DISSERTATION

AN AFFECTIVE INTERVENTION TO IMPROVE LONG-TERM EXERCISE PARTICIPATION BY ENHANCING ANTICIPATED, IN-TASK, AND POST-TASK AFFECT

Submitted by

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In partial fulfillment of the requirements

For the Degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Spring 2019

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ABSTRACT

AN AFFECTIVE INTERVENTION TO IMPROVE LONG-TERM EXERCISE PARTICIPATION BY ENHANCING ANTICIPATED, IN-TASK, AND POST-TASK AFFECT

The benefits of regular exercise are immense. Among these benefits are lower morbidity and mortality rates and an improved quality of life. Currently in the United States though, most adults do not meet exercise recommendations; in addition, per capita health care costs have more than doubled since 2000, and nearly 30% of adults are obese. Exercise is a prime mechanism to improve the health of Americans, but current behavior-change models in this area only modestly predict exercise behavior. The lack of exercise enjoyment is a major barrier towards behavior change, and for many, exercise does not feel good. This dissertation describes an intervention that built off both the hedonic theory of motivation and past research in the area of affect and exercise. Both adults in the Northern Colorado area and students at Colorado State University were recruited to participate in an intervention with the goal of increasing exercise behavior by improving exercise-related affect. Seventy-four participants went through a 15-week period where their exercise behavior was tracked: at a baseline laboratory visit, those in the affective intervention condition learned how to make exercise more enjoyable and the importance of doing so, while those in the standard intervention condition set personal exercise goals. Participants in the affective intervention condition increased their exercise levels over baseline levels more so than participants in the standard intervention condition throughout each of the fifteen weeks, although a mixed model repeated measures analysis of variance showed that this effect did not

reach traditional measures of statistical significance. Fitness level and exercise performance saw no significant changes from pre- to post-intervention testing in either group. Implications from this experiment extend from adding to past research in this area by adding a longitudinal affective intervention to the literature to creating a new, forward-thinking mechanism towards health behavior change. In addition, these results highlight the difficulty of behavioral interventions in exercise science without strong incentives for participants to increase their exercise behavior. Some of the reasons for that difficulty, such as participants' perceived lack of available time to exercise (the most commonly reported barrier), are discussed in this dissertation's discussion section.

ACKNOWLEDGEMENTS

I would like to sincerely thank my advisor, Dan Graham, for not only his guidance and help with this project, but for his mentorship throughout my time in graduate school.

Through times when I was a good graduate student to the many times I displayed "opportunity for growth," Dan was caring and supportive. When I look back on my time in Colorado, I will remember a challenging but immensely positive experience – and Dan is such a large part of that.

Pleasant memories are, at least in my opinion, one of the greatest gifts someone can give to another.

Dan is the epitome of what I aspire to be someday: prolific at his work, practicing what he preaches outside of work in his health and fitness, and more importantly, someone who is kind, enthusiastic, and funny.

For his guidance and support throughout the year and a half of his project, as well as through all of my years in graduate school, I would like to give a large, sincere thank you to Dan.

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CHAPTER 1 - INTRODUCTION

Physical Inactivity in the United States and its Associated Health Risks

Despite the ominous and ubiquitous warnings that portray the dangers of a primarily sedentary lifestyle, the majority of adults in the United States do not engage in regular physical activity, or exercise. Only about 20% of American adults currently meet physical activity guidelines (Centers for Disease Control and Prevention (CDC), 2015), and the lack of physical activity has been shown to be directly associated with over 10% of the healthcare costs in the United States (> $300 billion) (Carlson et al., 2015). Additionally, health care costs in the United States are rising at an alarming rate, and per capita health care costs have more than doubled since 2000 and are currently 18% of the national Gross Domestic Product (GDP) (Centers for Medicare and Medicaid Services, 2017). Regular physical activity is also associated with a decreased risk for depression and anxiety, as well as an improved self-concept and greater quality of life (Faulkner & Taylor, 2005). There are clear public health and quality of life reasons for more Americans to engage in more physical activity, and with regular physical activity being a highly effective preventative health mechanism, increasing population level physical activity rates would significantly reduce health care costs.

Obesity in the United States is yet another reason to believe there should be more physical activity among U.S. citizens. There is currently an epidemic of obesity (condition where a person has accumulated excess body fat) in the United States (i.e., over 35% of adults are overweight, and nearly 30% are obese; CDC, 2015), and this condition comes with multiple health concerns. Obesity has been shown to influence the development of heart disease, Type 2 Diabetes, and many different types of cancer – and those with obesity are at an increased risk for

a low quality of life, regular body pain, and mental illness (CDC, 2015). Regular physical activity is an optimal strategy towards fighting obesity. Physical activity fights against obesity and works in a preventative measure in multiple ways, such as through increased energy expenditure and decreased body fat (Harvard School of Public Health, 2017). In addition, muscle strengthening activities (such as weight lifting) increase muscle mass; muscle-strengthening activities therefore result in an increase in calories burned throughout the day (from rebuilding and increasing of muscle tissue), even while at rest (Harvard School of Public Health, 2017).

Commonly Reported Barriers to Engaging in Regular Physical Activity

There are likely many reasons for this low rate of physical activity participation among adults in the United States. One commonly reported barrier is the **lack of time** to engage in regular physical activity, or that engaging in physical activity would be inconvenient (CDC, 2011; Potvin, Gauvin, & Nguyen, 1997). Many Americans purport *wanting* to engage in more physical activity, but perceive that their daily schedules do not allow it.

Another common barrier to engaging in regular physical activity is **low self-efficacy** towards exercise behavior, or feelings of incompetence towards performing movements associated with exercise (CDC, 2011; McAuley & Blissmer, 2000).

A third commonly reported barrier to engaging in exercise is the **lack of enjoyment** of physical activity (CDC, 2011). Enjoying exercise programs has been shown to be a key determinant in whether participants drop out (Wankel, 1985), and strong associations have been reported between increases in exercise levels over time and enjoyment of exercise (Hagberg et al., 2009). Enjoying exercise seems to be an important factor that is associated with physical activity levels.

Although these three barriers are the most commonly reported, the CDC lists ten common barriers to engaging in regular physical activity (2011). They also report suggestions for overcoming these barriers. Of the ten they list, the only barrier they do not have suggestions for overcoming is "do not find exercise enjoyable," which may highlight this barrier's unique challenge to overcoming and the lack of known mechanisms to do so. Considering that this barrier keeps a large amount of people from exercising regularly, finding mechanisms to help people enjoy exercise is of paramount importance (Hagberg et al., 2009; Wankel, 1985).

Lack of Effective Mechanisms to Increase Physical Activity Rates

Established cognitive theories show only modest associations with exercise behavior, showing that although variables such as those in the theory of planned behavior (attitudes, subjective norms, and perceived control) may be a few pieces of the puzzle in explaining exercise behavior (TPB; Ajzen, 1985), a lot of variability has gone unexplained in empirical work thus far. Overall, cognitive models account for no more than a quarter of the variation in exercise behavior (Ekkekakis & Defermos, 2012). Another cognitive mechanism used in behavior change that contributes to exercise behavior is goal setting, and understanding this mechanism's relationship to behavior change helps to form a clearer picture of motivation in an exercise context.

Goal setting is a common behavior change strategy for increasing exercise levels, as evidenced by the common focus on goal setting in guides for personal trainers to help their clients stay committed to exercise programs (ACSM's Resources for the Personal Trainer, 2013). A literature review looking at goal setting as a strategy for physical activity behavior change found the evidence for this strategy to be inconclusive (Shilts, Horowitz, & Townsend, 2004). Although some studies found support for goal setting in increasing physical activity levels,

overall only 32% of the studies fully supported goal setting as a strategy that successfully produced physical activity behavior change. This strategy may be insufficient for producing sustained behavior change efforts, and could even undermine intrinsic motivation towards an activity.

Intrinsic & Extrinsic Motivation

In observing how physical activity levels relate to intrinsic and extrinsic motivation, as well as how these types of motivations relate to goal setting, a further understanding can be attained of the relationship between goal setting and physical activity. Intrinsic and extrinsic motivation are central components of self-determination theory. When a person is intrinsically motivated to do something, they are doing it for their inherent enjoyment in that task (Ryan & Deci, 2000). In other words, they are not motivated by anything being attained once the task is finished, but rather by simply engaging in the task itself.

In contrast to intrinsic motivation, extrinsic motivation indicates being motivated by something that would be attained with participation in the activity, most notably once the task is finished (e.g., a reward). Deci and Ryan (1985) described four ways in which behavior can be extrinsically motivated, one of which is called regulation through identification. This occurs when a person values a goal to where they feel that accomplishing the goal is an important and valued part of their life. In other words, a person engaging in physical activity with a specific goal in mind would be extrinsically motivated by regulation through identification, and therefore may be less intrinsically motivated. This is not to say that the person cannot be enjoying the activity, but rather that the presence of the specific goal would present extrinsic motivation as at least part of the reason why they are engaging in the activity.

The Overjustification Effect

The overjustification effect explains how this extrinsic motivation may lead to decreased levels of physical activity over time, and is defined as a person's intrinsic interest in a behavior possibly being diminished by engaging in that behavior as an avenue towards an extrinsic goal (Lepper, Greene, & Nisbett, 1973). The premise of this effect is that extrinsically motivated behavior undermines intrinsic motivation because the *reason* for a person engaging in a behavior shifts towards extrinsic factors. A person may then lose a sense of autonomy in regards to the specific behavior – this therefore leads to decreased enjoyment when engaging in the behavior due to the loss of perceived autonomy.

The overjustification effect has been demonstrated in several paradigms, the first of which used money as an extrinsic reward for completing a puzzle (Deci, 1971). In the experiment, participants (college students) were randomly assigned to one of two conditions. The first condition was to work on a puzzle task three times with no monetary rewards throughout, and the second was to work on the same puzzle task three times with one monetary reward after the second time the students completed the task. What the researchers found was that the group that was paid after session two lost a significant amount of intrinsic motivation to partake in the activity when they were no longer paid the monetary reward during the third session. They concluded that extrinsic rewards decreased intrinsic motivation while positive feedback (i.e., verbal reinforcement), which was used instead of money in the other condition, increased intrinsic motivation.

A similar paradigm was conducted in preschool-aged children who had previously shown interest in a certain drawing task (Lepper, Greene, & Nisbett, 1973). The researchers split the children into three randomly assigned conditions: one condition had the children complete the

task while expecting a reward for doing so, another condition had the children complete the task and receive an unexpected reward for doing so, and the third condition had the children complete the task with no expectation or receipt of a reward. Relative to children receiving no reward for completing the task or receiving an unexpected reward after completing the task, receiving an expected reward after task completion significantly decreased the children's intrinsic activity in the task.

Implications of Extrinsically Motivated Behavior

There may be an important implication from this research on physical activity-related goals: it can be reasoned that achieving a goal would be an expected reward since it is explicitly known before actual accomplishment. Another overjustification-based paradigm has been tested on the practice of adult blood donation (Mellstrom & Johannesson, 2008). In the first condition, potential donors were simply given the chance to donate blood with no compensation, similar to the standard way in which blood is donated; in the second condition, potential donors were given an expected small monetary compensation for donating; finally, in the third condition, potential donors were given a choice between the same small compensation or to give a similar sized amount of money to charity. The second condition, where potential donors were given an expected small monetary compensation for donating, produced significantly fewer donors than did the other conditions.

These experiments show an important relationship between extrinsic rewards and subsequent intrinsic enjoyment and motivation. If engaging in physical activity for the reason of trying to accomplish one's goals (which can be reasoned to be at least *somewhat* extrinsic motivation due to engaging in the behavior not *solely* for one's enjoyment of it) decreases enjoyment and motivation to partake in subsequent physical activity, this could have a

detrimental effect on subsequent behavior. There is also an increasing amount of evidence that suggests physical activity maintenance is a product of affective responses (such as positive affect and enjoyment) to exercise just as much as it is a product of thoughtful, rational decision making, further justifying the importance of understanding the links between physical activity planning, affective responses to exercise, and enjoyment of exercise (Ekkakakis & Dafermos, 2012).

Attitudes Toward Physical Activity

Attitudes undoubtedly have an effect on behavior. This connection between attitudes and behavior has been shown in multiple contexts, such as attitudes toward religion predicting involvement in religious activities (Trusty & Watts, 1999), attitudes toward birth control predicting birth control use (Kothandapani, 1971), and attitudes toward illicit drugs predicting use of those drugs (McMillan & Conner, 2003); this connection also forms the foundation of frequently employed theories that attempt to bridge the gap between intention and behavior, such as the TPB (Ajzen, 1985). Attitudes toward physical activity have also been shown to predict behavior. Correlation coefficients between exercise attitude and behavior have been shown to be moderately strong (0.53 over a two-week period) (Terry & O'Leary, 1995), and the association between attitudes towards vigorous physical activity and self-reports of engaging in that behavior have been found to be moderately strong as well (correlations of around 0.45) (Godin et al., 1987).

Attitudes toward physical activity are not always positive in current culture though, such as when someone does not prioritize the time to be physically active, or avoids physical activity due to its perceived difficulty and/or unpleasantness. A negative attitude may be one factor that is causing the current low physical activity rates in the United States. Epidemiological interviews show that a significant portion of adults in the United States see regular physical activity as a

burden, both time-wise and physically (e.g., working out does not feel good) (CDC, 2011; Ekkekakis, Parfitt, & Petruzzello, 2011; Stutts, 2002).

If a mechanism to feel better and enjoy physical activity was established, it is sensible to think attitudes toward the behavior may change in a positive direction. In addition, research has shown that affective feelings toward a behavior, or how someone anticipates feeling if they engaged in or avoided a behavior, may play a unique role in formation of attitudes toward that behavior (Clore & Schnall, 2005). Overall, these improved attitudes toward engaging in regular physical activity would seem to have a positive impact on behavior, and likely would result in increased exercise participation.

Affect's Relationship to Physical Activity Behavior

It is likely that attitudes and intrinsic motivation towards engaging in physical activity would improve with a better affective relationship to physical activity. In addition, certain outcomes would likely improve, such as overall exercise participation. An affective reaction to physical activity can be defined as simply the pleasure or displeasure that physical activity brings about; this type of affect is often referred to as "basic affect" and is widely accepted in physical activity research (Ekkekakis & Petruzzello, 2000). Moods and emotions may be components of affect, and are often considered *distinct* affective states, but basic affect is more broadly defined (Williams et al., 2008). Similar to moods and emotions though, affect is a psychophysiological state and results from an interaction of the mind and body.

An affective relationship to physical activity has three domains: 1) anticipated affective reactions to physical activity, 2) in-task affective reactions to physical activity, and 3) post-task affective reactions to physical activity (i.e., how ones feels after exercise). In the following

sections, the parameters and use of these three domains will continue to be explained through their use in previous research.

