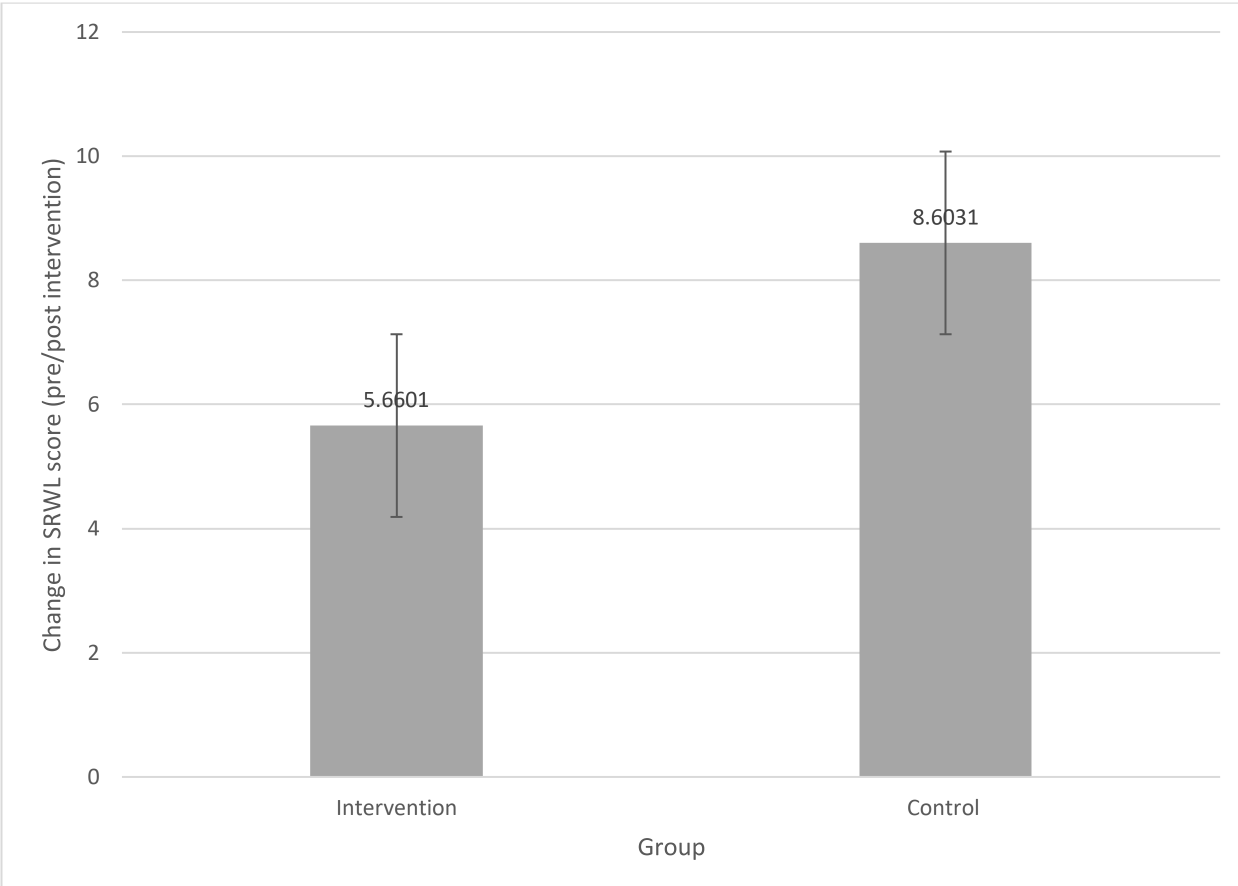
Mean Change Scores of LSE



Note. Change scores are pre-post intervention (week 3 post-chat minus week 1 pre-chat).

