

The Effect of Remembered Affect on Voluntary Exercise and Depressive Symptoms

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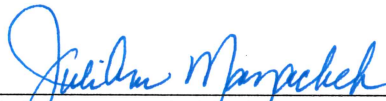
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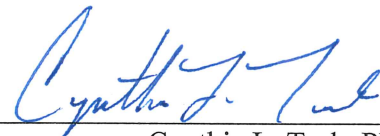
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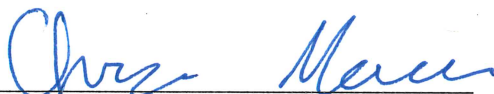
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The Effect of Remembered Affect on Voluntary Exercise and Depressive Symptoms

There is a vast amount of literature on the benefits of exercise. Exercise has been shown to reduce the risk of developing obesity, cancer, and cardiovascular disease (Centers for Disease Control and Prevention, 2014). Exercise not only benefits physical health but has been shown to reduce the incidence of a variety of mental health concerns and to promote well-being (Penedo & Dahn, 2005). In fact, as a method for treating depression and anxiety, exercise produces reductions in symptoms comparable to medication and cognitive behavioral therapy (Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005).

Despite the benefits of exercise, according to the Centers for Disease Control and Prevention, only 1 in 5 adults meet the 2008 Physical Activity Guidelines, which are 150 minutes of moderate-intensity aerobic activity each week, plus two or more muscle strengthening sessions each week (Centers for Disease Control and Prevention, 2014). Fortunately, recent research has identified factors that increase the likelihood of engaging in exercise behavior, including intentionally modifying the thoughts and feelings people have about exercise (Kangas, Baldwin, Rosenfield, Smits & Rethorst, 2015; Rhodes & Kates, 2015; Sala, Baldwin & Williams, 2016).

Remembered Affect and Exercise Adherence

In the past three decades there has been an increase in research on affect-related concepts as determinants of health behavior. More specifically, research has focused on the mechanisms behind exercise motivation and adherence focusing on the role of affect. In other words, how essential a person's affect is to their ability to maintain a regular commitment to physical activity is an emerging area of research interest. In a recent study by Kwan, Stevens, and Bryan (2017),

remembered affect has been directly associated with exercise intention and subsequent exercise behavior.

Remembered affect can be explained by affective associations. Affective processing is the cognitive processing of previous or anticipated affective responses to the target behavior, including, affective association. Affective associations are automatic associations between the target behavior and previously experienced affective responses to the target behavior, otherwise known as remembered affect. Hedonic theory states that people seek to increase pleasure and avoid or minimize pain. This theory provides a framework for understanding how affective response to exercise relates to exercise adherence (Williams, 2008). Researchers in this area have operated under the pervasive assumption that positive affective responses to any behavior are likely to lead to more frequent performance of that behavior, and negative affective responses lead to less frequent performance (Williams & Evans, 2014). Affective response is measured by assessing how people feel during and after exercise (Sala, Baldwin, & Williams, 2016). Compared to anticipated affect and affective attitudes, affective associations have received less attention in health behavior research. However, few studies have empirically demonstrated that more positive affective associations or remembered experiences are associated with future behavioral choices than anticipated choices. (Kwan et al., 2017; Wirtz, Kruger, Scollon, & Diener, 2003).

Cognitive interventions may be strategically targeted as an exercise bout is nearing its end, encouraging exercisers to focus on positive aspects of the experience (Kwan et al., 2017). The peak-end rule provides a framework for understanding the importance of the timing of exercise-related affect experienced. The peak-end rule was formulated by Fredrickson (2000) and suggests that affective memory is influenced by two episodes during a bout of exercise: 1) at

the 'peak', and 2) at the 'end'. The 'peak' is the moment of the highest affective intensity, regardless of whether the affect is positive or negative. The 'end' is the moment of the most recent recollection of the affective experience that occurred during the exercise bout (Parfitt & Hughes, 2009). According to the peak-end theory, people evaluate certain kinds of past affective experience by referencing a few moments which then guide their choices about which past experiences they would avoid, repeat, or recommend to others. This theory suggests that peaks and ends carry self-relevant information and that these two meanings can construct a whole episode of memory (Fredrickson, 2000; Parfitt & Hughes, 2009). According to the peak-and-end rule (Fredrickson, 2000), remembered affect tends to reflect affect experienced at the peak of an experience (whether high or low) or the end of an experience. Based on their findings, Kwan et al., (2017) suggest cognitive interventions may be strategically targeted as an exercise bout is nearing its end, encouraging exercisers to focus on positive aspects of the experience.

The dual mode model proposed by Ekkakkis, Hall, and Petruzzello (2004) provides a framework for understanding the relationship between affect, exercise intensity, and exercise adherence. Under this theory, intensity is associated with ventilatory threshold (VT) such that when exercise intensity is at, below, or above the VT, changes in affect occur. VT is a nonlinear increase in expired carbon dioxide relative to the consumed oxygen or a rise in blood lactate concentration as a result of the rate of production exceeding the rate of clearance. When the intensity increases above the VT, neurologically-based interoceptive factors become the major influence on affective response. In contrast, when intensity is at or below VT, cognitive factors such as self-efficacy, goals, and expectations become more important (Hall, Ekkekakis, & Petruzzello, 2002; Ekkakakis et al., 2004; Williams, 2008).