Affective reactions to exercise, including anticipated, during, and directly after exercise, are key predictors of exercise behavior (Conner et al., 2015; Rhodes, Fiala, & Conner, 2009; Williams et al., 2008). In addition, in-task measures of affect and mood are not only more accurate representations of how one feels during exercise than post-task questionnaires, but are also more predictive of later exercise behavior (Schneider et al., 2009). Remembered affective reactions to certain events and behaviors, which are intimately related to the *anticipated* affective reactions of that behavior, have also been shown to predict the decision to engage in the behavior in the future (Kahneman et al., 1993; Redelmeier & Kahneman, 1996).

For example, Williams et al. (2008) exposed thirty-seven adults to a short and moderately intense exercise stimulus and measured their in-task affective response to that stimulus (running on a treadmill). The authors found that affective reactions to the moderately-intense physical activity stimulus predicted exercise behavior both six and twelve months later, even controlling for baseline physical activity behavior. Williams et al. (2012) found similar results in another study with 146 low-active adults following a ten-minute walk on a treadmill. Affective responses in these participants also predicted physical activity behavior both six months and twelve months into the future.

Anticipated affective reactions to certain health behaviors (e.g., exercise, eating, etc.) may also be particularly important for translating intentions into actual behaviors. Conner et al. (2015) measured health behaviors of over 300 adults through a questionnaire, along with measures relative to those behaviors, such as perceived norms and attitudes. Of all of these measures, only anticipated affective reactions strongly moderated the relationship between

intention and behavior. From this, it was concluded that one's anticipated affective reaction to a behavior may be particularly important for the transition from intending to engage in a behavior to actually engaging in that behavior. Adding to the case that anticipated affective reactions to physical activity may be an important determinant of behavior, Loehr and Baldwin (2014) found that affective forecasting (i.e., predicting one's own emotional and affective state in the future) errors were much more common in novice exercisers and those who are sedentary compared to experienced exercisers. Affect-related messaging, such as showing an exerciser smiling, has also shown to be a more effective type of messaging towards increasing a person's exercise levels related to cognitive-related messaging, such as a picture of a heart (Conner, Rhodes, Morris, McEachan, & Lawton, 2011).

Factors that Predict Positive Affective Responses to Exercise

Research over the last ten years has identified many factors such as exercise intensity (Greene & Petruzzello, 2015; Reed & Ones, 2006; Vazou-Ekkakakis & Ekkakakis, 2009) and different types and social contexts of exercise (Plante et al., 2011; Thompson Coon et al., 2011) that predict affective and mood responses to exercise. For example, when exercise intensity goes up, affect tends to become less positive. Factors such as these are crucial in knowing what variables to target and measure for an intervention using affect and mood to promote both short- and long-term engagement in physical activity.

Research on "Peak-End" Mood effects indicates that individuals recall the mood impact of an entire event as the average of their peak emotional response and their final emotional response during that event (Kahneman et al., 1993; Redelmeier & Kahneman, 1996). These findings may have important implications for health behavior change. For example, men who had a colonoscopy remembered the procedure as being less painful overall when their procedure

had a few minutes added to its end in which the colonoscope rested in a less-painful position. Although these men underwent a longer procedure (the same exact colonoscopy PLUS the additional less painful end portion), their memory of the event was improved, and they were consequently more likely to undergo future colonoscopies (Redelmeier & Kahneman, 1996).

Similar research has been done on bandage removal for burn patients. This bandage removal procedure, which often has to be done on a weekly basis and is immensely uncomfortable for the patient, is usually done by a caregiver (e.g., a nurse) as quickly as possible. Ariely (2008) conducted a series of experiments where instead of removing the bandages quickly, nurses removed the bandages at a slower rate that took longer but had a lower perceived peak pain level. Even though this variation of bandage removal exposed the patients to pain for a longer amount of time, it was mostly preferred by patients, and they perceived the process as being less painful overall.

In addition to peak-end research that gives insight into factors that relate to post-task affect, experiments have been run that aim to directly manipulate affective reactions to exercise. Kwan, Stevens, and Bryan (2017) manipulated anticipated affect through an experimental design. There were three randomly assigned conditions: positive anticipated affect for physical activity, negative anticipated affect, or neutral anticipated affect. The researchers manipulated anticipated affect using deception through social norms. Researchers first told participants that the intensity of exercise that they had been prescribed to undertake was normal for someone like them; from there, the experimenters went on to share that at the prescribed intensity, a certain affective reaction should be expected. At this point, the researchers described the affective reaction appropriate to the participant's randomly assigned condition. Their manipulation worked in that it had a significant effect on expected and experienced affective reactions to

exercise, but it did not affect exercise behavior (which was measured by adherence to a seven-day exercise prescription).

In addition, Zenko, Ekkakakis, and Kavetsos (2016) created a method to change the affective forecasting of participants regarding a future exercise session. By randomly assigning participants to anchor around different desirable exertion intensities, participants in the experimental condition saw future exercise as more desirable affectively, and also had more intention to exercise in the future. Participants in the positive intervention group also were asked to describe their best experience ever with exercise and what they liked the most about exercise – participants in the negative intervention group were asked to do the opposite and describe their worst experience and what they liked least about exercise. The positive intervention group saw better affective attitudes and intentions to exercise after the manipulation.

Exercise intensity also plays an important role with affect. Research consistently shows that exercise intensity has a direct causal relationship to affective reactions to exercise (Greene & Petruzzello, 2015), and that this relationship also predicts later exercise behavior (Williams et al., 2015). This causal relationship between intensity and affective reactions can be seen through experimental paradigms that manipulate exercise intensity. The mechanism and nature of this relationship likely lies in the positive neurochemical reward that follows positive affect (Berridge & Kringelbach,. 2013) and in the negative physiological reaction to high-intensity exercise that may occur for some exercisers (Ekkekakis, Lind, & Vazou, 2010).

Zenko, Ekkekakis, and Ariely (2016) developed a new method that tested the relationship between the change in physical activity intensity over time and its relation to affective responses to physical activity. There were two main conditions in this experiment: an increasing intensity over the time of a workout, or a decreasing intensity over the time of a workout. This made the

"displeasure" of a workout either front-loaded or back-loaded during an exercise session. The major dependent variables of interest were overall enjoyment of the exercise session and how they perceived to affectively react to future physical activity (i.e., their forecasted pleasure and displeasure of future physical activity). Consistent with peak-end effects, the researchers found that using a downward slope of intensity (where displeasure was front-loaded during an exercise session and the end of the workout was more pleasurable) created more overall enjoyment, remembered pleasure and enjoyment, and forecasted pleasure for future exercise. The researchers concluded that this downward slope of intensity is an innovative mechanism for creating intense exercise sessions that do *not* lead to an overall negative affective workout. Considering physical activity intensity's relationship to affect (in general, higher intensity leads to a worse affective experience), this finding may be crucial in creating exercise recommendations that lead to 1) intense workouts that are physically demanding, and 2) a positive affective experience.

Williams et al. (2015) reported on the relationship between prescribed exercise intensity and exercise program adherence. In this study, fifty-nine healthy but inactive adults were prescribed a six-month training program that involved daily walking. Participants were randomly assigned to walk at a self-selected pace or at a moderate intensity: those who were able to self-select their intensity reported more overall walking than those who had to walk at a moderate intensity. The authors concluded that more autonomy in the way the participants were able to exercise led to increased exercise behavior.

Greene and Petruzzello (2015) conducted a within-subjects experiment looking at the relationship between exercise intensity, affect, and enjoyment in a resistance training, or anaerobic, context. Their findings were similar to affect research involving aerobic exercise,

most notably that when exercise intensity rises, affective responses become less positive. When participants were prescribed less-than-maximum effort for seven different exercises (e.g., bench press), enjoyment was significantly greater than when prescribed maximum effort (maximum effort was operationalized as doing sets of 10 repetitions at a weight that they could only do 10 repetitions for; less-than-maximum effort was operationalized as doing the same amount of repetitions with 70% of the weight of their 10-rep-maximum weight). In addition, when participants were asked to give maximum effort, in-task affect (measured with a single-item) was significantly positively correlated with enjoyment directly after the exercise session.

Contextual influences during exercise may also play an important role in affect. Exercising with and around people that are more supportive of the exerciser has been shown to be beneficial towards short-term goal pursuit (Heidrick & Graham, 2018). In addition, Dunton et al. (2015) looked at contextual influences during physical activity sessions and their relation to affective responses in a natural setting. Similar to other findings in this area, more positive affect was reported (through ecological momentary assessment) when participants were exercising with others versus exercising alone. In addition, less negative affect (or "displeasure") was reported by participants when exercising outdoors versus indoors, indicating that being outdoors may act as a buffer against negative affect.

Being with others can have a negative effect on exercise though in certain contexts. For example, exercising with strangers in a highly self-aware environment (in front of a mirror) has been shown to have a negative effect (e.g, more exhaustion and less tranquility) on exercise for sedentary women (Martin Ginis, Burke, & Gauvin, 2007). Other research has shown that for women with social physique anxiety, exercising in private causes better affective responses to exercise in relation to exercising in public (Focht & Hausenblas, 2006).

Plante et al. (2011) ran a controlled experiment that tested multiple contextual factors during an exercise session: exercising alone versus with a partner, exercising indoors versus outdoors, and exercising with or without music. Participants engaged in a 20-minute exercise session at roughly 70% of their maximum heart rate. The authors found affect-related benefits to exercising with a partner and with music, such as greater enjoyment of an exercise session and superior mood directly after. In addition, more enjoyment and less stress was related to exercising outdoors versus indoors. Recent research also shows that listening to self-selected music causes greater enjoyment during bouts of exercise that are likely to include negative affect, such as intense interval training (Stork, Kwan, Gibala, & Ginis, 2015). In this study, participants either engaged in four short bouts of intense exercise with no music at all or with music that they chose themselves. Self-selected music also may cause exercisers to work harder during an exercise session, as a within-subjects experiment showed over two exercise sessions that were spaced two days apart (Hutchinson, Jones, Vitti, Moore, Dalton, & O'Neil, 2018). Even though participants worked harder while listening to music in this study, their affective reactions did not worsen. They also remembered the exercise sessions as more pleasurable when they had listened to self-selected music.

In addition, survey results suggest that when people exercise outdoors (instead of indoors), they may spend more time exercising (Kerr et al., 2012). Specifically, those who were active outdoors at least once per week did at least 30 minutes more of moderate and vigorous physical activity per week than those who exercised exclusively indoors. Among these survey respondents, the benefits of being physically active outside (at least time-wise, meaning they spent more overall time being physically active) were dependent on exercising outdoors *at least once per week* and not exclusively exercising indoors. This may suggest that the benefits of

exercising outdoors do not depend on *always* exercising outdoors. Participants who exercised outdoors also reported feeling healthier.

A systematic review article showed that people enjoyed, were more satisfied with, and were more engaged with physical activity outdoors versus indoors, and were also more intent than were indoor exercisers to repeat that activity on a later date (Thompson Coon et al., 2011). They also found that exercising outside rather than inside may also have unique mental benefits. These studies point towards more positive affective reactions to outdoor-, rather than indoor-, exercise.

Hedonic Theory

The main theory that this affective intervention was built upon is the hedonic theory of motivation. The hedonic theory of motivation posits that humans naturally position themselves to be exposed to experiences of pleasure rather than displeasure (Ekkekakis, Hall, & Petruzzello, 2008). In essence, this theory makes the prediction that affective experiences are an important determinant of future behavior and decision-making (Williams et al., 2008). This experiment contributes to this theory in that its effectiveness was evaluated against physical activity interventions that do not incorporate this theory, specifically the TPB and goal-setting.

Research that has looked at the hedonic theory of motivation in an exercise context has all been conducted in the last fifteen years and has considered affective response to physical activity as an important factor towards behavior change. What is known about this theory as it relates to exercise behavior and motivation is that affect *does* matter in a physical activity context, and that affect *can* be manipulated. What is unknown about this theory as it relates to exercise behavior and motivation is the best way to manipulate affect towards long-term behavior change (i.e., becoming more physically active) in a natural context – essentially, that is

what this affective intervention aimed to do with the primary outcome data being how much exercise participants engaged in throughout their everyday lives.

Unique Contribution of the Research

Although anticipated, in-task, and post-task affective reactions to physical activity have been researched in a short-term context (e.g., those who are not physically fit and engage in intense physical activity will have poor affective reactions), these have not been researched together in a long-term intervention with the goal of sustained behavior change until this intervention. The results of this intervention help further clarify affect's relationship to physical activity behavior, and help highlight specific difficulties when manipulating and optimizing affect as the prime mechanism towards long-term behavior change.

The lack of methods to create a positive affective exercise experience over the long-term has been explicitly stated by top researchers in this area (Zenko, Ekkekakis, & Ariely, 2016). In addition, at present this literature has not investigated ongoing, iterative, building processes such as what was done in this intervention. This phenomenon has largely been investigated in terms of how the affect and mood-related memory of one event impacts likelihood of engaging in one future event. It is critical to know how this process unfolds over time for events that occur much more frequently.

Affective Intervention Logic Model

This is an intervention that aimed to manipulate three core affective characteristics (i.e., anticipated affective response to exercise, affect during exercise, and affect following exercise) that impact exercise participation (i.e., workouts per week, hours of exercise per week, etc.) through two psychological states (i.e., enjoyment of exercise and intrinsic motivation to exercise). To manipulate these three core affective characteristics, exercise intensity, exercise

type, and contextual influences on exercise were enhanced for the affective intervention group in a way that empirical evidence shows creates a better affective experience during exercise. In doing so, this intervention also attempted to improve participants' exercise-specific social support and exercise-specific self-efficacy, both of which improve exercise participation. An increased level of exercise participation hypothesized in the affective intervention group would then lead to superior physical fitness levels in that group. See Figure 1 for visual logic model (Appendix A).

Other Strengths of the Research

This intervention enrolled both college students and adults from the Northern Colorado area (students received course credit and adults were compensated with $50 for completing the entire study; participants are described further in the Method section), resulting in a wide array of ages and backgrounds of participants. Another strength of this research is that it adds to the literature in creating a mechanism towards population-level economic benefits. Health care costs in the United States are rising at an alarming rate, and per capita health care costs have more than doubled since 2000 and are currently 18% of the national Gross Domestic Product (GDP) (Centers for Medicare and Medicaid Services, 2017). With low physical activity levels being a prime reason for high health care costs (Carlson et al., 2015), a mechanism to increase population-level physical activity rates could drastically lower health care costs. Such an intervention succeeding would also create many co-benefits for those who begin exercising more, such as an improved quality of life and more independence as they grow into old age.

The results from this research also make a significant contribution to research on anticipated, in-task, and post-task affective responses to exercise, and to the scientific literature on "peak-end" mood effects on behavior. In addition, the results could start a subtle shift in the

way in which people think about exercise. It is reasonable to assume that more people would be willing to exercise if they knew there was a mechanism that could reliably increase their enjoyment of exercising. This would be a dramatic and much needed change from the current strict and willpower-dependent paradigm of many existing exercise programs such as those that promote following a specific exercise plan and making sure you "stick to your routine." That paradigm has proven to be ineffective over the long-term, which highlights the need for a societal change in the way in which we think about exercise.