Figure 7

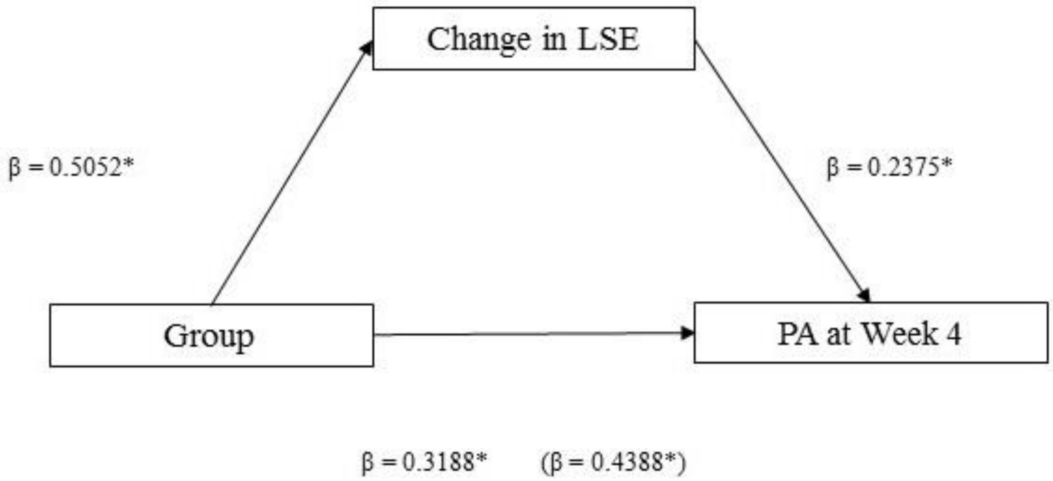
Mean Change Scores of SRWL



Note. Change scores are pre-post intervention (week 3 post-chat minus week 1 pre-chat).

Figure 8

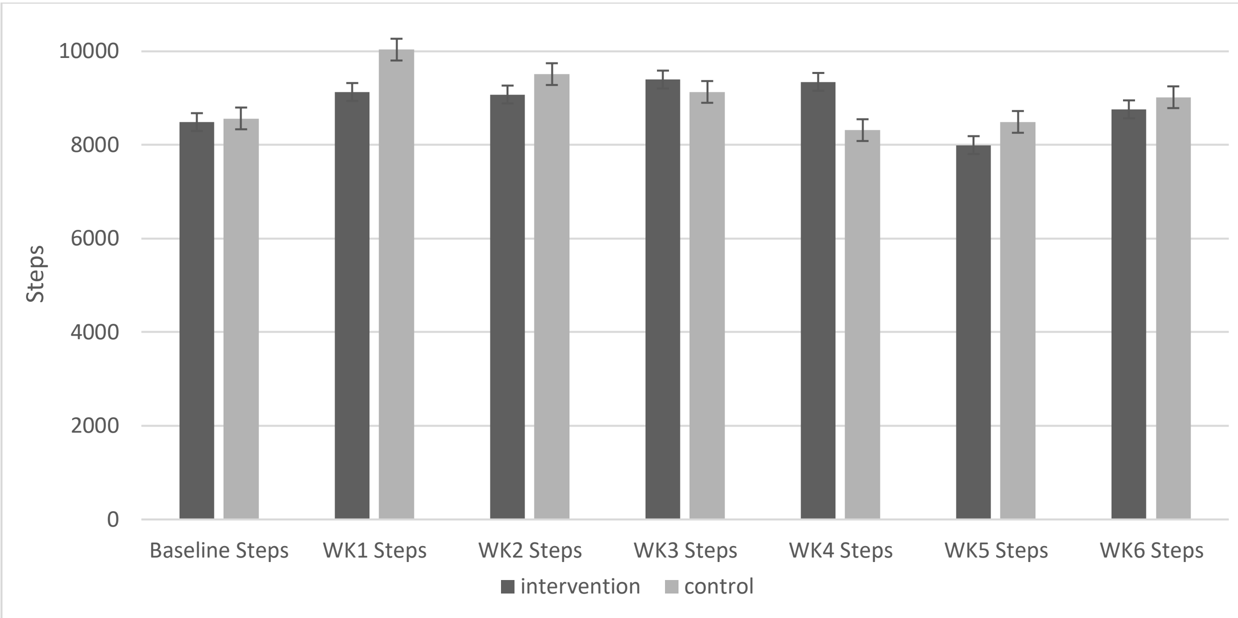
Mediation Analysis between Group and Physical Activity as Mediated by LSE change