When participants are able to self-select their intensity, they are more likely to choose an intensity that results in a positive affective response. Self-paced exercise has been shown to be more positive regardless of where it falls on the exercise intensity continuum. In other words, people tend to select an intensity that approaches but does not exceed the VT (Williams, 2008). This relationship between exercise intensity and affect is consistent with self-determination theory that suggests increased choice over selected behavior leads to increased perception of competence and autonomy. This relationship has received empirical support in studies demonstrating that choosing one's mode of exercise is related to more positive affective responses to the bout of exercise (Daley & Maynard, 2003; Williams 2008). In the current study participants were able to choose the type and intensity of their exercise sessions in hopes of increasing a positive affective response.

Depression and Exercise

There is a substantial amount of history in the scientific literature that consistently demonstrates how exercise promotes improved well-being, including how exercise can be used to supplement, or even replace, traditional psychotherapy or medication-focused treatments for depression (Barbour, Edenfield, & Blumenthal, 2007; Kvam, Kleppe, Nordhus, & Hovland, 2016; Schuch, Vancampfort, Richards, Rosenbaum, Ward, & Stubbs, 2016). Studies have examined both frequency and intensity of exercise as potential predictors for decreasing depressive symptoms (Meyer, Koltyn, Stegner, Kim, & Cook, 2016; Nyström, Neely, Hassmén, & Carlbring, 2015; Perraton, Kumar, & Machotka, 2010). While limited research has suggested that higher intensity exercise may be particularly effective in decreasing depressive symptoms, other studies report no differences in effect across light, moderate, and high intensity efforts, as all have been shown to decrease depressive symptoms. Furthermore, exercise, whether the

intensity is low, moderate or vigorous, has been shown to reduce depressive symptoms significantly more than treatment as usual. Treatment as usual includes cognitive behavioral therapy, depression medication or both in conjunction. (Helgadóttir, Forsell, Hallgren, Möller, & Ekblom, 2017; Helgadóttir, Hallgren, Ekblom, & Forsell, 2016; Mata, Thompson, Jaeggi, Buschkuhl, Jonides, & Gotlib, 2012). Therefore, identifying ways to increase participation in, and adherence to, a regular exercise routine as a means for reducing mental health symptomatology is an area that could benefit from additional research.

Given the large body of research demonstrating that exercise can help reduce depressive symptoms, researchers have investigated whether exercise can be used as a preventive measure (Kvam et al., 2016; Schuch et al., 2016). In a systematic review of studies examining the potential effects of exercise as a preventive intervention for depression, Mammen and Faulkner (2013) concluded that 25 of 30 studies reviewed demonstrated how physical activity was negatively associated with a risk of subsequent depression, thereby providing strong support for the intentional implementation of physical activity to prevent future depression. Most recently, Harvey, Overland, Hatch, Wessely, Mykletun, and Hotopf, (2018) followed 33,000 individuals over an 11-year period and also concluded regular exercise of any intensity provides protection against future depression. According to Munoz, Le, Clarke, & Jaycox, (2002) preventative measures are aimed at individuals with early signs of depressive symptoms but who do not yet meet criteria. For this reason, this study intentionally did not examine a clinical population.

Purpose of the Study

The purpose of the present study is to examine the impact of remembered affect on adherence to exercise behavior and exercise-related affect. The literature has shown affective responses to exercise can be experimentally manipulated and can predict future exercise behavior

(Helfer, Elhai, & Geers, 2014; Kwan et al., 2017; Rhodes & Kates, 2015). While previous studies have examined the relationship between affective responses and exercise adherence over a two-week duration of exercise behavior, the current study will extend that timeframe to one month. The current study will also assess the severity of depressive symptoms as a function of remembered affect. The decision to adopt a four-week timeframe is consistent with research in other areas indicating that it takes three or more weeks to establish a new behavioral habit that is resistant to extinction, and in recognition that noticeable health benefits from increased and more consistent participation in exercise are more likely if behavioral changes can be maintained over a relatively long timeframe and preferably become permanent changes in lifestyle (Tobias, 2009).

The current study also adopted a more naturalistic approach such that participants were accessed in their self-selected exercise environment and in real-time. Most previous research has prescribed both the type of exercise and intensity level, whereas this study allowed the participants to self-select both mode of exercise and exercise intensity because an individuals' exercise preferences have been shown to affect affective response to the exercise (Daley, & Maynard, 2003; Parfitt, & Gledhill, 2004; Parfitt, Rose, & Burgess, 2006; Williams, 2008). While the majority of studies have used self-report questionnaires to determine exercise behavior, the current study utilized self-report exercise diaries to monitor behavior. The advantage of having the participants report their experiences in real time using electronic diaries is the potential reduction of bias when participants are asked to recall their experience (Hoyle, Harris, & Judd, 2002; Shiffman, Stone, & Hufford, 2008). While a growing number of recent studies have used more naturalistic methods, none of these studies have examined how affective response to exercise impacts actual exercise behavior. While a sequential model indicating how

variables moderate each other can be logically conceptualized, such that remembered affect would influence attitudes toward exercise and subsequent exercise behavior, culminating in changes in depressive symptoms, such an analysis is beyond the scope of this study. In this early developmental stage of this research area, it is merely hypothesized that participation in a four-week intervention that intentionally manipulates remembered affect about exercise will produce several effects, including increases in positive affect related to exercise, increased adherence to a recurring exercise routine and a decrease in depressive symptoms.