Developing an Intervention & The Transtheoretical Model

For the purposes of this intervention, it is important to clarify the difference between the terms *physical activity* and *exercise*. Physical activity is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Casperson, Powell, & Christenson, 1985, p. 126). Exercise is defined by the same authors as structured time to engage in physical activity with the objective to improve physical fitness. Although these terms are often used interchangeably, the purpose of this intervention was specifically to increase *exercise* behavior. Although increasing overall physical activity participation may be an outcome of that purpose, this intervention focused directly on increasing exercise behavior.

In developing an intervention to increase exercise behavior, it was important to define the population of interest. The transtheoretical model is a conceptualization of different stages of behavior change (Prochaska & DiClemente, 1986). There are six stages that a person may be in relative to a behavior: precontemplation, contemplation, preparation, action, maintenance, or termination. As an example, a person in the contemplation stage of increasing their exercise levels is thinking about exercising more, but has not gone about actually preparing to exercise more (e.g., they have not joined a gym).

In the context of stages of change and the transtheoretical model, participants in this intervention were not in the "precontemplation" stage, since people in this stage often do not value the importance of changing their behavior (Prochaska & DiClemente, 1986) – educating participants about the benefits of physical activity was not a part of this intervention, and thus precontemplators were excluded from participation.

Potential Control Variables

Sleep quality was a potential control variable that may have impacted how the manipulation improved affective reactions to exercise. Research shows that sleep quality has a large effect on physical performance (Reilly & Edwards, 2007), and may impact affective reactions to exercise (i.e., more prone towards negative affect). The mechanism as to how sleep may impact affective reactions is less clear.

To begin, the National Sleep Foundation highlights some important reasons for athletes to get a good night's sleep (2017). Not getting enough sleep, or getting poor-quality sleep, can cause fatigue and low energy the next day, which would not only impact one's performance, but whether they decide to exercise at all.

Mah et al. (2011) found a myriad of physical and mental benefits for college athletes when they extended their sleep times. Not only did performance measures such as speed and shooting accuracy increase with extended sleep times, but vigor increased, fatigue decreased, and overall mental well-being was improved.

A literature review observing the relationship between sleep and athletic performance found similar associations between the two (Fullagar et al., 2015). The effects of not getting enough sleep can be similar to the effects of overtraining (physically stressing the body faster than the body's rate of recovery), which has severe negative physiological effects on the body.

For these reasons, it is reasonable to assume that people who sleep better may have better affective reactions to exercise, due to less fatigue and greater mental well-being. It is also reasonable to assume that those who sleep better simply have a greater likelihood of choosing to engage in physical activity.

Sleep has an intimate relationship with stress. In one direction of this relationship between these two variables, Polysomnographic (PSG) evidence shows that stress has a clear and distinct negative effect on sleep (Kim & Dimsdale, 2007). In the other direction of the relationship, sleep likely also has an effect on stress in both direct and indirect ways. Although done with self-report in a non-experimental setting, Lee et al. (2016) showed that poorer sleep leads to worsened experience of daily stressors the following day. Stress was therefore another possible control variable if stress levels were different between the affective intervention and standard intervention group.

Hypotheses

The following hypotheses were made based on the research described throughout the introduction section. The variables described throughout these hypotheses are those that should be positively impacted if a successful affective intervention takes place.

1) Affective reactions to physical activity will vary by condition (between affective intervention and standard intervention groups). Those in the affective intervention group will have a more improved affective relationship with physical activity from session one to session two relative to the standard intervention group.
2) Enjoyment of engaging in physical activity will vary by condition. Those who receive the affective intervention will see a greater increase in their enjoyment of engaging in

physical activity from the beginning of data collection to the end (fifteen weeks later) compared to participants in the standard intervention group.

3) Intrinsic motivation to engage in physical activity will vary by condition. Those who receive the affective intervention will see a greater increase in their intrinsic motivation to engage in physical activity from the beginning of data collection to the end (fifteen weeks later) compared to participants in the standard intervention group.
4) Physical activity-specific self-efficacy will vary. Those in the affective intervention condition will have a greater increase in their physical activity-specific self-efficacy from session one to session two relative to the standard intervention group.
5) Physical activity-specific social support will vary by condition. Those in the affective intervention condition will have a greater increase in their physical activity-specific social support from session one to session two relative to the standard intervention group.
6) Body mass index (BMI) will vary by condition. Those in the affective intervention condition that have a goal of losing weight will see a larger decrease in their BMI from session one to session two relative to the standard intervention group.
    a. During session one, participants will be asked, "is a goal of yours to lose weight, gain weight, or neither?" The participant's answer to this will be relevant to the way in which this dependent variable is evaluated: if a participant does not desire to lose weight, their change in BMI will not be included in this analysis.
7) Physical activity participation will vary by condition. Those who receive the affective intervention will see a greater increase in their physical activity rates from the beginning of data collection to the end (fifteen weeks later) compared to participants in the standard intervention group.

CHAPTER 2 - METHOD

Participants

The target population was adults who wanted to be more physically active but may have struggled with dreading possible future exercise, not enjoying the types of exercise they have tried, or have negative perceptions of past exercise. This included those who were already active but were seeking variety and alternative exercises that they may enjoy more than their past/current types of exercise. In essence, anyone who wanted to incorporate more physical activity into their schedule and/or who wanted to increase their intrinsic motivation to exercise would have been an appropriate participant for this experiment. Participants were excluded if they were in the "precontemplation" stage of the transtheoretical model (Prochaska & DiClemente, 1986). In addition, participants were excluded if they did not *want* to engage in more exercise or were not healthy enough to do so, and this was clearly conveyed in recruitment material. To ensure their own safety, participants completed the American College of Sports Medicine (ACSM)'s Physical Activity Readiness Questionnaire (PAR-Q) during their first session with the experimenter to ensure their health and readiness to begin or continue exercising.

Two recruitment strategies were utilized. The first was through lower-level Psychology classes at Colorado State University. Students enrolled in PSY100, Introduction to Psychology, and PSY 250, Research Methods in Psychology, were recruited through the Department of Psychology at Colorado State University. Students enrolled in PSY100 and PSY250 are required to participate in research as a part of their course grade; they receive compensation for the time with course credit.

The second recruitment strategy was through mass emails to the general adult public in the Northern Colorado area. The Northern Colorado community participants were compensated by receiving $50 ($15 for completing the baseline assessment, $15 for the follow-up assessment, and $20 for completing at least twelve of the fifteen weekly reports).

A total of 31 students from Colorado State University and 70 adults from the Northern Colorado community ended up participating in this intervention, most to the full extent of fifteen weeks. Further information about these participants, as well as which participants' data was included in the statistical analyses, can be seen in the "Results" section below.

Procedure

This project was submitted and approved through Colorado State University's IRB system. The intervention followed a general procedure for participants in both the affective intervention and standard intervention groups: an initial ninety-minute session with the experimenter, fifteen weeks of data collection for exercise participation, and a second and final sixty-minute session with the experimenter fifteen weeks after the initial session. An experimental protocol for sessions one and two can be seen in Appendix O.

Participants met the experimenter in a lab space at Colorado State University for the initial session. The experimenter for all participants was the principal investigator of the project, a certified personal trainer (American College of Sports Medicine; ACSM). The experimenter first welcomed the participant and then began by explaining to the participant that in the initial session they would do the following: engage in a short exercise session, review tips with the experimenter regarding how to be more physically active, and complete a short online questionnaire. Participants were also told that at the end of their session, the experimenter would explain the data collection procedure that would occur over the following fifteen weeks.

The experimenter then gained written informed consent from the participant and gave more detailed instructions regarding the experiment. These instructions included what specific exercises the participant would be performing, which included planks to assess core strength and endurance (variations were shown to accommodate different levels of physical fitness, including planks held on forearms and toes, planks held on forearms and knees, and planks held on hands and toes such as the start of a pushup), pushups to assess upper body strength and endurance (variations shown included pushups on hands and toes, pushups on hands and knees, and pushups with knees on floor and hands on a stable table used as an incline), a wall-sit to assess lower body strength and endurance, and a one-mile run to assess aerobic fitness. Each stationary exercise was done to failure (i.e., until the participant chose to stop or could not continue) and took place in a Colorado State University laboratory. Participants were told, for the running portion, to run at a comfortable pace but that they will be timed. The run took place on a one-mile predesignated route around campus until November 1st, which is the time a treadmill was purchased for the lab space. All runs after that time took place on the treadmill in order to hold constant the conditions under which the runs were completed. Thirty-nine of the 101 participants therefore ran their initial mile outside. An approximately equal number of participants in each condition (n = 20 for standard intervention and n = 19 for affective intervention) completed their baseline run outside – there is an obvious difference between running indoors versus outdoors in that there are differences in incline, scenery, and weather (also given that one of the recommendations for enhancing one's affective response is to exercise outdoors), but this change had an approximately equal effect on the mean mile time in each condition (running outdoors was 38 seconds (5.6%) and 41 seconds (4.9%) faster on average, respectively, for the standard intervention and affective intervention conditions). The Physical Activity Affect Scale (PAAS)

was administered after the final exercise was completed. Affective scores for participants participating in the outdoor run during their first session had an average of 33.4, which was consistent with the overall 1st session affect average for those who ran indoors for their first session (33.0), indicating little to no effect of running outdoors versus indoors on affect for this experiment.

After the exercise session, participants returned to the lab and were offered water and a quick break to rest before completing the remainder of the study. They were told that they would be engaging in another exercise session when they returned to the lab in fifteen weeks, but they were not given details about this second session – this gave the participants a rough idea of what would happen during their second session, but did not focus them on developing their fitness on the few specific exercises that they engaged in during the initial session (as described below, participants would engage in the *same* exercise session during their second session).

All participants then reviewed with the experimenter some tips to be more physically active (slightly modified from CDC's "Getting Started with Physical Activity for a Healthy Weight," 2015) and were given a copy of those tips to take home.

Affective Intervention Procedure

Participants then experienced either the experimental manipulation (affective intervention) or standard intervention. The condition the participant experienced was randomly assigned. Participants in the affective intervention condition worked with the certified personal trainer/experimenter to create a set of personalized exercise recommendations toward an improved affective relationship with physical activity. First, the experimenter gave the basis and justification for an affective intervention related to physical activity, including how it can improve the participant's exercise behavior.

The explanation of an affective intervention was mostly provided as an explanation of the enjoyment of exercise and why that is important, and closely reflected the following quote (this was *not* a direct quote that was read verbatim to participants): "Why it is important to enjoy exercise: Enjoying exercise increases one's intrinsic motivation to engage in exercise. Being more intrinsically motivated means that it becomes easier, over time, to engage in an activity (e.g., it's more instinctual to engage in it, it takes less willpower to engage in it, etc.). Intrinsic motivation simply means motivation to engage in a behavior because one enjoys the act of engaging in that behavior. This is in contrast to extrinsic motivation, where one is engaging in a task to receive a reward. For many people, exercise is mostly extrinsically motivated: they exercise to reach a goal, to have a nicer body, to become healthier, etc… If someone is exercising for these reasons, exercise becomes a means to an end, and exercise is therefore mostly extrinsically motivated. This extrinsic motivation decreases enjoyment of exercise over time and makes mental discipline and willpower very important for one to exercise regularly. Relying on discipline and willpower is not realistic for most people who are often busy and/or tired (Baumeister & Vohs, 2007; Muraven & Baumeister, 2000). It is alright to have some extrinsic motivators to exercise (it actually makes a lot of sense to exercise to become healthier - this seems like an honorable thing), but people's *main* motivation to engage in exercise should be because they like to exercise if they want to increase their intrinsic motivation over time, which should increase amount of exercise over time as well."

The experimenter, having already established the physical fitness level of the participant, also established the participant's experience level with different types of physical activities, their preference and liking for certain types of physical activities, and their preference for certain types of contextual influences during physical activity. The recommendations toward an

improved affective relationship with physical activity involved three main categories: 1) exercise intensity should fit the participant's physical fitness level; therefore, the general recommendation was given to engage in physical activity of an intensity that matched their fitness level. For participants who had low levels of fitness, recommendations were given to slowly build up intensity of exercising; 2) exercise type should fit the participant's preference; therefore, the experimenter shared with the participant a list of many possible ways to exercise. In discussing these, the experimenter asked about what types of exercise the participant may have enjoyed in the past, or what he/she may enjoy in the future; 3) contextual influences should promote a positive affective relationship with exercise; therefore, it was recommended to the participant to exercise outdoors at least once a week, with a friend or partner that they find supportive of their exercise, and with music when possible. In addition to these recommendations, participants in the affective intervention condition also went through tested paradigms to create more positive anticipated affective reactions to physical activity (Kwan, Stevens, & Bryan, 2017; Zenko, Ekkakakis, & Kavetsos, 2016). Lastly, following peak-end research, it was recommended to these participants that they should not exercise to an intensity level that creates extreme displeasure (as operationalized by the Feeling Scale, described further in Measures section below), and to finish their exercise session with an activity they find pleasant and/or enjoy. It was explained that "if someone who is in bad shape runs on the treadmill at 8 mph for 10 minutes, this will elicit a very negative affective response. Not only will they *really* not enjoy this, but their body will naturally remember exercise as being something that is dangerous, which will make it harder for them to exercise in the future (it will require more willpower). An analogy here is how when you get close to an edge of a cliff, your body naturally tries to restrict you from moving in a certain direction."

Participants were given time to take notes on an electronic document at differing timepoints throughout these explanations. Completed documents ranged from 1/3 of a page to 2 pages and included, in the participants' words, why it is important to enjoy exercise and how to do so. When done, the experimenter saved their document on the desktop of the lab computer and moved on with the experimental procedure.

Standard Intervention Procedure

After reviewing the tips to be more physically active, participants in the standard intervention condition worked with the personal trainer/experimenter to set intentions and goals that reflect the TPB and goal-setting, as this reflected a standard intervention to increase exercise behavior. The trainer then led them through a quick discussion about their attitudes, perceived norms, and perceived behavioral control around exercise and how those may relate to their intentions around exercise. Participants were shown the model of the TPB and were informed about how these factors (i.e., attitudes, subjective norms, and perceived control) can relate to exercise participation. They were then given a few minutes to write down one idea for each of the three components of the TPB regarding how they can improve it to increase their own exercise levels, such as "try to be more positive about exercise" in relation to improving their attitudes.

Participants were then asked to set five goals that follow the guidelines of the commonly-used "S.M.A.R.T." acronym for goal-making, ensuring that their goals are Specific, Measurable, Achievable, Relevant, and Time-targeted. They were told that these goals should be at least somewhat related to their exercise levels over the next fifteen weeks. They were then given as much time as they needed to complete this task. When done, the experimenter saved their document on the desktop of the lab computer and moved on with the experimental procedure.