Note: Standardized regression coefficients are shown for the relationship between group and physical activity levels (7-day average step count at Week 4) as mediated by change in LSE scores. The standardized regression coefficient between group and PA, controlling for change in LSE scores, is in parentheses. *$p < 0.05$.

Figure 9

Weekly Step Count (7-day average) by Group



Chapter VII: Tables

Table 1

Comprehensive List of Measures

Construct	Measure	Assessment Time-Point
Health History	Health History Questionnaire	Screening
Demographics	Demographics Questionnaire	Screening
Primary Outcomes		
Self-efficacy	Lifestyle Efficacy Scale (LSE; McAuley, 2009)	Baseline, Pre/post-video chats, 7-week Follow-up
	Self-efficacy to regulate work and life (Chan et al., 2016)	Baseline, Pre/post-video chats, 7-week Follow-up
	Barriers Self-efficacy Scale (BARSE; McAuley, 1992)	Baseline, 7-week Follow-up
Secondary Outcomes		
Physical activity	Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985)	Baseline, 7-week Follow-up
	Sedentary Behavior Questionnaire (SBQ; Rosenberg et al., 2010)	Baseline, 7-week Follow-up
Self-regulation	Exercise Planning and Scheduling Scale (EPSS; Rovniak et al., 2002)	Baseline, 7-week Follow-up
	Physical Activity Self-regulation Scale (PASR; Hallam, 1998)	Baseline, 7-week Follow-up
Outcome Expectations	Multidimensional Outcome Expectations for Exercise Scale (MOEES; Wojcicki, White, & McAuley, 2009)	Baseline, 7-week Follow-up
Affect	The Feeling Scale (FS; Hardy & Rejeski, 1989)	Pre- and Post-baseline treadmill assessment
	Anticipated Negative Affect Questionnaire (ANAQ) (Wang, 2011)	Pre- and Post-baseline treadmill assessment
	Forecasted Pleasure (Zenko et al., 2016)	Pre- and Post-baseline treadmill assessment
General and Job-related Stress	Brief Job Stress Questionnaire (BJSQ; Kawada & Otsuka, 2011)	Baseline, 7-week Follow-up
	Perceived Stress Scale (PSS; Cohen et al., 1983)	Baseline, 7-week Follow-up
Work-life Balance	Work-Life Balance Scale (LWB-6; Gropel, 2006)	Baseline, 7-week Follow-up
Program Enjoyment and Satisfaction	Physical Activity Enjoyment Scale (PACES; Kendzierski & DeCarlo, 1991)	7-week Follow-up
	Program satisfaction and feasibility questions (e.g. “Would you recommend this program to others?”)	7-week Follow-up: to be completed via in-person interview for assessing feasibility and acceptability

Table 2

Baseline Demographic Characteristics by Randomized Group.