Hypotheses

The current study will examine three hypotheses:

1. While receiving an intervention designed to promote positive remembered affect, participants will report more positive *attitudes toward exercise* and physical activity compared to participants who were prompted to engage in remembrance of negative exercise-related affect.
2. While receiving the positive remembered affect intervention, participants will report more consistent participation in and *adherence* to a program of exercise behavior compared to participants who were prompted to engage in remembrance of negative exercise-related affect.
3. Participants who received the positive remembered affect intervention will report less severe *depression-related symptoms* compared to participants prompted to engage in remembrance of negative exercise-related affect.

Method

Participants

Participants were recruited from a mid-sized midwestern university. Students recruited from currently enrolled psychology courses were awarded credit for research participation consistent with departmental policies. All participants who completed the essential elements of this research study received \$10 cash. Participants who reported suffering from a cardiovascular, pulmonary, or metabolic disease or other health problems that would create a high risk for a medical emergency or injury because of increased exercise, or if exercise was contraindicated due to any other reasons, were excluded from participation. No participants were excluded based on these criteria. To be accepted for participation, persons must have reported having access to exercise equipment. A total of 56 individuals expressed interest in participating the study. Six participants did not complete all four in-person sessions, therefore were excluded from the analysis.

A total of 50 participants were included in the analysis, with 22 participants in the positive intervention group (50% female and male) and 28 participants in the negative intervention group (64% female, 36% male). Participants' ages ranged from 18-86 years with a mean age of 39.8 ($SD = 24.5$) years. The majority of the participants were female 58%, while 42% were male. The majority of the participants were Caucasian 62%, while 18% were African American, 8% were Hispanic, 2% Asian/Pacific Islander, 2% Mixed, and 2% Other.

Measures

Center for Epidemiologic Studies Depression Scale Revised (CESD-R). Severity of depression will be measured using the CESD-R (Appendix A). The CESD-R improved upon the original Center for Epidemiological Studies Depression Scale (CES-D; Eaton, Muntaner, Ybarra, Smith, & Tien, 2004) in several ways. The original CES-D scale was created prior to the DSM-III, whereas CESD-R was created based on the subsequent DSM-IV. Therefore, it is more

consistent with the more recently published DSM-5. More specifically, the CESD-R includes items assessing depressive symptoms in the areas of anhedonia, psychomotor retardation/agitation and suicidal ideation found in the DSM-5 that were not included in the original CES-D. Eight CES-D items that are no longer directly related to the current criteria for major depression were removed in the CESD-R (Eaton et al., 2004).

In contrast to measures such as the BDI, the CESD-R is more appropriate for use in the present study (Eaton et al., 2004; Radloff, 1977). While studies have found the CES-D and Beck Depression Inventory to be comparable, they differ in two important ways. First, the BDI was originally intended to measure depressive severity for individuals diagnosed as clinically depressed, and the CES-D was designed as a measure of depressive severity for adults in the general population, which is consistent with the current study. Second, on the CES-D respondents report the frequency of symptoms, whereas the BDI response format assesses different degrees of severity. Results suggest that the CES-D may be more discriminating of individual differences in depressive severity than the BDI. Consequently, the CES-D may be more desirable for investigating individual differences in depressive severity in student populations, where small individual differences in depressive severity must be detected. The CES-D is considered appropriate for use with adults and has been used in several studies utilizing college-aged students (Eaton et al., 2004; Santor, Zuroff, Ramsay, Cervantes, & Palacios, 1995; Skorikov, & VanderVoort, 2003).

The CESD-R includes 20 items to measure the nine symptoms of depression as defined in the DSM-5. The item numbers from the CESD-R that correspond to each symptom of depression are included in parentheses: sadness (items 2, 4, 6), loss of interest (items 8, 10), appetite (items 1, 18), sleep (items 5, 11, 19), thinking/concentration (items 3, 20), guilt (items 9, 17), tired

(fatigue; items 7, 16), movement (psychomotor agitation/retardation; items 12, 13), and suicidal ideation (thoughts of death and dying; items 14, 15). Each of the nine symptoms of depression is assessed by at least one item, with some symptoms reflected in two or three items. Each item utilizes a 4-point Likert scale ranging from 0 (not at all or less than one day) to 3 (5-7 days or nearly every day for 2 weeks). A total scale score is calculated by summing across all items to produce a range of scores from 0 to 60. The CESD-R also uses total scale scores to classify individuals into five levels of severity. Individuals who produce a score of less than 16 are deemed to experience depression at a level that has ‘no clinical significance.’ Criteria for experiencing a ‘Major depressive episode’ is met when a person endorses five symptom groups occurring nearly every day for the past two weeks.

Previous research has reported good psychometrics for the CESD-R. The CESD-R is found to be reliable with high internal consistency, with Cronbach’s alpha = .92 reported across the full set of items (Eaton et al., 2004). Direct comparisons to the CES-D have produced convergent validities with CESD-R, ranging from $r = .89$ to $.93$ (Eaton et al., 2004).

The Physical Activity Affect Scale (PAAS). The PAAS (Appendix C) was used to measure affect experienced by participants in relation to physical activity. The PAAS is a 12-item scale that includes the four subscales of positive affect (e.g. upbeat), negative affect (e.g. miserable), tranquility (e.g. calm) and fatigue (e.g. tired). The PAAS captures positive and negative activated affect via the positive and negative affect subscales, and positive and negative deactivated affect via the tranquility and fatigue subscales. Each subscale is represented by three items. Each item utilizes a five-point Likert scale ranging from 0 (Do not feel) to 4 (Feel very strongly). When responses are summed, each subscale total score ranges from 0 to 12 and then the average is

taken from the sum. The higher score represents feeling more negative or feeling more positive affecting depending on which scale is being measured.