Procedure, continued

All participants then completed an online survey that addressed demographic variables (i.e., age, gender, and race), intrinsic motivation to exercise, exercise-specific self-efficacy, exercise-specific social support, exercise enjoyment, and their exercise participation levels over the past month. After completing the questionnaire, the participants were measured for height and weight (a stadiometer and scale were available in the lab). The experimenter then went over the data collection procedure with the participant (explained in "data collection procedure" section below). The experimenter then gave the participant their payment in cash or awarded them their class credit. Lastly, the experimenter gathered and organized the materials from the experiment and made the room ready for the next participant. Participation took no longer than one and a half hours for all participants and averaged roughly 70 minutes.

A follow-up phone call was made to all participants two weeks after their initial session. The phone call reviewed the topics and recommendations discussed in the initial meeting with the experimenter. If participants were in the affective intervention condition, the specific affective recommendations tailored for that participant were again discussed. The reasoning behind this phone call was to remind the participant of their unique recommendations to engage in more exercise.

This phone call also had the testing effect in mind – the participants were first asked to tell the experimenter what their unique recommendations were, instead of the experimenter simply relaying the information right away during the phone call. Roediger and Butler (2011) showed that retrieval processes consolidate information into memory better than simply studying. In addition, Pyc and Rawson (2010) further explained testing as enhancing memory by showing how retrieving (or even attempting to retrieve) information actually strengthens that

information in memory. After participants attempted to retrieve this recommendation information from their memory, the experimenter filled any gaps in information and/or corrected any false recommendations the participant recalled. Although all recommendation information was reviewed during the participants' initial session, reiterating those recommendations during a follow-up phone call was meant to help them remember and internalize their unique recommendations.

Participants returned to the lab fifteen weeks after their initial appointment. The procedure for this second and final session was identical across all participants, regardless of their condition. Each participant went through the same exercises (plank, pushups, wall sit, and one-mile run) as they did during the first session, while also completing the PAAS scale after their exercise session. All physical activity relevant scales were again administered. Participants were debriefed about the details and purpose of the study and thanked for their participation. This second session took no longer than one hour for all participants and averaged roughly 45 minutes.

Data Collection Procedure

To ensure that people were staying aware of their effort to increase their amount of exercise, weekly reminders were sent by email to each participant. The electronic document that participants filled out during their initial session was attached to each of these emails. Participants were required to fill out one survey per week through Qualtrics. The link to this survey was included in the weekly emails. These weekly surveys assessed five measures: MET scores, number of workouts during the previous week, intrinsic motivation to exercise, remembered positive affect during exercise, and remembered negative affect during exercise. These were the measures included in the weekly surveys because they were cognitive and

reflective measures, which were different than the other current-feeling state measures. Since these weekly surveys were not necessarily done directly after an exercise session, only these cognitive and reflective measures were included in the weekly surveys. For participants to have received the full amount of compensation or class credit for being a part of the experiment, these surveys had to be completed; participants were given three grace weeks in the case that they occasionally forgot or were unable to fill out the weekly survey.

Materials

A stadiometer and scale (combined device with both height and weight capabilities; Tanita brand by Sercom model 4704) measured participants' height and weight. Other materials that were used were paper questionnaires, lab space to meet with participants (Room C10 in Colorado State University's Clark C building), technology (i.e., computers with access to internet and with emailing capability) to remind participants of their intervention, electronic tools to collect data (i.e., computer with internet access), a treadmill (ProForm Performance 400i), ActiGraphs (ActiLife v6.13.3 Firmware v1.7.1, described in "Dependent variables" section), and statistical analysis software (SPSS v. 25.0 & Mplus v. 8.0, described in "Analyses" section).

Measures

Independent variable

Randomly-assigned condition. This experiment had one independent variable with two levels (i.e., affective intervention and standard intervention). The experimental condition consisted of an intervention that attempted to improve participants' anticipated, in-task, and post-task exercise-related affect with the goal of improving their long-term exercise participation.

Dependent variables

Physical Activity Affect Scale. To measure participants' affective reactions to exercise, the Physical Activity Affect Scale (PAAS) was used (Lox et al., 2000; Appendix B). This scale has been shown to be superior in validity compared to previous scales attempting to measure similar physical activity-induced states (Lox et al., 2000). An example item from this scale is: "On a scale from one (do not feel) to four (feel very strongly), at this moment in time, how miserable do you feel?" This scale was administered directly after each of the participants' exercise sessions during their initial and second session. The Feeling Scale, which is a single-item eleven-point measure ranging from "I feel very good" to "I feel very bad" (Ekkekakis, Parfitt, & Petruzzello, 2011; Hardy & Rejeski, 1989), was used in the weekly surveys for participants to report their most positive level of exercise-related affect throughout the week as well as their most negative level of exercise-related affect.

Physical Activity-Specific Intrinsic Motivation. Intrinsic motivation to engage in physical activity was an outcome variable of this experiment. The purpose of assessing this variable was to determine if the participant's randomly assigned condition affected enjoyment and intrinsic motivation to engage in physically active behaviors (Murcia et al., 2008; Ryan & Deci, 2000). The interest and enjoyment subscale of the Intrinsic Motivation Inventory was used to assess this construct (Ryan, 1982; Appendix C). This subscale measures intrinsic motivation for a particular activity, in this case the participant's chosen exercise regimen. Research has found the Intrinsic Motivation Inventory to be adequately valid and reliable in the realm of sports (McAuley, Duncan, & Tammen, 1989), and experiments related to other forms of physical activity (endurance tests) have found it to be reliable as well (Tsigilis & Theodosiou, 2003). An example of a question on this scale is "I enjoyed doing this activity very much" which is then rated on a seven-point scale from 1 (not at all true) to 7 (very true).

Physical Activity Enjoyment. The next outcome variable was enjoyment of physical activity. This was measured through the Physical Activity Enjoyment Scale (PACES; Appendix D). One experiment looking at physically active children with asthma found the internal consistency of PACES to be excellent (Cronbach's alpha: 0.906) and its test-retest reliability was sound as well (Spearman's $\rho = 0.868$, $p < 0.001$) (Roman, Pinillos, Martinez, & Rus, 2014). High internal consistency and sound test-retest reliability has also been found in other experiments involving both children and adults (Kendzierski & DeCarlo, 1991; Moore, Yin, Hanes, & Duda, 2009). An example item on this scale, answered on a five-point scale from 1 (totally disagree) to 5 (totally agree) is: "When I'm active, it's not at all interesting."

Metabolic Equivalents. A person's metabolic equivalent of task (MET) score is simply an indication of how much energy they expend during a task. For this study, participants' MET scores were accumulated for their total reported exercise-related activities throughout one week (Appendix E). MET scores are calculated by measuring how often participants self-report engaging in three intensities of activity during a typical seven-day period: light-intensity activities (such as easy walking or golfing), moderate-intensity activities (such as brisk walking or easy swimming), and strenuous-intensity activities (such as running, soccer, or basketball). This measure gives an idea of how often participants exercise and at what intensities. Higher MET scores have been associated with lower BMI measurements and lower rates of hypertension (Mindell & Holmes, 2007). MET scores were calculated using Ainsworth et al.'s (2011) compendium of activities and their associated MET scores.

Two researchers, the principal investigator and an undergraduate research assistant, coded participants' responses to the question: "Please list below the physical activities you've engaged in over the past week, as well as how many minutes you engaged in that type of

physical activity over the course of those seven days. An example of this would be: "Weight-lifted (90 minutes)" into a summary measurement of MET scores across a week using Ainsworth et al.'s (2011) compendium. Inter-coder agreement was high between researchers (agreement on 99.3% of MET scores) and the few discrepancies were resolved quickly by discussion of the MET scores in question. A thorough training was done before coding MET scores, led by the principal investigator, which likely led to the high level of agreement between coders. Both researchers were blind to participants' assigned condition when coding exercise behavior into MET scores.

Accelerometer data was used as a validity check of participants' self-reported exercise data. To collect this data, participants wore an Actigraph accelerometer watch (ActiLife v6.13.3 Firmware v1.7.1) for the last week of their 15-week intervention. Fifty-eight of the 74 participants wore an accelerometer watch for a one-week period during the intervention. Logistical issues or participants being unresponsive caused sixteen participants to never wear an Actigraph. These watches collect data on three axes of movement (horizontal, vertical, and rotational). Participants' average daily vector magnitude (VM), which incorporates all three axes of movement, was used as the validity check data. Daily VM was used instead of weekly VM to easily control for participants who forgot to wear their accelerometer watch for a day or two during their week of having the watch.

Participants were encouraged to wear the Actigraphs at all times, except for bathing or being immersed in water (e.g., swimming). Participants were also told to take the Actigraphs off while sleeping if the devices were uncomfortable in any way and disrupted their sleep. Compliance was excellent, with all but three of the Actigraph-wearing participants wearing these watches for at least six of the seven allotted days in which they possessed the Actigraph. Only

one participant misplaced an Actigraph for a short period of time – but this was quickly resolved when the participant discovered the Actigraph among their family's dog toys. Compliance was likely high due to most participants being full-time working adults (as opposed to a population such as high school students who may not be as conscientious) who were getting paid for their participation, likely eliciting a psychological feeling of reciprocity towards the experimenter who had asked them to wear the Actigraph for a week.

Weekly Exercise Sessions. Exercise participation was also measured by number of reported weekly exercise sessions. For some participants who were in poor physical condition, it may have been necessary for them to complete short exercise sessions. In addition, it may have been necessary for them to have exercise sessions at low intensities. Having this additional dependent variable for exercise participation helped capture a wider array of exercise behavior that fits different fitness levels of participants.

Physical Activity-Specific Self-Efficacy. Another dependent variable in this experiment was physical activity-specific self-efficacy (Appendix F). This measure was included because self-efficacy towards physical activity has been found to be a very important predictor of subsequent exercise behavior, and there is reason to expect that a successful affective intervention would increase self-efficacy for exercise, since such an intervention would encourage people to engage in activities they enjoy and are comfortable with (Rodgers & Brawley, 1991). A scale that measures physical activity-specific self-efficacy has been shown to be both valid and reliable, and was used as the self-efficacy measure for this experiment (Sallis et al., 1988). Items in this scale are premised with the question, "How sure are you that you can do these things?" An example item is "get up early, even on weekends, to exercise." Response options range from 1 (I know I cannot) to 5 (I know I can).

Physical Activity-Specific Social Support. Physical activity-specific social support was another dependent variable (Appendix G). This was assessed by a thirteen-item scale that asks questions about support for exercise that one receives from family and friends; this scale has shown acceptable reliability and validity through two validation studies with over two-hundred participants (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). An example of an item on this scale is "During the past three months, my family (or members of my household) or friends gave me encouragement to stick with my exercise program." Response options range from 1 (not at all) to 5 (very often). For participants in the affective intervention group, recommendations about exercising with others had the intention to foster greater perceived social support for physical activity, which was measured through this scale.

Body Mass Index. The last dependent variable was BMI. Measured height and weight were used to calculate a proportion of mass to height (kilograms/m^2). Although BMI is not a direct measurement of body fat, research has shown that it correlates well with more direct measurements (Mei et al., 2002; Garrow & Webster, 1985). If BMI levels saw a greater decrease in the affective intervention group relative to the standard intervention group, this would suggest that body fat levels dropped more among the affective intervention participants over the time of the intervention.

Potential Control Variables

Sleep Quality. Sleep quality was assessed as a potential control variable in this exercise intervention (i.e., it would be controlled for if significantly different between the two groups), and this was measured by The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989; Appendix H). Test-retest reliability and validity for the PSQI have been measured to be acceptable in multiple studies (Backhaus et al., 2002; Buysse et al., 1989), with a Cronbach's

alpha of 0.8 showing acceptable internal consistency (Carpenter & Andrykowski, 1998). An example question from this scale is: "During the past month, how many hours of *actual* sleep did you get at night? (this may be different than the number of hours you spend in bed)."

Stress level. Stress level was measured by the Perceived Stress Scale, and this was also a potential control variable (Cohen, Kamarck, & Mermelstein, 1994; Appendix I). This is a widely-used scale that shows good reliability and validity (Cohen, Kamarck, & Mermelstein, 1983). Additionally, internal consistency scores of over 0.8 have been found (Andreou et al., 2011). This scale asks participants about their perceptions regarding stress over the past month. An example question, answered on a five-point scale (where 0 = Never and 5 = Very often), is: "How often have you felt difficulties were piling up so high you could not overcome them?"

Potential Moderators

Likability of experimenter. Likability of the experimenter was measured by Reysen's likeability scale, as experimenter likability may have moderated participants' adherence to the intervention (Reysen, 2005) (Appendix J). Internal consistency of this scale has been found to be around 0.9, and convergent validity has been shown through secondary liking behaviors, such as laughing (Reysen, 2005). Two items were discarded from this scale as they were deemed inappropriate by the experimenter for the experimental situation. The two items that were discarded, both answered on a 7-point scale indicating agreement, were: "This person is physically attractive" and "I would like this person as a roommate."

Agreeableness and Conscientiousness. Participants' agreeableness was measured by the Big Five Inventory (BFI) (Pervin & John, 2008) (Appendix K). This was also included as a potential moderator. Finally, conscientiousness was also included as a moderator and measured by the BFI (Pervin & John, 2008) (Appendix L). The BFI has been found to be both valid and

reliable (Soto & John, 2009) and stable for at least 18 months (Hahn, Gottschling, & Spinath, 2012). These two personality measures were assessed because they may have impacted participants' adherence to the intervention.

Analyses

Descriptive analyses were first run to produce frequencies and percentages of demographics for all participants together, and for the standard intervention group and the affective intervention group separately. Then, to analyze the efficacy of the affective intervention relative to the standard intervention, multiple types of analyses were used. All continuous variables measured pre- and post-intervention were tested to ensure normal distribution. There were three methods by which normality was tested. First, variables were plotted on histograms to visually assess normal distribution. Second, kurtosis and skewness were tested against a comparison of +- 3.29 for each statistic divided by their respective standard error. This number, with below 3.29 representing a normal distribution, was used due to the sample of this experiment being medium-sized (Kim, 2013). Lastly, Shapiro-Wilk's test of normality was used at an *a* level of 0.001 (Tabachnick & Fidell, 2007). A significant Shapiro-Wilk p-value signifies a non-normal distribution.

To analyze pretest and posttest measures that were taken only during the first and second session with the experimenter, Analyses of Covariances (ANCOVA) were used with the pretest scores as covariates. Dimitrov and Rumrill (2003) highlight an ANCOVA's use in pretest-posttest analysis to reduce error variance relative to other types of analyses. Assumptions for ANCOVA analyses were first checked for each analysis. The first of these assumptions was checking to ensure that no significant differences on pretest scores were measured between groups. Next, the homogeneity of regression was measured for each ANCOVA.

Mixed model repeated-measures ANOVAs were then used to assess group differences over the fifteen-week period in longitudinal variables (i.e., positive affect, negative affect, METs, exercise sessions, & intrinsic motivation). Within-subject variability across all participants was tested by examining the random slope of the within-subjects effect of week on the five longitudinal variables. In addition, t-tests were used to assess group differences in means measured during participants' second session, notably liking of the experimenter. Also, correlational analyses were then conducted between variables measured during participants' laboratory sessions and their average MET scores from their weekly self-reports along with their average adjusted MET score (controlled for how much exercise they were doing before the onset of the study). These analyses tested associations between exercise-relevant constructs and exercise in general and *also* to see if certain variables predicted this particular intervention working better. The above analyses were conducted in 2018 using SPSS software (IBM Corp., Armonk, NY, version 25.0).