	Intervention (N=36) *N/M (SD)*	Control (N=36) *N/M (SD)*
Sex (female)	30	23
Race		
Caucasian	29	25
African American	2	5
Asian	4	6
Mixed Race	1	0
Ethnicity		
Hispanic or Latino	2	2
Not	34	34
College (degree)	32	33
Employment		
Govt. Employee: State govt.	28	23
Govt. Employee: Local govt.	1	3
Private Sector: For Profit	3	6
Private Sector: Non-Profit	4	3
Self-employed	0	1
Household Income		
Less than $20,000	1	1
$20,001-$39,999	3	4
$40,000-$74,999	18	6
$75,000-$99,999	4	9
More than $100,000	8	13
Prefer not to respond	2	3
Age (yrs.)	46.32 (9.010)	46.83 (9.51)
Married	20	23
Physical activity (7-day step average)	8488.34 (4756.40)	8567.23 (2882.70)
Degree of difficulty with seeing:		
None	24	26
Slight	12	8
Moderate	0	2
Degree of difficulty with hearing:		
None	28	25
Slight	7	10
Moderate	1	1
Degree of difficulty with walking:		
None	33	32
Slight	2	4
Moderate	1	0
Degree of difficulty with lifting:		
None	34	34
Slight	2	1
Moderate	0	1
Degree of difficulty with memory:		
None	20	23
Slight	13	8
Moderate	3	5
Diagnosed with heart disease:		
No	34	36
Yes	2	0
Diagnosed with cancer:		
No	33	36
Yes	3	0
Diagnosed with diabetes:		
No	33	33
Yes	3	3

Note. No significant differences were observed at baseline across groups.

Table 3

NCCIH Feasibility Questions for Pilot Study.

Feasibility Questions	Feasibility Measures	Response
Can I recruit my target population?	Number screened per month; number enrolled per month; average time delay from screening to enrollment	N=101 screened over 5-month time span (April: n=41, May: n=10, June: n=12, July: n=25, August: n=13) Number enrolled per month: April: n=35, May: n=5, June: n=2, July: n= 28, August: n=2 Very little delay (1-2 days) from screening to enrollment Conversion rate of enrolled to interested/screened: 72:101 N=2 participants were interested and passed screening but were lost to follow-up
Can I randomize my target population?	Proportion of eligible screens who enroll; proportion of enrolled who attend at least one session	N=72/101 were enrolled; 72/72 attended at least one session.
Can I keep participants in the study?	Treatment-specific retention rates for study measures; reasons for dropouts	Intervention: 36/36 completed psychosocial battery at baseline and follow-up; Control: 35/36 completed psychosocial battery at baseline and follow-up; 1 dropout reason: lost to follow-up
Will participants do what they are asked to do?	Treatment-specific adherence rates to study protocol (in-person session attendance, homework, home sessions, etc.); treatment-specific competence measures	Intervention: 36/36 adhered to all aspects of study; Control: 35/36 adhered to all aspects of study; 77.78% of sample had valid Fitbit days for the entirety of the study 2.85% missing Fitbit data (65/3,024 possible days of wear (six full weeks for 72 participants).
Can the treatment(s) be delivered per protocol?	Treatment-specific fidelity rates	100% of scheduled video chats were completed
Are the assessments too burdensome?	Proportion of planned assessments that are completed; duration of assessment visits	72/72 completed baseline assessment (1 hour visit); 71/72 completed follow-up (30-minute visit)
Are the treatment conditions acceptable to participants?	Acceptability ratings; qualitative assessments	93% enjoyed participating in 7-week study; 82% did not find study to be a burden; 71% enjoyed all of the video chats; 84% would recommend to a friend or family member
Are the treatment conditions credible?	Treatment-specific expectation of benefit ratings	40% of experimental group found video chats helpful for increasing PA; 40% replied maybe; 20% reported not useful for increasing PA

Table 4

Correlations of LSE and SRWL Scores Across Study

	PA Week 1	PA Week 2	PA Week 3	PA Week 4	PA Week 5	PA Week 6
LSE Chat 1 - Pre	.30*	.33*	.36*	.29*	.13	.16
LSE Chat 1 - Post	.36*	.36*	.44*	.37*	.26*	.19
LSE Chat 2 - Pre	.35*	.33*	.36*	.27*	.18	.20
LSE Chat 2 - Post	.34*	.31*	.38*	.30*	.17	.20
LSE Chat 3 - Pre	.27*	.35*	.36*	.22	.27*	.17
LSE Chat 3 - Post	.26*	.33*	.32*	.20	.24*	.24*
SRWL Chat 1 – Pre	.22	.18	.22	.05	-.03	.02
SRWL Chat 1 - Post	.27*	.20	.23	.07	-.02	-.02
SRWL Chat 2 - Pre	.37*	.31*	.35*	.22	.10	.14
SRWL Chat 2 - Post	.36*	.31*	.34*	.21	.08	.14
SRWL Chat 3 - Pre	.21	.19	.20	.01	.03	.00
SRWL Chat 3 - Post	.22	.20	.19	.00	.07	.05