Initial research using the PAAS showed that in combination the four feeling states of positive affect, three states (negative affect, fatigue and tranquility) accounted for 71.98% of the total variance in exercise induced affect (Lox, Jackson, Tuholski, Wasley, & Treasure, 2000). Strong internal consistencies have been reported for all four subscales of the PAAS, with alphas for positive affect reported as .94, for negative affect, .86, for fatigue, .91, and for tranquility .84 (Lox et al., 2000). Factor analysis of the items on the PAAS identified factor loadings on the positive affect subscale ranged from .72 to .92; on the negative affect subscale from .73 to .82; on the tranquility subscale from .61 to .80; and on the fatigue subscale from .77 to .84. (Lox et al., 2000).

The Feeling Scale (FS). The FS (Appendix D) was used to measure core affect experienced by participants in relation to exercise. The FS is a single-item, 11-point dimensional measure that asks respondents to indicate how “good” or “bad” they felt during exercise on a scale from -5 = very bad, to 0 = neutral, and +5 = very good. The FS has been used as a measure of affective valence in a number of physical activity studies (Rhodes & Kates, 2015). When Hardy and Rejeski (1989) aimed to determine whether the bipolar adjective pair good/bad represents an important dimension in affect, these authors compared responses from the FS to responses from the Multiple Affective Adjective Check List (MAACL-R). The authors found the participants clearly associated a good feeling with positive affect during exercise and a bad feeling with a negative affect. The classification matrix used to analyze results revealed a 95.2% accuracy. Both the PAAS and the FAS scale are being used in this study because both scales measure different aspects of affect such that PAAS measures affect specifically related to exercise and the

FS scale measure affective valence (pleasure vs displeasure). Given FS scale is a single scale this facilitates the ease of administering during the exercise.

Daily Exercise Diary. To measure exercise behavior (Appendix E), participants were asked to report three elements of their physical activity behavior each day they performed exercise using an experience sampling procedure during the four-week study period. During the initial face-to-face meeting with the researcher, participants were provided with a link that allowed them to access an online exercise diary. If the participants could not get access to the link, they were given paper format. The diary asked participants to report three types of information to describe their exercise activity throughout the duration of the four-week study. First, they reported the *type* of physical activity they had engaged in. Second, they reported the level of *intensity* of their physical/exercise activity using the standard 15-point Rating of Perceived Exertion (RPE) scale described below. Third, they reported the *duration* in terms of how many minutes they engaged in physical activity/exercise. Information about the *frequency* of participant's exercise behavior was also available based on how many times they completed and submitted the exercise diary. Based on their response and the amount of time spent engaged in exercise, the data was coded as 'day of exercise' or 'day of no exercise.' The total number of "days of exercise" across the four-week study period was used as the measure of the dependent variable of *exercise adherence*. Given that 30 minutes of low intensity exercise has been identified as the minimum threshold for accruing health benefits, a "day of exercise" is defined as any aerobic activity rated as an RPE of 9 or above for at least 30 minutes. Light exercise intensity has been shown to effectively treat decrease depression and is comparable to moderate and high intensity exercise therefore rating of 9 was acceptable (Helgadóttir, et al., 2017).

Procedure

Participants were recruited using several recruitment strategies. One approach faculty making announcements about the study to students enrolled in undergraduate psychology courses. The researcher and several trained research assistants also obtained permission to locate themselves in various workout facilities at different times throughout the day and evening to engage in direct recruitment as potential participants entered the facility. Regardless of recruitment source, all potential participants were provided with the Informed Consent which informed the participants of the purpose of the study, eligibility criteria and a brief overview describing the study, including: 1) the four-week duration of the study; 2) the need to complete a packet of measures to initiate participation; 3) the need to complete brief measures before, during and after one workout each week during an in-person interaction with a member of the research team; 4) and the expectation to access an online survey to record all workouts completed during the four weeks of the study. Participants who expressed eligibility and a willingness to participate signed the Informed Consent form (See Appendix F). Following the signing of the Informed Consent form, a random number chart was used to randomly assign participants to the positive remembered affect intervention group or the negative remembered affect intervention group. For participants who did not have access to the internet, paper forms were used to collect data format. The participants began the study by completing the demographics form (See Appendix G), followed by completion of the CESD-R, PAAS and FS scale.

Participants randomly assigned to the positive intervention group received an intervention designed to promote positive remembered affect. Each time they accessed the Daily Exercise Diary, and during the one-on-one weekly contacts with a research assistant, they were prompted to respond to the question “Think back to how you felt during today’s workout, choose 3 or more words that best describe positive feelings you experienced during today's workout.” What

positive feelings do you remember?” The participants chose from a list of words provided by the research team (see Appendix H). Participants in the negative intervention group were asked to respond to the question “Think back to how you felt during today’s workout, choose 3 or more words that best describe negative feelings you experienced during today's workout.” The participants also chose from a list of words provided by the research team (see Appendix H).