Generally, with a repeated measures and longitudinal design, statistical power and reliability are increased; therefore, fewer participants are needed in order to detect effects of an intervention relative to a control, than, say, a cross-sectional study (Willett, 1989). Therefore, the number of participants that was originally proposed to be recruited was twenty adults from the Northern Colorado Area and twenty students from Colorado State University. This proposed amount created a balance between enough participants to detect a difference between conditions while being a realistic number of participants for the experimenter to meet with twice for at least an hour over the course the Fall 2017 semester – but because of high demand from potential participants as well as an extension of the data collection period through the Spring 2018 semester, a total of 101 participants ended up being recruited.

CHAPTER 3 - RESULTS

Participant Inclusion/Exclusion in Analyses

Although a total of 101 participants went through an initial session with the experimenter, only 74 participants' data were included in the data analyses described throughout this Results section. The first 21 participants in this study were students obtaining research credit in the Fall of 2017. The duration of the study for these participants was only 8 weeks (compared to 15 weeks for the remaining 72 community-dwelling, as well as eight students from the Spring of 2018 semester, participants) due to time constraints related to the academic semester. For this reason, those 21 initial college-student participants were not included in the following data analyses.

An additional six participants' data were also not included. Of these six, two participants dropped out of the study before completing at least 10 weeks of weekly surveys. The other four participants whose data were not included were participants who reported extremely low desire to increase their exercise levels over the course of the study (on a scale of 1-100, each reported a number lower than 20). These participants also had consistently been exercising at high levels for at least one month before the initiation of the study. These four participants were allowed to participate in the study after their initial session due to high interest and excitement shown to the experimenter, and each reported being grateful to have participated once the study was over. Their participation was evenly distributed across the experiment's two conditions.

Participant Characteristics & Descriptive Statistics

Demographics by condition can be seen in Table 1. No significant differences on any demographic variable existed across the two conditions at baseline, although the difference in

baseline BMI between the two groups was approaching significance, with those in the affective intervention group being of higher BMI ($t(72) = 1.62$, $p = 0.105$). Of the 74 participants, 57 identified as female (77%) and 17 (23%) identified as male. The sample was composed of both undergraduate students (8; 11%) and adults from the northern Colorado community (66; 89%), with a high variability in age ($M = 38.01$, $SD = 11.87$). The youngest participant was 19 years old while the oldest was 68 years old. The sample was 86.5% Caucasian, 4% Hispanic, 1.5% Korean, 1.5% Mexican, and 1.5% Native American, while 5.5% identified as more than one race. Using measured height and weight during participants' first session to calculate body mass index (BMI), the sample was fairly balanced between healthy, overweight, and obese participants. Thirty-two (43%) participants were of healthy weight (BMI between 18.5 and 24.9), 23 (31%) of participants were overweight (BMI between 25 and 29.9), and 19 (26%) participants were obese (BMI > 30). Overall, the average BMI across all participants was slightly overweight ($M = 27.25$, $SD = 5.20$). T-tests were used to test for baseline differences between groups on all constructs of interest and no differences were found.

Actigraph Data Validity Checks

Overall, agreement between Actigraph data and self-report METs was high, meaning that participants who self-reported higher levels of exercise tended to have accelerometer measurements of overall movement. A correlation between average daily VM (calculated by the Actigraphs) and self-reported weekly METs was moderately strong ($r(57) = 0.53$, $p < 0.001$). A few participants appeared to significantly underestimate their self-reported exercise levels; after communicating with these participants, it was determined that this discrepancy was likely caused by the participants engaging in high amounts of walking that was not deemed by them as

"exercise," and therefore not self-reported. No participant self-report data was discarded after these Actigraph validity checks.

Results of Hypothesis Testing using Pre-Post and Longitudinal Data

1) *Affective reactions to physical activity will vary by condition (between affective intervention and standard intervention groups). Those in the affective intervention group will have a more improved affective relationship with physical activity from session one to session two relative to the standard intervention group.*

An ANCOVA analysis showed no significant effect of condition on affective reactions to exercise from pre- to post-test, $F(1, 50) = 0.069$, $p = 0.794$, meaning that affective reactions to exercise did not change in a significantly different way between the standard intervention and affective intervention groups. Means and standard deviations for pre- and post-test scores on this variable can be seen in Table 1 (Appendix M). A paired-samples t-test showed that affective reactions to exercise did not significantly change for participants from session one to two, $t(52) = 0.70$, $p = 0.485$. Since affective scores for participants that ran outdoors were consistent with affective scores for participants that ran indoors (as was reported in the method section), the change in affect from session one to two was consistent for all participants (i.e., no change in affect) regardless of where the runs took place.

Means and standard deviations for the 15-week longitudinal data of these measures can be seen in Table 2 (Appendix M). Figures that plot the means of each group over the 15 weeks can be seen in Figures 2 and 3 (Appendix N). The repeated-measures ANOVA showed no significant difference between groups over the 15-week period on reported positive affect, $F(1, 73.09) = 0.04$, $p = 0.835$. The random slope of week

predicting weekly positive affect was also not statistically significant ($S = 0.040$, $SE = 0.032$, $p = 0.120$), suggesting that a one-week change in time forward was associated with no change in positive affect.

The repeated-measures ANOVA also showed no significant difference between groups over the 15-week period on negative affect, $F(1, 72.32) = 1.83$, $p = 0.181$, although this difference was approaching significance with the affective intervention group consistently reporting *more* negative affect. For all participants though, the random slope of week predicting weekly negative affect was negative and statistically significant ($S = -0.082$, $SE = 0.034$, $p < 0.001$), suggesting that a one-week change in time forward was associated with a 0.082 decrease in negative affect.

2) *Enjoyment of engaging in physical activity will vary by condition. Those who receive the affective intervention will see a greater increase in their enjoyment of engaging in physical activity from the beginning of data collection to the end (fifteen weeks later) compared to participants in the standard intervention group.*

An ANCOVA analysis showed no significant effect of condition on enjoyment of engaging in physical activity from pre- to post-test, $F(1, 55) = 0.35$, $p = 0.554$, meaning that enjoyment of engaging in physical activity did not change in a significantly different way between the standard intervention and affective intervention groups. Means and standard deviations for pre- and post-test scores on this variable can be seen in Table 1 (Appendix M). A paired-samples t-test showed that exercise enjoyment did not significantly change for participants from session one to two, $t(57) = 1.09$, $p = 0.281$.

3) *Intrinsic motivation to engage in physical activity will vary by condition. Those who receive the affective intervention will see a greater increase in their intrinsic motivation*

to engage in physical activity from the beginning of data collection to the end (fifteen weeks later) compared to participants in the standard intervention group.

An ANCOVA analysis showed no significant effect of condition on intrinsic motivation to engage in physical activity from pre- to post-test, $F(1, 53) = 0.19$, $p = 0.663$, meaning that intrinsic motivation to engage in physical activity did not change in a significantly different way between the standard intervention and affective intervention groups. Means and standard deviations for pre- and post-test scores on this variable can be seen in Table 1 (Appendix M). A paired-samples t-test showed that intrinsic motivation decreased for participants from session one to two, although this difference was not statistically significant, $t(55) = -1.51$, $p = 0.138$.

Means and standard deviations of the two groups can be seen in Table 4 for physical-activity specific intrinsic motivation over the 15-week period (Appendix M). Plots of each group's means over the 15 weeks can be seen in Figure 6 (Appendix N). The repeated-measures ANOVA showed no significant difference between groups over the 15-week period on intrinsic motivation to engage in physical activity, $F(1, 72.50) = 0.32$, $p = 0.571$. For all participants though, the random slope of week predicting weekly intrinsic motivation was negative and statistically significant ($S = -0.082$, $SE = 0.035$, $p = 0.006$), suggesting that a one-week change in time forward was associated with a 0.082 increase in intrinsic motivation (lower scores indicated more intrinsic motivation).

4) *Physical activity-specific self-efficacy will vary. Those in the affective intervention condition will have a greater increase in their physical activity-specific self-efficacy from session one to session two relative to the standard intervention group.*

An ANCOVA analysis showed no significant effect of condition on physical activity-specific self-efficacy from pre- to post-test, $F(1, 65) = 0.65$, $p = 0.423$, meaning that physical activity-specific self-efficacy did not change in a significantly different way between the standard intervention and affective intervention groups. Means and standard deviations for pre- and post-test scores on this variable can be seen in Table 1 (Appendix M). A paired-samples t-test showed that self-efficacy did not significantly change for participants from session one to two, $t(67) = 0.24$, $p = 0.807$.

5) *Physical activity-specific social support will vary by condition. Those in the affective intervention condition will have a greater increase in their physical activity-specific social support from session one to session two relative to the standard intervention group.*

An ANCOVA analysis showed no significant effect of condition on physical activity-specific social support from pre- to post-test, $F(1, 57) = 0.64$, $p = 0.425$, meaning that physical activity-specific social support did not change in a significantly different way between the standard intervention and affective intervention groups. Means and standard deviations for pre- and post-test scores on this variable can be seen in Table 1 (Appendix M). A paired-samples t-test showed that social support did not significantly change for participants from session one to two, $t(59) = 0.43$, $p = 0.672$.

6) *Body mass index (BMI) will vary by condition. Those in the affective intervention condition that have a goal of losing weight will see a larger decrease in their BMI from session one to session two relative to the standard intervention group.*

    a. *During session one, participants will be asked, "is a goal of yours to lose weight, gain weight, or neither?" The participant's answer to this will be relevant to the*

way in which this dependent variable is evaluated: if a participant does not desire to lose weight, their change in BMI will not be included in this analysis.

For participants who indicated in their first session that they wanted to lose weight throughout the 15-week study period, an ANCOVA analysis showed no significant effect of condition on BMI from pre- to post-test, $F(1, 49) = 0.08$, $p = 0.785$, meaning that BMI did not change in a significantly different way between the standard intervention and affective intervention groups. Means and standard deviations for pre- and post-test scores on this variable can be seen in Table 1 (Appendix M). A paired-samples t-test showed that BMI did not significantly change for participants from session one to two, $t(51) = 0.07$, $p = 0.944$.

7) *Physical activity participation will vary by condition. Those who receive the affective intervention will see a greater increase in their physical activity rates from the beginning of data collection to the end (fifteen weeks later) compared to participants in the standard intervention group.*

This hypothesis was tested with both METs per week and exercise sessions per week. MET scores for each participant were controlled for by how much weekly exercise participants engaged in before participating in this study. Those in the affective intervention group had a higher average MET score for each of the 15 weeks, although a repeated-measures ANOVA showed that this difference was not statistically significant (scores can be seen in Table 3).

Means and standard deviations can be seen in Table 3 for these measures (Appendix M). Figures 4 and 5 plot the mean scores of METs and exercise sessions for each group over the 15 weeks (Appendix N). The repeated-measures ANOVA showed no

significant difference between groups over the 15-week period on MET scores, $F(1, 72.94) = 2.59$, $p = 0.112$. For all participants, the random slope of week predicting weekly METs was also not statistically significant ($S = 0.025$, $SE = 0.033$, $p = 0.136$), suggesting that a one-week change in time forward was associated with no change in METs.

The repeated-measures ANOVA showed no significant difference between groups over the 15-week period on exercise sessions per week, $F(1, 72.35) = 0.30$, $p = 0.588$. For all participants though, the random slope of week predicting weekly exercise sessions was positive and statistically significant ($S = 0.066$, $SE = 0.030$, $p = 0.019$), suggesting that a one-week change in time forward was associated with a 0.066 increase in number of exercise sessions.

Additional Correlational Results

All correlations can be seen in a correlation matrix in Table 5 of Appendix M. First, average weekly MET scores had significant and positive correlations with: exercise self-efficacy ($r(72) = 0.349$, $p = 0.002$), exercise social-support ($r(66) = 0.460$, $p < 0.001$), affective reactions to exercise during the in-person sessions ($r(53) = 0.346$, $p = 0.010$), and exercise-specific intrinsic motivation ($r(55) = -0.279$, $p = 0.036$). Average MET scores had a significant and negative correlation with self-reported stress levels ($r(68) = -0.236$, $p = 0.049$). Next, average weekly MET scores controlling for previous exercise behavior only had a significant and positive correlation with reported hours of sleep per night ($r(67) = 0.243$, $p = 0.048$).

Other notable associations were positive and significant correlations between liking of the experimenter and desire to increase exercise levels over the course of the study ($r(66) = 0.302$, $p = 0.012$) as well as liking of the experimenter and use of exercise recommendations

from the initial session ($r(66) = 0.252$, $p = 0.038$). In addition, stress levels were significantly and negatively correlated with a multitude of variables, including average METs ($r(69) = -0.236$, $p = 0.049$), exercise self-efficacy ($r(69) = -0.411$, $p < 0.001$), exercise social-support ($r(64) = -0.265$, $p = 0.033$), and exercise-specific intrinsic motivation ($r(60) = 0.365$, $p = 0.004$), showing that positive exercise variables were consistent associated with lower reported levels of stress.

Additional Results of Analyses Between Standard and Affective Intervention Groups

An independent samples t-test analyzing the difference between groups in liking of the experimenter showed that those in the standard intervention group ($M = 46.47$, $SD = 5.96$) liked the experimenter significantly more than those in the affective intervention group ($M = 43.24$, $SD = 5.48$), ($t(66) = 2.33$, $p = 0.023$, $d = 0.56$). In addition, those in the standard intervention group had a stronger desire to increase their exercise levels ($M = 69.29$, $SD = 22.72$) than those in the affective intervention group ($M = 61.86$, $SD = 25.77$), although this difference was not statistically significant ($t(67) = 1.27$, $p = 0.208$, $d = 0.31$).

September 2018 Exercise Levels

Participants were contacted in September of 2018 (4-7 months after completing their second laboratory session) to inquire about their current exercise levels and were asked to report the number of minutes of exercise they were currently completing per week, on average, over the previous month. Those that were in the affective intervention group reported thirty more minutes of exercise per week ($M = 165.40$, $SD = 140.02$) than those that were in the standard intervention group ($M = 136.55$, $SD = 106.29$), although an independent samples t-test showed that this difference was not statistically significant, $t\ (40) = 0.76$, $p = 0.45$. This quick survey saw a weakened response rate (only 42 participants responded), and as indicated by the standard

deviations of minutes of exercise per week, there was very high variability in participant responses.

Qualitative Data

While completing the questionnaire during their second in-person session, participants were given the prompt: "If you exercised as much as you wanted to over the course of this study, explain why you thought you did so. If you did not exercise as much as you wanted to over the course of this study, explain why you think that occurred. Basically, use the space below to explain your thoughts as to the biggest reasons/factors that contributed to your exercise behavior over the course of this study. There are no right or wrong answers here - we're just interested in what YOU think." Participants were given as much space as they needed to type out their answer.