Note. * = $p < .05$, LSE = Lifestyle Self-efficacy Scale; SRWL = Self-efficacy to Regulate Work and Life Scale

Table 5

Average Weekly Step Count via Accelerometer Data with and without Imputations.

	M Without Imputation (*SD)*	*M* With Imputation (*SD)*
Week 1	9416.50 (4311.29)	9583.96 (4217.37)
Week 2	9179.52 (3847.93)	9295.50 (3686.02)
Week 3	9174. 57 (3746.51)	9265.15 (3640.93)
Week 4	8773.64 (3691.44)	8832.61 (3613.74)
Week 5	8180.90 (3169.84)	8244.86 (3154.48)
Week 6	8717.26 (3703.75)	8890.72 (3568.04)

Table 6

Baseline and Follow-up Psychosocial Measures by Group.

Measure	Baseline		Follow-up	
	Intervention (N=36) *N/M (SD)*	Control (N=36) *N/M (SD)*	Intervention (N=36) *N/M (SD)*	Control (N=35) *N/M (SD)*
FS[a]	3.14 (1.82)	2.61 (2.03)	N/A	N/A
ANAQ[b]	4.36 (0.95)	4.50 (0.85)	N/A	N/A
FP[c]	42.22 (39.94)	25.00 (40.39)	N/A	N/A
Stroop Inhibition Reaction Time (ms)	857.39 (451.411)	952.72 (267.001)	N/A	N/A
SBQ[d]				
Weekday total	12.40 (3.99)	10.59 (5.28)	10.53 (3.67)	9.59 (5.24)
Weekend total	11.19 (5.23)	9.69 (5.51)	9.22 (4.18)	8.77 (4.24)
Total weekly hours	84.35 (28.12)	72.32 (34.37)	71.10 (24.97)	65.51 (31.58)
GLTEQ[e]	21.89 (21.62)	26.42 (22.38)	74.94 (69.81)	52.86 (26.73)
LSE[f]	81.25 (21.64)	77.87 (24.63)	69.31 (23.97)	65.10 (28.38)
BARSE[g]	56.03 (21.67)	47.12 (22.28)	52.46 (22.69)	42.84 (20.65)
SRWL[h]	73.50 (18.13)	67.22 (17.64)	72.89 (21.55)	65.77 (20.70)
EPSS[i]	18.67 (6.88)	21.47 (7.10)	23.72 (7.29)	23.94 (6.76)
PASR[j]	25.92 (7.86)	28.44 (9.19)	37.00 (9.97)	33.97 (7.88)
Self-monitoring subscale	4.78 (1.96)	5.64 (2.07)	7.22 (1.69)	6.71 (1.74)
Goal-setting subscale	4.78 (1.94)	4.78 (1.90)	6.22 (2.38)	5.74 (1.96)
Social support subscale	3.28 (1.83)	3.39 (1.66)	4.17 (2.09)	3.46 (1.98)
Reinforcement subscale	6.44 (2.30)	6.72 (2.54)	7.72 (2.30)	7.60 (2.05)
Time management subscale	3.81 (1.58)	4.19 (2.00)	5.94 (2.34)	5.89 (1.83)
Relapse prevention subscale	3.67 (1.53)	3.92 (1.89)	5.92 (2.27)	4.94 (2.11)

Table 6

(Cont.)