During the weekly one-on-one meeting with a research assistant, participants in both conditions completed the PAAS before they initiated their exercise session. Participants were then encouraged to perform their exercise of choice. After being allowed to exercise for at least 10 minutes, a member of the research team located the participant in the workout area and asked them to complete the PAAS again. During this mid-workout contact, the participant was asked to check-in with the researcher after they had completed their exercise session, and before leaving the workout area. During this third contact, participants again completed the experienced affect measures. Therefore, during each weekly in-person contact, experienced affect was measured at three time points in time: prior to the start of the workout, at the midpoint of their workout, and after completion of their workout. The in-person weekly contact concluded with the researcher and the participant scheduling another in-person contact for the following week. This type of in-person session occurred a total of four times, and at approximately 1-week intervals throughout the four-week study. Following the fourth and final exercise session that included an in-person contact with a research team member, participants were instructed to complete the CESD-R to obtain a post-test assessment of depressive symptoms.

For each exercise session they completed during the duration of the study, the researcher instructed the participants to go online to *Google Forms* using their phone to access the Daily Exercise Diary and record the type, duration and the intensity of the exercise they had

performed. If they were unable to record their exercise immediately after completing a workout, they were instructed to record the workout as soon as possible. After completing the surveys during the 4th in person session, participants were debriefed (Appendix I).

Results

Preliminary Analyses

A *t*-test indicated that the positive intervention group and negative intervention group did not differ on age, depression severity, or the amount of exercise they typically performed weekly prior to the study. However, they did differ in their desirability to exercise with the positive group ($M = -1$, $SD = 1.5$) and negative group ($M = -2.2$, $SD = 1.9$) with the negative group reporting a somewhat higher level ($t(36) = 2.1$, $p = .04$). This pre-test difference could influence the results such that if the negative group had higher expectations, any significant findings suggesting they were less likely to meet those expectations might be confounded by this pre-test difference between the groups. Chi-square analyses revealed the positive and negative intervention groups did not differ on gender or ethnicity.

Positive Remembered Affect

An independent-samples *t*-test was conducted to compare the average score from the Preworkout positive PAAS subscale across the positive ($M = 2.2$, $SD = 0.93$) and the negative ($M = 2.2$, $SD = .81$), intervention groups. The group means were virtually identical, and did not produce a significant difference in the scores between the groups ($t(48) = 0.00$, $p = 1.0$).

A 2 group (positive intervention group, negative intervention group) X 2 time (pre, post) ANOVA was conducted using scores from the positive subscale of the PAAS as the dependent variable. While neither the interaction between time and intervention ($F(1, 48) = .008$, $p = .93$) nor the main effect of intervention ($F(1, 48) = .001$, $p = .98$) were significant, the main effect of

time was significant $F(1, 48) = 33.48, p = 0.00$ with the pre-test PAAS scores having a mean of 2.2 (.86) and a post-test mean of 2.5 (.69). This result suggests that there was an increase in positive affect experienced by participants who exercised consistently regardless of the remembered affect intervention.

An independent-samples t -test was conducted to compare the average score of the FS scale from the mid workout in the positive and negative intervention group. There difference between the FS scores for the positive intervention group ($M = 3.5, SD = 1.1$) and the negative intervention group ($M = 3.2, SD = 1.3$), was not significant ($t(48) = 0.93, p = 0.36$).

Exercise Adherence

An independent- samples t -test was conducted to compare the total number of Daily Exercise diaries recorded in each condition. The difference between the number of workout diaries recorded for the positive intervention group ($M = 7.6, SD = 5.1$) and the negative intervention group ($M = 7, SD = 4.7$), was not significant ($t(48) = .46, p = 0.47$).

An independent-samples t -test was conducted to compare the change in self-reported baseline frequency of weekly workouts prior to participation of the study and the number of weekly workouts recorded in the Daily Exercise Diaries during the 4th week of the study. These change scores were virtually identical for both groups, with the positive intervention group producing a mean of $M = -1.5(SD = 1.6)$ and the negative intervention group producing a mean of $M = -1.5(SD = 1.6)$. Therefore, the lack of difference between produced a non-significant result ($t(42) = 0.09, p = 0.93$).

However, an independent-samples t -test comparing the two conditions using the difference between the number of workouts recorded in the Daily Exercise Diaries during the 4th

week of the study and self-reported desired number of weekly workouts prior to the study as the dependent variable did obtain significance. Here, the positive intervention group produced a mean of $M = -1.0$ ($SD = 1.6$) and the negative intervention group a mean of $M = -2.2$ ($SD = 1.9$), resulting in a $t(36) = 2.1$, and $p = 0.04$. Therefore, while the actual workout frequency engaged in during the four weeks of this study failed to match pre-study expectations for participants assigned to both groups, the positive intervention group reported being closer to their desired exercise frequency goals than the negative intervention group.

Depression

A 2 group (positive intervention group, negative intervention group) X 2 time (pre, post) ANOVA was conducted using scores from the CESD-R as the dependent variable. On this analysis, neither of the main effects or the interaction were significant, with the main effect of time producing an $F(1, 38) = .03$ and $p = .86$; the interaction between time and intervention an $F(1, 38) = 2.12$ and $p = .15$; and the main effect of intervention an $F(1, 38) = .27$ and $p = .61$.