A qualitative analysis to identify any themes in responses showed that "time" was by far the most reported barrier that kept people from exercising as much as they wanted (83% of participants who reported that they did not exercise as much as they wanted cited time as a reason for not meeting their goal). The second-highest reported barrier was "lack of motivation" (38%). Illness was the only other barrier reported by more than one participant (7%).

Roughly a third (31%) of participants reported that they exercised as much as they wanted to over the course of the study, with no significant difference between conditions. Among those that reported this satisfaction with their exercise levels, the most reported motivator (cited by 58% of participants who reported that they exercised as much as they wanted) was accountability, meaning that they were motivated to exercise in order to show on their weekly surveys that they had exercised. Enjoyment and exercise feeling good was the

second most reported motivator (40%). No other motivators were mentioned by multiple participants.

CHAPTER 4 - DISCUSSION

Summary of Hypothesis Testing

Results show that those in the affective intervention group averaged more exercise, controlled for by previous exercise behavior before the onset of the study, than those in the standard intervention for each of the 15 weeks during the intervention. Those in the affective intervention group also reported 30 more minutes of exercise per week over the past month in a survey done 4-7 months after their completion of the study. Although these results may indicate a meaningful practical difference between these two groups, neither result reached statistical significance.

The present study examined the change over time among five longitudinally-measured dependent variables, as well as the moderating effect of randomly assigned group. Results revealed that reported negative affect significantly declined over time, whereas number of exercise sessions and intrinsic motivation significantly increased over time. Condition did not moderate (i.e., explain differences in slope) the relationships between any longitudinally-measured dependent variable and week. Although those in the affective intervention group had higher average MET scores for each of the 15 weeks, this difference was not statistically significant.

In addition, analyses of variables measured during participants' initial and second session showed that little to no change occurred during the 15-week study period. In these pre-post analyses, only intrinsic motivation showed a decrease, although this difference was not statistically significant, and there was no significant difference in this change between groups. Affective reactions to exercise, exercise enjoyment, exercise-specific self-efficacy, exercise-

specific social support, and BMI levels did not change for participants from session one to two, and there were no significant differences between groups as well.

Intrinsic motivation for exercise declining in pre-post testing but increasing during the 15-week data collection period may be explained by how this variable was measured. In pre-post testing, intrinsic motivation was measured as a reflection of their exercise sessions during their lab sessions. In the 15-week study period, intrinsic motivation was measured as a reflection of exercise they were conducting of their own volition. As autonomy has been shown to be an important factor in intrinsic motivation (Ryan & Deci, 2000), the monotony and repeating of the same exercise session during participants' second session may have played a part in a slight decrease in intrinsic motivation from session one to two.

Summary and Interpretation of Additional Results

Although participants in the affective intervention group averaged more energy expenditure than participants in the standard intervention group, there are reasons to believe the affective intervention was not fully successful. A key indication that this affective intervention did not fully succeed in improving participants' affective relationship with exercise is that those in the affective intervention group actually reported *more* negative affect in their weekly surveys. Since a core part of the affective intervention was educating participants on the importance of avoiding strongly negative reactions to exercise, it seems as if participants either did not 1) internalize this point, or 2) understand how to implement this point in their personal exercise. It is possible though that affective intervention participants were simply more aware of their negative affective reactions (e.g., these reactions were more salient), since they had discussed the concept of affect with the experimenter during their initial session, and research would indicate that this inward focus may have led to more negative affect (Mor & Winquist, 2002).

Participants, across both conditions, also most often reported *accountability* as their highest motivator of exercise behavior during the course of this study. Accountability in this study referred to participants filling out a weekly survey that included measures of their exercise levels. It seems as if many participants were more motivated by being able to put down in this survey that they had exercised, or exercised a high amount, than by either the information conveyed in the affective intervention or in the standard intervention during their initial session.

Additionally, in the analysis of qualitative data, it was shown that the lack of exercise enjoyment was not a self-reported barrier that kept people from exercising. It could be that for these participants, lack of exercise enjoyment simply was not a barrier that kept them from exercising – but, it is possible that people did not comprehend the importance of enjoying exercise, and the significantly positive effect that increasing their enjoyment of exercise would have.

Finally, measurements of participants' self-reported stress levels had significant and negative correlations with a multitude of exercise variables, including exercise levels, exercise self-efficacy, exercise social support, and exercise intrinsic motivation. These results are consistent with past research linking exercise and lower levels of stress (Edenfield & Blumenthal, 2011).

Strengths of the Research

Strengths of this experiment included its long-term design that measured changes after a 15-week period, its longitudinal collection of certain variables to track temporal changes *during* this 15-week period, and its experimental design that included random assignment that allowed causal inferences from the manipulation to the results. In addition, there was a very good

response rate on weekly surveys that indicated strong participant involvement and led to valid longitudinal data.

Limitations of the Research

There were a few notable limitations of this study. First, longitudinal exercise data were mostly self-reported. Although self-report was appropriate for remembered affect and intrinsic motivation, exercise levels ideally would have had a more objective measurement throughout the 15-week period. This limitation was attempted to be addressed by the use of Actigraphs as validity checks on participants' self-report data, but participants were not asked to wear Actigraphs for the entire 15-week period due to a limited number of devices and the potential participant burden. A more controlled setting to measure participants' affective reactions to exercise, such as a predetermined exercise task followed by an affective measure that could track changing affective reactions to similar exercise tasks, may have also been a desirable 15-week longitudinal variable. Unfortunately though, having all 101 participants come into the lab space 15 times was also not feasible.

A simple measurement of weekly *time* spent exercising was also not recorded. MET scores are not a direct measurement of PA time, and because of large variances in MET intensities (e.g., vigorously swimming laps versus walking slowly), MET scores can be quite different even though they may signal a similar amount of time exercising. This may be especially relevant in an intervention that intervenes on affect, as those in the affective intervention condition may have exercised for longer periods at a lower intensity than those in the standard intervention condition (due to seeking out "easier" or more pleasurable types of exercise). This discrepancy between MET scores and exercise time was the motivation for including the amount of exercise sessions as a measure in this study, but it is recommended that

future exercise intervention studies include total exercise time as well to capture even further differences in participants' exercise participation.

The measurement tools used in this experiment also did not account for daily fluctuations in mood and affective responsiveness – Chow, Grimm, Fujita, and Ram (2009) found that emotions cycle not only weekly, but daily as well. The findings of this research suggest that a more accurate measurement tool would provide variable, random timing of affective measurement to account for repeating mood cycles.

Another limitation was the small amount of contact the experimenter had with participants between sessions one and two, which possibly diminished the effect of the intervention. The most-reported barrier to exercising for participants was *time*, possibly indicating that participants' lives were hectic and busy enough for them to not focus on their learned principles from their initial session during the 15-week period.

The sample of participants not being very racially diverse was another limitation. Colorado State University and the Northern Colorado Region are predominantly white; Larimer, Weld, and Boulder county all have over 85% Caucasian residents (Demographic Profile of Northern Colorado, 2016). By having a homogenous sample, this study may not have been able to observe exercise behavior differences among different cultures. Because of this, the results are less generalizable to a diverse population, and more generalizable to a specific population of students and adults in the Northern Colorado area.

Another limitation of this study may have been that it was done during a time of year (predominantly winter) when exercise options in Colorado are more limited than other months. A key recommendation for the affective intervention group was to exercise outdoors at least once

per week, which may have been much more difficult and potentially less enjoyable during this colder time period.

Although this was a long-term intervention that measured multiple dependent variables over multiple months, an ideal intervention would measure these variables for an even longer time period (e.g., one year) than the fifteen weeks designated in this intervention. A longer intervention would improve the external validity of the results of such an intervention, since an increase in exercise participation caused by an intervention would ideally continue indefinitely (assuming the participant remains in good enough health to keep exercising). The intervention described in this paper was capped at fifteen weeks due to time constraints of the principal investigator. Permission was requested from the IRB to follow up with participants after the main data collection period was done, so this limitation only involved participants activity being involved with the study, since exercise levels were measured 6+ months after some participants completed their 15 weeks of participation.

The salience of affective reactions to exercise may have been another limitation. Due to participants in the affective intervention group focusing on the role of affect during their intervention session, simply being more *aware* of affect may have led to more awareness of negative affect during their exercise sessions, and therefore this salience may have led to more reported negative affect for that intervention group. The question is then: how could we have masked the focus on affect to reduce this possible salience effect? One strategy could be to mask the true purpose of the study to affective intervention participants. This could be done by explaining enjoyment strategies as "ways to make exercise more efficient" or something similar without explicitly explaining the concept of affect and how negative affect in particular can be detrimental towards behavior change. A bolder strategy would be to mask the purpose of the

study to be something non-exercise related, such as measuring daily behaviors (exercise being one of many behaviors being measured). A final strategy could be to introduce the concept of affect to standard intervention participants as well, but not give that group specific strategies to counter negative affect. This may lead to similar levels of affective salience between groups, but would still have the affective intervention group equipped with a plan (e.g., to sometimes listen to music or finish exercise sessions with something pleasurable) to produce less negative affect and more positive affect during their exercise sessions.

Participants' perceived lack of time to exercise was another limitation of this study. Broadening the concept of "exercise sessions" to "any physical activity throughout the day" may have improved participants' perceived ability to engage in exercise throughout the day, since people are generally able to find time for a few short walks (or a few sets of pushups, depending on the participant's particular inclinations) rather than a full exercise session at a gym or a park. This strategy may also pair well with more use of accelerometers for participants as an objective measure of exercise, as this measurement tool would capture any short spurts of exercise that participants may not recall in a weekly survey.

Future Directions

Sustaining behavior change with exercise is difficult. Recent research shows that affective responses during exercise may not decrease in negativity until people are in the "maintenance" stage, meaning that negative affect persists in intensity through *both* the "preaction" and "action" stage of behavior change (Dunton, Leventhal, Rothman, & Intille, 2018). Recent research such as Dunton et al. (2018) provides evidence that affective responses to exercise may be a key determinant in sustained behavior change.

In addition, 15 weeks may have been too long of an intervention without stronger experimenter manipulation *during* the 15 weeks. More specifically, weekly emails may simply not have been enough of a reminder and enforcer of their learned principles from the initial session to sustain the effects over 15 weeks. Weekly quizzes, utilizing the testing effect, may have ensured that participants were kept aware of the concepts they were initially taught. Additionally, in-person lab sessions at 5 and 10 weeks would have been an opportunity to 1) further teach participants about the role of affect, 2) conduct objective fitness tests, and 3) further legitimize the experiment in the minds of participants by having them invest more time into their participation. A shorter time-period may have been more feasible: research recently conducted at a Canadian university showed that incoming female students' exercise behavior was significantly positively impacted by the presentation of exercise as enjoyable and stress reducing, rather than the presentation of exercise as a means to become healthy (Ruissen, Rhodes, Crocker, & Beauchamp, 2018). In that experiment though, the intervention was completely done at the beginning of a *four-week* period.

Additionally, the results in our experiment may have been different if each group had completed the goal-setting activity first, with the affective intervention group then conducting their affect activity. This may be an applicable area for future research as it would control for the effects of the goal-setting intervention (albeit introducing variance in the time of the experiment and how many total activities took place). This may promote a greater difference in outcomes between groups because the affective intervention's effect would likely build on top of any effect of the goal-setting intervention. In addition, affective principles could be educationally applied to the participant's personal goals (e.g., participants could be taught how to reach their goals through affectively-positive behaviors similar to the principles taught in the affective

intervention condition), possibly bringing more autonomy and meaning into the affective activity. Further ideas for filler control activities, such as a non-relevant writing activity, should be explored to provide comparable times and activities for each experimental group.

The present intervention and results described in this paper could reasonably be applied to future health behavior change research. It is reasonable to think that similar affect and mood-based interventions could be undertaken to promote different health behaviors that are also more likely to be pursued over the long-term by people who are enjoying their regimen (e.g., healthy eating behaviors, stress reduction behaviors, etc.). The difficulties of such an intervention can better be addressed with the knowledge of the methods and results of this experiment.

Specific lessons learned from the present study that could inform the design of other health interventions include: 1) the need for manipulation checks throughout the data collection period to ensure the lasting effects of a manipulation; and 2) the need for longitudinal data collection methods that do not motivate participants more than a manipulation. Both of these recommendations likely include more interaction with participants during the data collection period, signaling a need for a large amount of resources (e.g., money, research assistants, etc.) by those that implement such an intervention. It would be important as well that this increased interaction with participants did not increase their feelings of accountability towards the study.

Conclusion

Even though participants in the affective intervention group averaged more exercise throughout each of the 15 weeks of the experiment, it appears as if affective intervention participants' affective relationship to exercise was not successfully manipulated. This experiment, the first that attempted to manipulate affect over a long-term exercise behavior

change, illustrates the unique difficulties in attempting a long-term exercise behavior change through the manipulation of affect.

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APPENDIX A

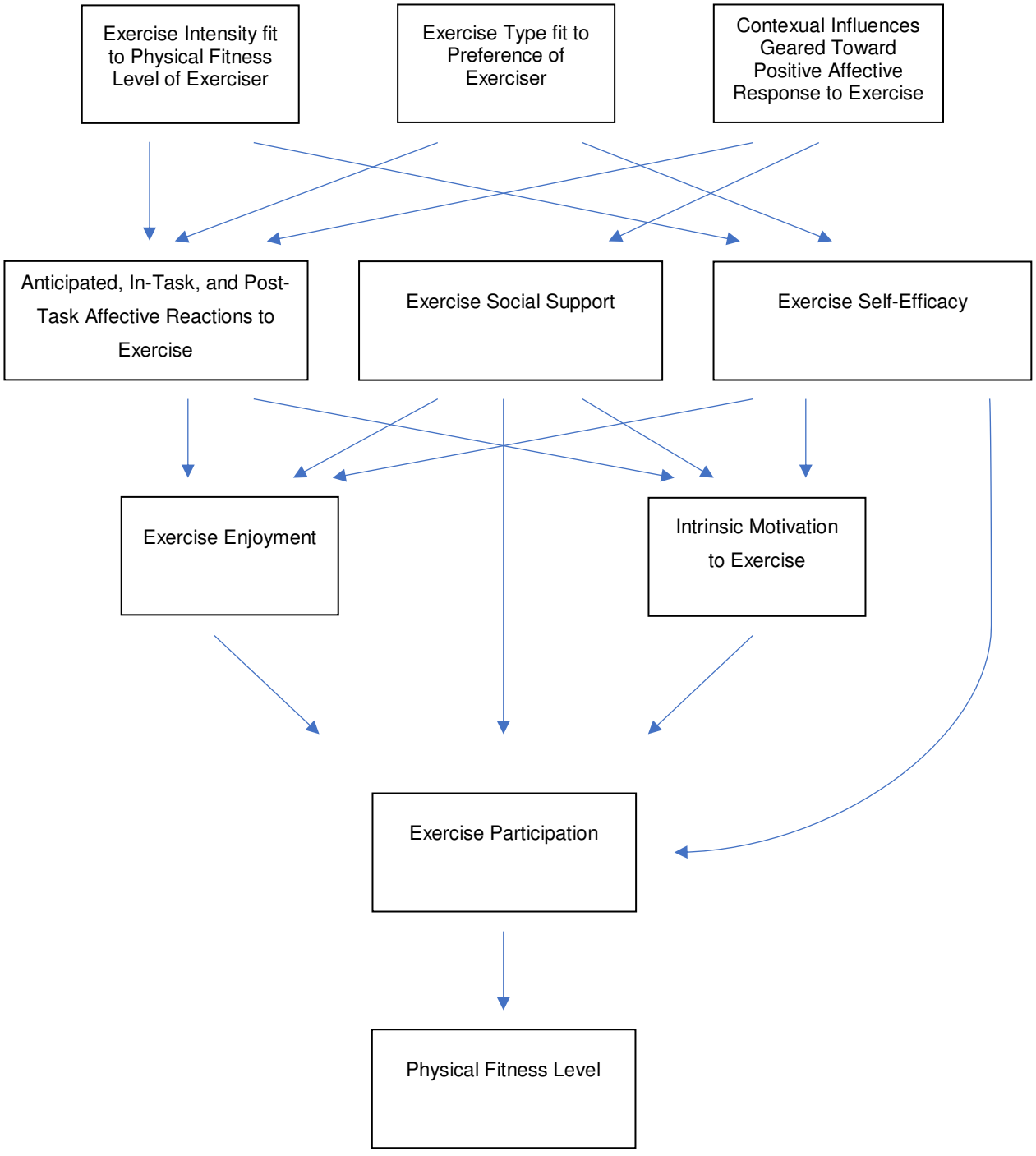

Figure 1. Affective intervention logic model.