Measure	Baseline		Follow-up	
	Intervention (N=36) *N/M (SD)*	Control (N=36) *N/M (SD)*	Intervention (N=36) *N/M (SD)*	Control (N=35) *N/M (SD)*
MOEES[k]				
Physical subscale	27.39 (2.41)	27.44 (2.57)	26.94 (2.67)	27.60 (2.80)
Self-evaluative subscale	22.28 (2.73)	21.44 (2.70)	21.91 (2.79)	21.89 (2.78)
Social subscale	12.19 (3.17)	11.58 (4.24)	11.56 (3.48)	12.03 (4.05)
BJSQ[l]	37.42 (5.93)	37.31 (7.00)	38.56 (7.06)	37.40 (6.34)
WLB-6[m]	24.67 (6.23)	24.64 (5.90)	24.00 (5.84)	24.60 (6.09)
PSS[n]	15.47 (6.82)	16.94 (5.80)	14.75 (5.89)	16.97 (6.71)
ESSQ[o]				
Exerciser Schematic	1	2	8	4
Nonexerciser	14	14	4	7
Aschematic	2	4	2	5
Unclassified	19	16	22	20
PACES[p]	87.28 (18.10)	85.69 (21.29)	94.92 (18.46)	85.94 (23.95)

Note. No significant differences were observed at baseline across groups.
a=The Feelings Scale, b=Anticipated Negative Affect Questionnaire, c=Forecasted Pleasure, d=Sedentary Behavior Questionnaire, e=Godin Leisure Time Exercise Questionnaire, f=Lifestyle Self-efficacy Questionnaire, g=Barriers-specific Self-efficacy Scale, h=Self-efficacy to Regulate Work and Life, i=Exercise Planning and Scheduling Scale, j=Physical Activity Self-regulation Scale, k= Multidimensional Outcome Expectations for Exercise Scale, l=Brief Job Stress Questionnaire, m=Work-life Balance Scale, n=Perceived Stress Scale, o=Exercise Self-schema Questionnaire, p=Physical Activity Enjoyment Scale

Table 7

Correlations between Psychosocial Questionnaires at Baseline and Physical Activity.

	PA Week 1	PA Week 2	PA Week 3	PA Week 4	PA Week 5	PA Week 6
SBQ-Weekday	-.06	-.01	-.00	-.01	-.05	-.13
SBQ-Weekend	.05	.08	.10	.14	.08	.01
SBQ-Total	-.02	.02	.04	.04	-.01	-.09
GLTEQ	.43*	.38*	.35*	.29*	.38*	.30*
LSE	.30*	.24*	.36*	.30*	.20	.15
BARSE	.17	.17	.17	.16	.01	.08
SRWL	.13	.16	.16	.04	.01	-.06
EPSS	.42*	.21	.28*	.17	.09	.29*
PASR	.14	.05	.10	.02	.14	.19
MOEES-Physical	.19	.16	.16	.14	.05	-.05
MOEES-Self	.18	.19	.19	.10	.00	.05
MOEES-Social	.03	.14	.13	-.04	-.02	.02
BJSQ	.18	.12	.14	.10	.06	.25*
WLB-6	.04	-.03	-.00	.03	-.13	-.10
PSS	.04	.02	-.02	-.09	.11	.21
ESSQ	-.27*	-.16	-.18	-.11	-.18	-.14
PACES	.32*	.33*	.35*	.24*	.22	.34*

Note. * = $p < .05$

Table 8

Correlations of Affect and Stroop Scores at Baseline Appointment with Physical Activity.

	PA Week 1	PA Week 2	PA Week 3	PA Week 4	PA Week 5	PA Week 6
FS[a]	.35*	.37*	.30*	.32*	.25*	.21
ANAQ[b]	.10	-.00	-.04	-.14	-.09	-.04
FP[c]	.31*	.37*	.31*	.39*	.21	.24*
Stroop (ms)	-.12	-.04	-.11	-.12	-.08	-.16

Note. * = $p < .05$; [a]=The Feelings Scale, [b]=Anticipated Negative Affect Questionnaire, [c]=Forecasted Pleasure

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