A paired samples t -test was used to compare the participants' depression level at the beginning to the end of the study using the CESD-R scores as the dependent variable. The positive intervention group did not report significantly lower depression scores at the end of the study ($M = 7.7$, $SD = 8.7$) compared the beginning of the study ($M = 9.1$, $SD = 8.1$), as this comparison produced a $t(17) = 0.99$ with $p > .05$. The result for the negative intervention group on comparisons of depression scores between pre-test ($M = 9.5$, $SD = 11.5$), and post-test ($M = 10.6$, $SD = 12.4$) was also not significant ($t(21) = -1.1$, $p > .05$)

Discussion

The present study endeavored to expand the understanding of the relationship between remembered affect in four important ways. First, while previous studies have only examined the

relationship between affective responses and exercise adherence over a maximum two-week duration of exercise behavior, the current study extended that timeframe to four weeks. Second, while previous research was limited to examining the relationship between remembered affect and exercise-related attitudes, the current study examined the relationship between remembered affect and the two additional variables of exercise adherence and depression. Third, in contrast to previous research which was conducted in an exercise lab setting with the type of exercise activity prescribed and scheduled by the researcher, the present study adopted a more externally valid approach by accessing participants in “walk-in” student rec center or community-based gym settings, allowing participants to engage in their self-determined preferred form of exercise. Fourth, technology was used that allowed participants to self-report the frequency of their exercise behavior in an efficient and more user-friendly manner by accessing the online Daily Exercise Diary.

Contrary to the hypotheses, participants in the positive intervention group did not report significantly more positive attitudes toward exercise and physical activity compared to the participants in the negative intervention group. In contrast to previous research by Kwan et al. (2017), which found that both experienced and remembered affect was associated with intentions to exercise outside the lab, but that only remembered affect was associated with lab-based exercise behavior during the next seven days, intentional manipulation of affect in the current study produced differences between pre-test to post-test rating of positive affect, but not differential effects as a function of the intervention. This suggests that the increase in positive affect experienced by study participants who exercised consistently over a four-week period occurred regardless of, or in the case of the those assigned to the negative remembered affect condition, even in spite of, the remembered affect intervention. And, that this pre-test to post-test

increase was not substantially enhanced by experiencing the positive remembered affect condition. The second significant finding suggests that those assigned to the positive remembered affect condition were able to more closely approximate their desired frequency of exercise than those assigned to the negative remembered affect group. More specifically, when asked to predict at the outset of the study how often they would exercise in the next four weeks, all participants offered what turned out to be an overestimate. However, the positive remembered affect intervention appeared to decrease the extent of the overestimate. Said another way, participants assigned to the positive remembered affect condition came closer to achieving their exercise frequency goals compared to those assigned to the negative remembered affect condition.

This result is confounded by the fact that the groups differed in their pre-study self-reported desirability to exercise, as those in the negative remembered affect group set higher goals for themselves making it more difficult to fulfill that lofty goal. Therefore, as the change in exercise frequency during the first and last weeks of this study did not differ between the groups, the finding that those in the negative group were less likely to fulfill their desired exercise frequency may be a function of their having set overly lofty goals.

Kwan et al. (2017) did not attempt to manipulate remembered affect in their study, nor did they examine how remembered affect impacted actual exercise-related behavior outside of their lab. Therefore, the design of the current study which intentionally manipulated remembered affect, and utilized self-report of self-initiated exercise, may have provided a more accurate assessment of the relatively limited utility of attempting to intentionally alter remembered affect as a means for improving exercise-related attitudes and increasing actual exercise behavior.

However, the results of the present study do not provide a definitive judgment on the potential utility of intentionally altering remembered affect to modify attitudes toward exercise and subsequent exercise behavior, as the form of intervention may have been insufficiently potent. While the research design provided multiple points of intervention with participants asked to engage in the remembered affect intervention during the four in-person meetings with the research assistants and each time the participant accessed exercise diary to record each workout, each intervention was rather brief, and may have been performed in a rather perfunctory manner. Anecdotally, participants assigned to the negative remembered affect condition often appeared to resist the intervention—as if they really did not want to think about their workout in “negative” terms--and merely complied with the researcher’s request to identify negatively-valenced affect words rather than truly “owning” what felt like a “forced” negative evaluation. This level and style of intervention may not have been potent enough to counteract other factors known to influence exercise-related affect. In addition, the data collected suggests that some participants who had established a regular exercise schedule prior to agreeing to participate in this study may not have submitted an exercise diary every time they exercised. Therefore, they would not have been appropriately exposed to the intervention. It is also likely that some participants may not have submitted their exercise diaries immediately after their workout as instructed. This could have also reduced the accuracy, and subsequent potency, of the remembered affect intervention. At the other extreme of exercise frequency, participants who did not frequently exercise had no reason to access the workout diaries and would only be exposed to the intervention during the four in-person sessions, which reduced their exposure to the intervention. Ultimately, the assumption that participants in the positive and negative remembered affect conditions received multiple and relatively equal exposure to the remembered

affect manipulation may not be accurate. In reality, the exposure may have been limited to four brief and perfunctory interactions with a member of the research team.

Additionally, previous research has consistently demonstrated a positive relationship between exercise and positive well-being and improvements in mental health, especially if performed on a consistent basis (Barbour et al., 2007; Helgadóttir et al. 2017; Perraton et al., 2010). The current study may have suffered from ceiling effects of exercise behaviors in that the analyses required significant increases in exercise-related affect and behavior to support the hypotheses. The participants from this entire sample self-reported a pattern of exercising 3.3 days on average per week the previous month before entering this study. This suggests participants had established a consistent exercise routine prior to beginning this study and may have been reluctant to alter or abandon that routine. Those assigned to the positive remembered affect condition may have had limited reason or motivation to “increase” the frequency of their behavior. For example, many regular exercisers adhere to a “program” that dictates the frequency of exercise sessions (e.g. lifting weights three times a week to allow for adequate muscle recovery between exercise sessions). Those assigned to the negative remembered affect condition may have utilized previously learned coping strategies to “battle” the interventions intended influence. As previously mentioned, many participants expressed concern and attempted to avoid the remembrance of “negative” evaluations of their workout and may have quickly and quite effectively discounted or counteracted the intervention via positive self-talk or refuting with evidence by continuing to exercise.