APPENDIX B

Physical Activity Affect Scale (PAAS)

"Please use the following scale to indicate the extent to which each word below describes how you feel at this moment in time."

	Do Not Feel	Feel Slightly	Feel Moderately	Feel Strongly	Feel Very Strongly
1. Upbeat	0	1	2	3	4
2. Calm	0	1	2	3	4
3. Energetic	0	1	2	3	4
4. Tired	0	1	2	3	4
5. Peaceful	0	1	2	3	4
6. Miserable	0	1	2	3	4
7. Worn-out	0	1	2	3	4
8. Relaxed	0	1	2	3	4
9. Fatigued	0	1	2	3	4
10. Discouraged	0	1	2	3	4
11. Enthusiastic	0	1	2	3	4
12. Crummy	0	1	2	3	4

APPENDIX C

Subset of Intrinsic Motivation Inventory (IMI) that Measures Intrinsic Motivation Post-Experimentally

"For each of the following statements, please indicate how true it is for you, using the following scale:

1 2 3 4 5 6 7

Not at all true Somewhat true Very true"

1. I enjoyed doing this activity very much
2. This activity was fun to do
3. I thought this was a boring activity
4. This activity did not hold my attention at all
5. I would describe this activity as very interesting
6. I thought this activity was quite enjoyable
7. While I was doing this activity, I was thinking about how much I enjoyed it

APPENDIX D

Physical Activity Enjoyment Scale (PACES)

"Please use the following scale to indicate your answer to the following statements. When I am active…"

1	2	3	4	5
Totally Disagree		Neither Agree or Disagree		Totally Agree

1. I enjoy it
2. I feel bored
3. I dislike it
4. I find it pleasurable
5. It's no fun at all
6. It gives me energy
7. It makes me depressed
8. It's very pleasant
9. My body feels good
10. I get something out of it
11. It's very exciting
12. It frustrates me
13. It's not at all interesting
14. It gives me a strong feeling of success
15. It feels good
16. I feel as though I'd rather be doing something else

APPENDIX E

Metabolic Equivalents (MET) Score

"Please indicate how many minutes, over the past week, you've engaged in physical activities (e.g., walking, jogging, calisthenics, bicycling, weight-lifting, swimming, etc.):"

Activity: _____ Minutes: _____

Activity: _____ Minutes: _____

Activity: _____ Minutes: _____

Activity: _____ Minutes: _____

Activity: _____ Minutes: _____

Activity: _____ Minutes: _____

Activity: _____ Minutes: _____

Activity: _____ Minutes: _____

APPENDIX F

Exercise-Specific Self-Efficacy

"Below is a list of things people might do while trying to increase or continue regular exercise. We are interested in exercises like running, swimming, brisk walking, bicycle riding, or aerobics classes. Whether you exercise or not, please rate how confident you are that you could really motivate yourself to do things like these consistently, for at least six months. Please circle one number for each question. How sure are you that you can do these things?:

1	2	3	4	5
I know I cannot		Maybe I can		I know I can"

1. Get up early, even on weekends, to exercise.
2. Stick to your exercise program after a long, tiring day at work.
3. Exercise even though you are feeling depressed.
4. Set aside time for a physical activity program; that is, walking, jogging, swimming, biking, or other continuous activities for at least 30 minutes, 3 times per week.
5. Continue to exercise with others even though they seem too fast or too slow for you.
6. Stick to your exercise program when undergoing a stressful life change (e.g. divorce, death in the family, moving).
7. Attend a party only after exercising.
8. Stick to your exercise program when your family is demanding more time from you.
9. Stick to your exercise program when you have household chores to attend to.
10. Stick to your exercise program even when you have excessive demands at work.
11. Stick to your exercise program when social obligations are very time consuming.
12. Read or study less in order to exercise more.

APPENDIX G

Exercise-Specific Social Support

"Below is a list of things people might do or say to someone who is trying to exercise regularly. If you are not trying to exercise, then some of the questions may not apply to you, but please read and give an answer to every question. Please rate each question *twice*. Under *family*, rate how often anyone living in your household has said or done what is described during the last three months. Under *friends*, rate how often your friends, acquaintances, or coworkers have said or done what is described during the last three months. Please write one number from the following rating scale in each space:

1	2	3	4	5
None	Rarely	A few times	Often	Very often

During the past three months, my family (or members of my household) or friends:"

1. Exercised with me.
2. Offered to exercise with me.
3. Gave me helpful reminders to exercise ("Are you going to exercise tonight?").
4. Gave me encouragement to stick with my exercise program.
5. Changed their schedule so we could exercise together.
6. Discussed exercise with me.
7. Complained about the time I spend exercised.
8. Criticized me or made fun of me for exercising.
9. Gave me rewards for exercising (bought me something or gave me something I like).
10. Planned for exercise on recreational outings.
11. Helped plan activities around my exercise.
12. Asked me for ideas on how *they* can get more exercise.
13. Talked about how much they like to exercise

APPENDIX H

The Pittsburgh Sleep Quality Index

"The following questions relate to your usual sleep habits during the last month *only*. Your answers should indicate the most accurate reply for the *majority* of days and nights in the past month.

During the past month, when have you usually gone to bed at night? _____

During the past month, how long (in minutes) has it usually taken you to fall asleep at night? _____

During the past month, when have you usually gotten up in the morning? _____

During the past month, how many hours of *actual* sleep did you get at night? (this may be different than the number of hours you spend in bed) _____

During the past month, how would you rate your sleep quality overall?

1. Very good 2. Fairly good 3. Fairly bad 4. Very bad

During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activities?

1. Not at all 2. Less than once a week 3. Once or twice a week 4. Three or more times a week"

APPENDIX I

Perceived Stress Scale

"The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate. For each question, choose from the following alternatives:

0	1	2	3	4
Never	Almost Never	Sometimes	Fairly Often	Very Often

In the last month...

1. How often have you been upset because of something that happened unexpectedly?
2. How often have you felt that you were unable to control the important things in your life?
3. How often have you felt nervous and "stressed"?
4. How often have you dealt successfully with irritating life hassles?
5. How often have you felt that you were effectively coping with important changes that were occurring in your life?
6. How often have you felt confident about your ability to handle your personal problems?
7. How often have you felt that things were going your way?
8. How often have you found that you could not cope with all the things that you had to do?
9. How often have you been able to control irritations in your life?
10. How often have you felt that you were on top of things?
11. How often have you been angered because of things that happened that were outside of your control?
12. How often have you found yourself thinking about things that you have to accomplish?
13. How often have you been able to control the way you spend your time?
14. How often have you felt difficulties were piling up so high you could not overcome them?

APPENDIX J

Reysen Likability Scale (modified)

"For the questions below, select how strongly you agree with each statement *in regard to the experimenter of this study* (the person you met with for your two sessions)."

1	2	3	4	5	6	7
very strongly disagree			neutral			very strongly agree

1. This person is friendly.
2. This person is likeable.
3. This person is warm.
4. This person is approachable.
5. I would ask this person for advice.
6. I would like this person as a coworker.
7. I would like to be friends with this person.
8. This person is similar to me.
9. This person is knowledgeable.

Note: two items were discarded from original scale: "This person is physically attractive" and "I would like this person as a roommate."

APPENDIX K

Agreeableness Scale

"Here are a number of characteristics that may or may not apply to you. Please indicate a number for each statement to indicate the extent to which *you agree or disagree with that statement*."

1	2	3	4	5
disagree strongly		neither agree nor disagree		agree strongly

I see myself as someone who…

1. Tends to find fault with others
2. Is helpful and unselfish with others
3. Starts quarrels with others
4. Has a forgiving nature
5. Is generally trusting
6. Can be cold and aloof
7. Is considerate and kind to almost everyone
8. Is sometimes rude to others
9. Likes to cooperate with others

APPENDIX L

Conscientiousness Scale

"Here are a number of characteristics that may or may not apply to you. Please indicate a number for each statement to indicate the extent to which *you agree or disagree with that statement*."

1	2	3	4	5
disagree strongly		neither agree nor disagree		agree strongly

I see myself as someone who…

1. Does a thorough job
2. Can be somewhat careless
3. Is a reliable worker
4. Tends to be disorganized
5. Tends to be lazy
6. Perseveres until the task is finished
7. Does things efficiently
8. Makes plans and follows through with them
9. Is easily distracted

APPENDIX M

Table 1

Descriptive statistics and results summary for pre- and post- measured variables. Standard deviations (SDs) in parentheses.

			Pretest		Posttest	
	Range of Scale	*Range of N*	Standard	Affective	Standard	Affective
Variable						
Age			38.4 (13.1)	37.7 (10.7)		
% women			74.4%	73.7%		
% students			13.9%	7.9%		
BMI[a]		64-71	27.1 (4.7)	29.3 (5.1)	26.6 (4.6)	30.1 (6.0)
SE	12-60	63-70	39.7 (5.8)	38.4 (5.6)	38.9 (8.3)	38.4 (7.1)
IM	7-49	60-69	21.9 (6.3)	24.0 (7.0)	23.8 (6.1)	25.5 (7.5)
EE	16-80	63-70	67.6 (7.2)	65.8 (7.8)	68.5 (7.6)	66.9 (8.5)
Affect	0-48	60-69	33.8 (6.0)	32.3 (4.8)	33.7 (5.9)	33.4 (6.6)
SS	26-130	63-70	95.1 (11.9)	94.4 (13.9)	92.5 (13.4)	95.3 (14.9)
Pushups		55-62	20.6 (8.1)	20.2 (7.6)	22.4 (11.9)	24.7 (10.1)
Plank		56-64	75.9 (40.1)	74.9 (31.4)	95.2 (43.1)	85.3 (39.2)
Wall-sit		56-62	110.4 (52.9)*	79.1 (38.3)*	135.1 (63.7)*	97.5 (47.0)*
Mile run/walk		55-59	669 (166)*	819 (247)*	638 (175)	763 (232)

[a]only participants that indicated a desire to lose weight were included in this analysis.

* $p<.05$ difference between groups within pretest measures or within posttest measures

Note: SE = exercise-specific self-efficacy; IM = exercise-specific intrinsic motivation, where lower scores indicate more IM. EE = exercise enjoyment. Affect = Affective reaction to exercise. BMI = body mass index. SS = exercise-specific social support. Pushups are measured in repetitions. Planks, wall-sits, and mile run/walk are measured in seconds.

Table 2

Average peak positive and negative affect for both standard and affective group across the 15-week period. Smaller scores indicate more positive affect. Range is from 1 (positive) to 11 (negative).

	Positive Affect		Negative Affect	
	Standard	Affective	Standard	Affective
Week				
1	2.28	2.84	6.14	6.21
2	2.75	2.76	5.83	6.11
3	2.81	2.68	5.75	6.11
4	2.83	2.68	5.61*	6.66*
5	3.17	2.90	5.81	6.26
6	2.83	3.18	5.69	6.24
7	2.67	2.84	5.19*	6.24*
8	3.17	2.84	5.64	5.97
9	2.44	2.87	5.64	5.68
10	2.75	3.00	5.72	5.84
11	2.53	2.66	5.42	6.08
12	2.77	2.88	5.53	5.84
13	3.16	3.18	5.83	5.86
14	3.03	3.00	5.84	5.99
15	2.73	2.36	5.54	5.61

* $p<.05$ difference between groups within affect type

Table 3

Adjusted weekly METs and exercise sessions for both standard and affective group across the 15-week period, controlled for exercise behavior before participation in study.

	Adjusted METs		Adjusted Exercise Sessions	
	Standard	Affective	Standard	Affective
Week				
1	95.18	276.63	1.72	1.54
2	48.99	191.32	1.69	1.43
3	96.95	253.42	2.08	1.75
4	-94.13*	733.54*	2.16	1.51
5	150.19	355.84	1.94	1.30
6	49.3	76.08	1.66	1.38
7	163.66	429.07	2.05	1.65
8	141.75	322.14	1.49	1.75
9	0.26*	566.20*	2.05	1.51
10	187.55	362.09	2.16	1.80
11	335.30	366.72	2.35	1.99
12	187.07	247.53	2.38	1.76
13	247.71	516.76	1.77	2.26
14	318.16	396.89	2.04	1.97
15	-28.23	170.99	1.42	1.84

* $p<.05$ difference between groups within exercise measure

Note: *Adjusted METs and Exercise Sessions control for baseline exercise behavior (i.e., follow-up METs/exercise sessions minus baseline METs/exercise sessions).*

Table 4

Average exercise-specific intrinsic motivation levels for both standard and affective group across the 15-week period. Lower scores indicate more intrinsic motivation. Scale range is from 7-49.

	Standard	Affective
Week		
1	17.33	17.55
2	17.30	16.15
3	16.47	16.10
4	17.07	16.74
5	17.74	17.01
6	16.92	18.06
7	16.19	15.19
8	17.81	16.27
9	16.76	15.51
10	16.64	15.90
11	15.96	15.68
12	16.49	16.55
13	17.50	16.37
14	16.69	16.51
15	15.06	13.62

* $p<.05$ difference between groups

Table 5

Correlations between key study variables.

	METs	SE	SS	AR	IM	CMETs	SL	HS	LE	DE	UR
METs	----										
SE	.35**	----									
SS	.46***	.44***	----								
AR	.35**	.40**	.43**	----							
IM	-.28*	-.36**	-.19	-.23	----						
CMETs	.35**	.01	.07	-.04	-.02	----					
SL	-.24*	-.41**	-.27*	.20	.37**	.02	----				
HS	.04	.16	-.06	-.04	-.10	.24*	-.22	----			
LE	.01	.15	.08	.27	.06	-.15	.07	-.18	----		
DE	-.07	-.02	.06	.07	.01	.05	.06	-.16	.30*	----	
UR	.09	.05	-.10	.09	.06	-.04	-.11	.07	.25*	.13	----

Note: * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

METs = Average weekly MET score. SE = Exercise-specific self-efficacy. SS = Exercise-specific social-support. AR = Affective reaction to exercise. IM = Exercise-specific intrinsic Motivation, where lower scores indicate more intrinsic motivation. CMETs =Average weekly MET score controlled for previous exercise behavior before study. SL = Stress levels. HS = Hours of sleep per night. LE = Liking of experimenter. DE = Desire to increase exercise levels during study. UR = Amount of use of exercise recommendations from 1st session.

APPENDIX N

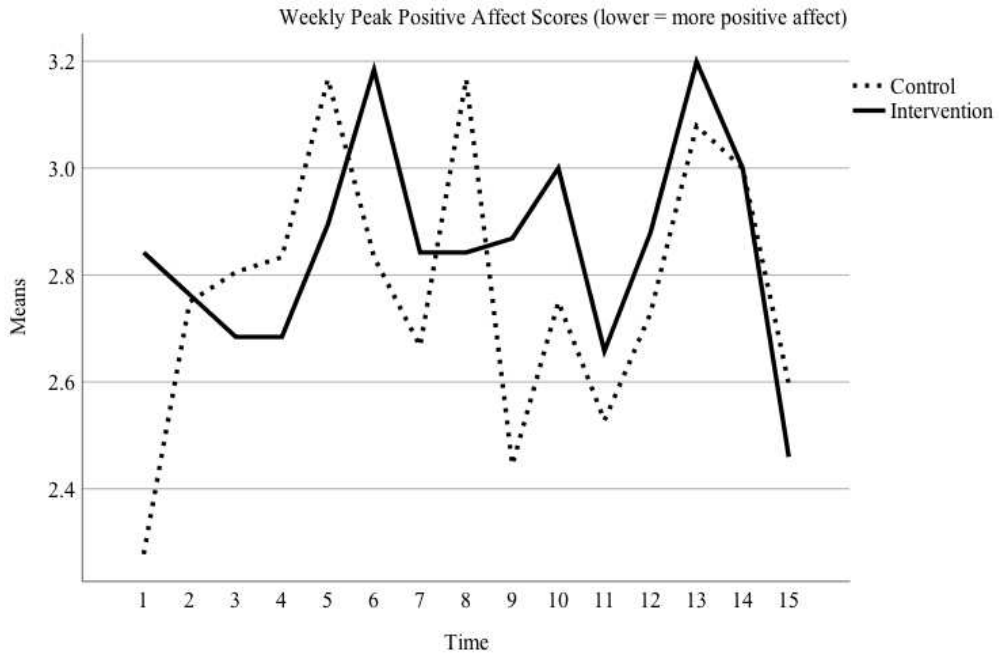

Figure 2. Range is from 1 (positive) to 11 (negative). Control = standard intervention.

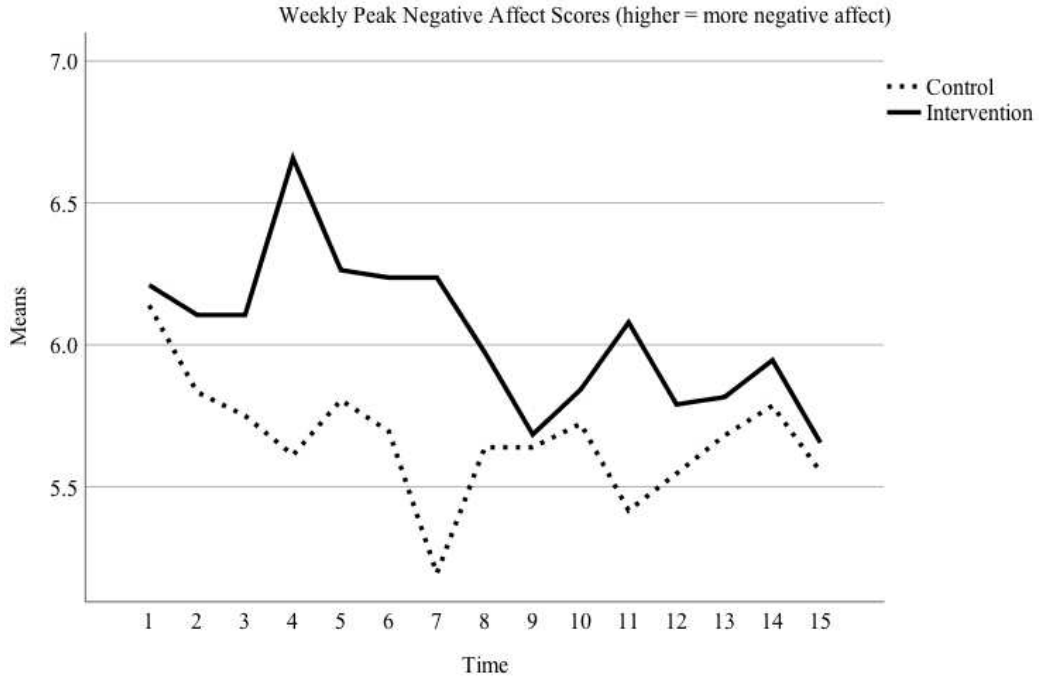

Figure 3. Range is from 1 (positive) to 11 (negative). Control = standard intervention.

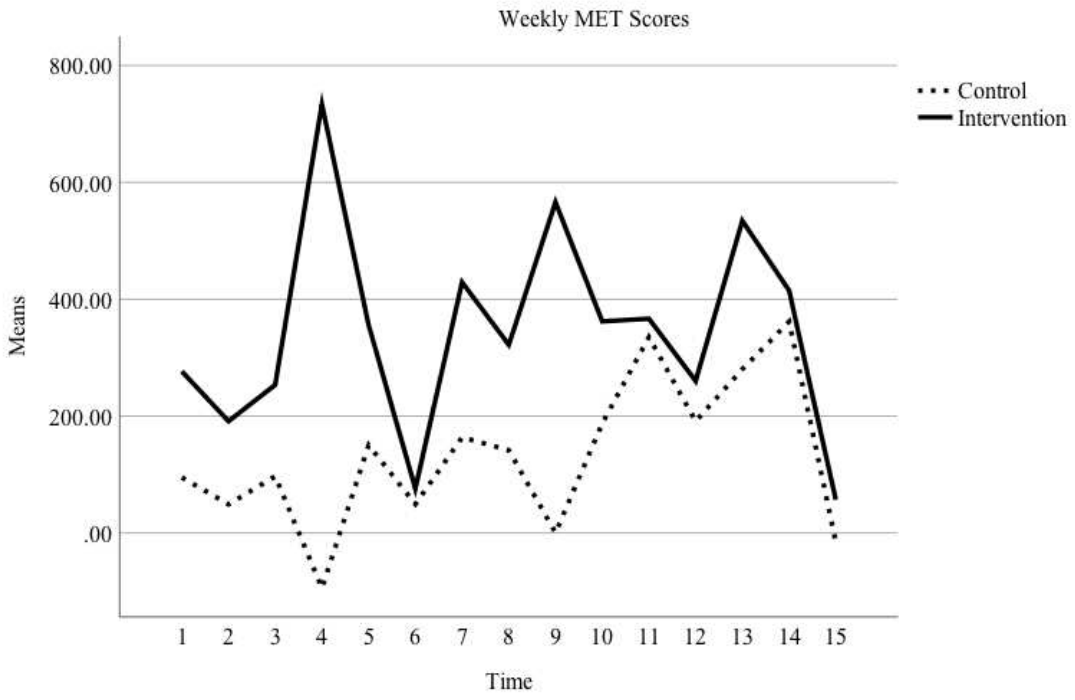

Figure 4. These scores control for participants' exercise behavior before onset of study. Control = standard intervention.

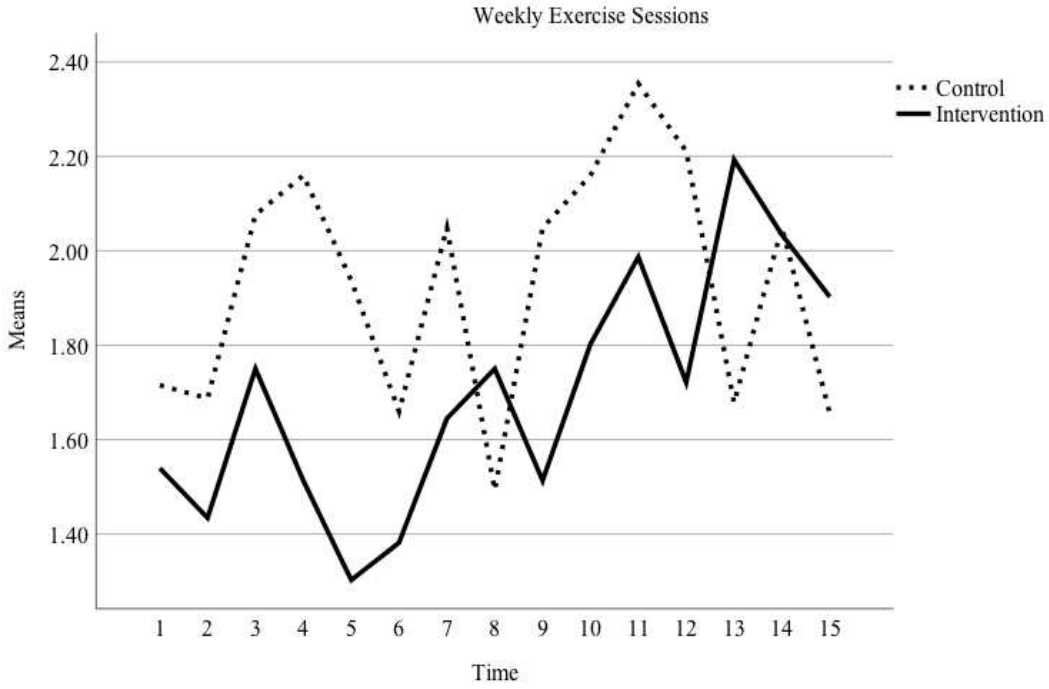

Figure 5. These scores control for participants' exercise behavior before onset of study. Control = standard intervention.

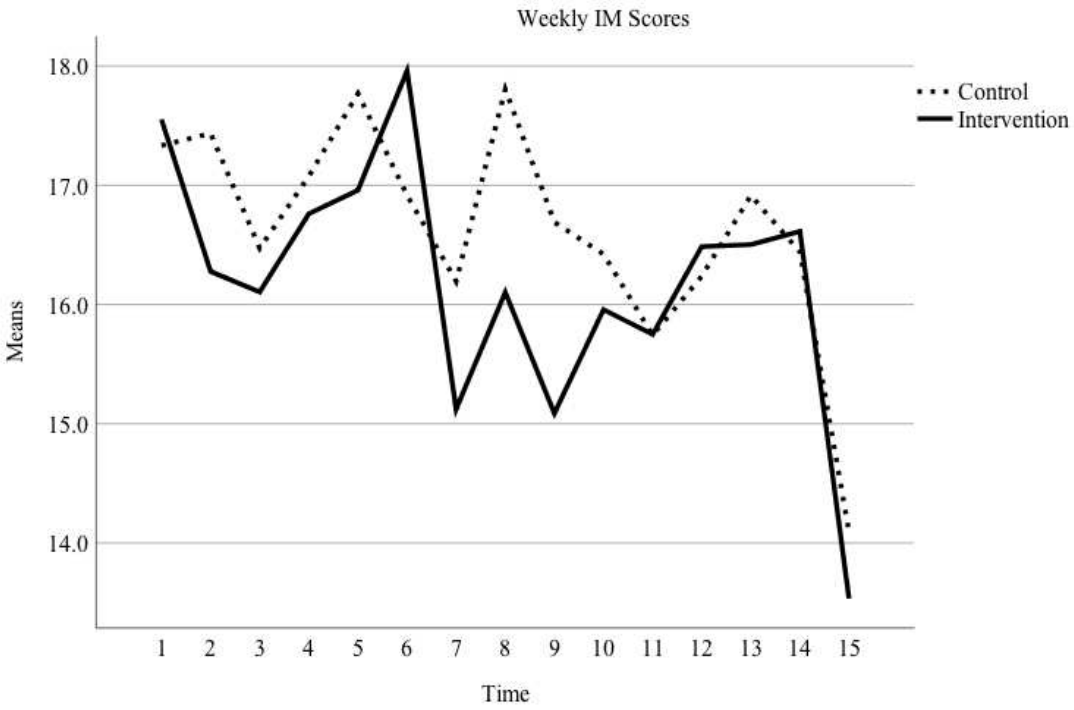

Figure 6. Range is from 7-49, with lower scores indicating more intrinsic motivation. Control = standard intervention.

APPENDIX O

Experimental Protocols for Sessions One and Two

First session:

1. Welcome!
2. Consent
3. Questions?
4. Give them money/class credit
5. Why did you sign up for this study?
6. Go over their exercise levels (and METs scale)
7. Overview of study and what they'll be doing today
8. Show them exercises
9. Workout session
10. Two scales (affect & IM)
11. Exercise recommendations (type up and email to them) ***MORE DETAIL ON MANIPULATION IN METHOD SECTION
    a. Condition 1 (standard intervention): show them model of TPB, have them write 1 thing in electronic document that they could do for each of 3 predictors. Then have them write out 5 SMART goals.
    b. Condition 2 (affective intervention): intensity, type, and contextual factors
        i. Have them write out in electronic document, in their own words, the rationale for an affective intervention after explaining it to them
        ii. Explain the three contextual factors and have them take notes after explanation of each factor
12. Questionnaire (online)
13. Height and weight measurements
14. Go over process for next few months
    a. Talk about how accelerometer will work (if they indicated "yes" on their consent form)

b. Inform them that they should not tell anyone else about the study
c. Ask them if they have any questions

15. Thank you!
16. Email participants their electronic document as well as plan for next 15 weeks

Second session:

1. Take back watch (accelerometer)
2. Give them money/class credit (did they do enough weekly surveys?)
3. Have them do weekly survey one last time
4. Workout session
5. Two scales (affect & IM)
6. Questionnaire (online)
7. Weight measurement
8. Were you involved in any other studies that caused you to exercise more or less than you might've without participating in that study?
    a. If so, what was the extent?
9. Have you discussed the study details with others during the course of the past 15 weeks?
10. Is there anything else that might've influenced your exercise levels besides standard barriers (such as time, energy, motivation)?
11. Debriefing
12. Goodbye and thank you!