Therefore, the decision to increase the external validity of the current study by accessing truly “voluntary” exercisers in the “natural environment” of a student rec center or community-based workout gym may have worked against the hypotheses in that it resulted in a biased

sample. Based on participants' self-report, there is reason to believe the sample in this study met the recommended guidelines of physical activity before participating in this study whereas the average number of Americans who meet the recommended guidelines of physical activity is only 1 in 5 adults (Centers for Disease Control and Prevention, 2014). Examination of participants' responses to the CESD-R, which assesses depressive symptoms, provides further support for having obtained a biased sample that detracted from the interventions potential to significantly reduce depression. The mean CESD-R score for this sample was 9.4 indicating 'No clinical significance,' with a score of at least 16 needed to be categorized as even "subthreshold depression." With this minimal endorsement of depressive symptoms across all participants, most of whom had already established a pattern of regular and frequent exercise, would have already experienced the benefits of exercise-related positive mood prior to the start of the study. This could be described as a "floor effect" as it is difficult to achieve significantly "lower" scores on a measure that produces relatively low scores at pre-test. To remedy this design flaw, future researchers should intentionally access participants who endorse a higher level of depressive symptoms, and possibly even people who meet criteria for clinical depression. Future research could also identify people who have not yet established a regular exercise routine.

Limitations and Suggestions for Future Research

The current study has a number of important limitations that could be addressed in future research. First, the total sample size was relatively small with only 50 participants. While the means produced by the two conditions in this study tended to be very similar, if the comparisons where small differences were evident was maintained, significance may have been achieved with a larger sample. More importantly, endeavoring to obtain participants who were not already engaged in a regular exercise routine could serve to reduce the ceiling (e.g.; difficulty increasing

the frequency of exercise behavior) and floor effects (e.g.; low endorsement of depressive symptoms at pre-test) previously described.

The recruitment method used in the current study accessed participants as they were entering a workout facility. Therefore, they had already overcome many of the obstacles that often prevent people from engaging in a regular exercise routine. Given that much of the data collection for this study occurred several weeks after the beginning of a new semester, and extended through the later weeks at the end of the semester, the participants may have included those who had persisted with their exercise routines despite the challenges and time demands experienced by college students. Or, participants may have been those who had made a conscious and intentional commitment to establishing and maintaining a regular exercise routine as a form of self-care to cope with stressors experienced earlier in the semester. In either case, the level of pre-determined commitment may have outweighed any effect produced by the remembered affect intervention.

The fact that participants were required to complete four in-person interactions across a four-week timeframe with a member of the research team to be included in the final analyses also guaranteed a rather high level of consistent exercise adherence. It is possible that some participants assigned to the negative remembered affect condition who were impacted by the intervention in the direction consistent with hypotheses were more likely to “drop out” of the study, and not included in the final statistical analyses. Future studies should design ways to follow-up with participants who “drop out” to obtain post-test data. More qualitative approaches may also be useful to gain a deeper understanding of how participants who did not fulfill the minimum requirements for inclusion in the final analyses were impacted by the interventions.

In summary, the current study sought to improve the understanding of exercise-related affect and its relationship to exercise adherence and depression. Results suggest that the approach used in the current study to intentionally manipulate exercise-related remembered affect may not have been sufficiently potent to modify previously established exercise routines. Results also suggest that other factors not directly examined in this study (e.g.; pre-existing aspects of more trait-based personality, previous experience with maintaining a regular exercise routine, personal and situational reasons for exercising) may possess greater explanatory value in understanding the relationship between exercise-related affect and exercise behavior. Based on the positive findings of this study, when targeting exercise behavior, it is critical to target those who are at the beginning stages of change. Those who participated in the current study had appeared to be in maintenance phase of change based on their previous and ongoing exercise behavior. When in the maintenance phase exercise itself serves as a medium to increase positive affect. Future research in this area should implement the suggestions described above to further examine how manipulation of remembered affect could be utilized to improve adherence to exercise among populations that are not already involved in a regular exercise routine. Intentionally studying persons who endorse a greater severity of depression symptoms may also further clarify the relationships between exercise-related remembered affect, exercise adherence, and depression.

Table

Table 1
Participant Characteristics

Characteristics	<i>N</i> (%)	Positive Intervention (<i>n</i> = 22)	Negative Intervention (<i>n</i> = 28)
Gender			
Female	29 (58%)	11 (22%)	18 (36%)
Male	21 (42%)	11 (22%)	10 (20%)
Ethnicity			
Caucasian	31 (62%)	15 (30%)	16 (32%)
African American	9 (18%)	3 (6%)	6 (12%)
Asian/ Pacific Islander	1 (2%)	0 (0%)	1 (2%)
Hispanic	4 (8%)	1 (2%)	3 (6%)
Native American	0 (0%)	0 (0%)	0 (0%)
Biracial	0 (0%)	0 (0%)	0 (0%)
Mixed	1 (2%)	0 (0%)	1 (2%)
Other	1 (2%)	1 (2%)	0 (0%)
Age	M =39.8, SD= 24.5		

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Appendix A

Center for Epidemiologic Studies Depression Scale Revised (CESD-R)

Below is a list of the ways you might have felt or behaved. Please rate how often you have felt this way during the past week.

- 0 = Not at all or Less than 1 day
1 = 1 or 2 days
2 = 3 to 4 days
3 = 5 to 7 days
3 = Nearly every day for 2 weeks

1. My appetite was poor.
2. I could not shake off the blues.
3. I had trouble keeping my mind on what I was doing.
4. I felt depressed.
5. My sleep was restless.
6. I felt sad.
7. I could not get going.
8. Nothing made me happy.
9. I felt like a bad person.
10. I lost interest in my usual activities.
11. I slept much more than usual.
12. I felt like I was moving too slowly.
13. I felt fidgety.
14. I wished I were dead.
15. I wanted to hurt myself.
16. I was tired all the time.
17. I did not like myself.
18. I lost a lot of weight without trying to.
19. I had a lot of trouble getting to sleep.
20. I could not focus on the important things.

Appendix B

Borg's Rating of Perceived Exertion

While doing physical activity, we want you to rate your perception of exertion. This feeling should reflect how heavy and strenuous the exercise feels to you, combining all sensations and feelings of physical stress, effort, and fatigue. Choose the number from below that best describes your level of exertion

6

7 Very, very light

8

9 Very light

10

11 Fairly light

12

13 Somewhat hard

14

15 Hard

16

17 Very hard

18

19 Very, very hard

20

Appendix C**The Physical Activity Affect Scale (PAAS)**

Instructions: Please use the following scale to indicate the extent to which each word below describes how you feel at this moment in time. Record your responses by circling the appropriate number.

- 0= Do Not Feel
- 1= Feel Slightly
- 2= Feel Moderately
- 3= Feel Strongly
- 4= Feel Very Strongly

- 1. Upbeat
- 2. Calm
- 3. Energetic
- 4. Tired
- 5. Peaceful
- 6. Miserable
- 7. Worn-out
- 8. Relaxed
- 9. Fatigued
- 10. Discouraged
- 11. Enthusiastic
- 12. Crummy

Appendix D

The Feeling Scale (FS)

Direction: Please indicate how you feel.

+5 Very good

+4

+3 Good

+2

+1 Fairly good

0 Neutral

-1 Fairly bad

-2

-3 Bad

-4

-5 Very bad

Appendix E

Exercise Diary

1) Pin Number

(e.g. 23A)

2) When was your workout completed?

(month, day, year)

3) What type of exercise did you perform?

(short answer text)

4) Intensity (RPE) (Appendix C)

5) How long was your workout?

(minutes)

6) Think back to how you felt during today's workout... (intervention see Appendix H)

Appendix F

Informed Consent

The Department of Psychology supports the practice of protection for human subjects participating in research. The following information is provided so that you can decide whether you wish to participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw at any time without penalty.

Purpose: The present research aims to better understand the relationship between mood, cognitions and exercise.

Eligibility Criteria: To be eligible to participate in this study you must be at least 18 years of age and not have any health conditions where exercise is contraindicated. As this study will require you to access materials online, you must own or have access to a smartphone or laptop computer. Membership in a gym or workout facility is also required.

Procedure: If you agree to participate, you can expect the following:

1. This study will continue for 4 consecutive weeks.
2. To initiate participation, you will be asked to meet with a member of the research team and complete a packet of measures.
3. You will need to schedule one workout each week that allows you to meet with a member of the research team to complete measures before, during and after those four workouts.
 - a. To schedule one workout each week with the research team please provide your cell phone number at the bottom of the informed consent.
 - b. At least one form of communication is required to schedule times to meet with a member of the research team. Additionally, the lead researcher will send reminders to the participants a day before their meeting time.
 - c. Once the study is completed, all electronic records will be deleted, and printed copies will be destroyed.
4. You will be asked to access a Workout Diary to record all workouts completed during the 4-week study period.
5. You will be asked to retain and include the PIN number that will be assigned to you during all communication regarding this study. This ensures that all the information you provide can be connected but remain anonymous and de-identified.

Benefits and Risks: Exercise has been shown to have many benefits such as improving positive well-being, physical health and mental health. The results of this study may help inform knowledge of exercise adherence. You will be allowed to select your own preferred workouts and will not be expected to exercise at a level of intensity or duration that is beyond your current fitness level. The study creates a minimal risk to loss of privacy. Data collection will be completed through Google Forms. Google Forms employs security measures to ensure your information is safe, secure, and only available to this researcher. A potential risk to participating in this study is that answering some survey questions may cause discomfort.

Reward: At the 4th and final meeting you will receive a \$10 cash for participation in this study.

Confidentiality and Privacy of Information: Access to your information will be limited to members of the research team. Your privacy will be protected by keeping all your information on a password-protected website and in a double-locked secure office setting. Information obtained during the study will be kept confidential, as your information will be associated with a pin number assigned only to you. Therefore, the information you share will not be associated with your name. Any publications or reports will use summary information rather than individually identifiable information. Once the study is completed, all electronic

records containing personal information about participants, including names, cell phone numbers, and email addresses will be deleted. Printed copies of such information will be destroyed.

Agreement: Your participation is solicited, but strictly voluntary. This agreement states that you have received a copy of this informed consent, that you agree to participate in this study, that you retain the right to withdraw from participation at any time. For any questions concerning the research project, you can contact the primary researcher, Jessica Barron, at 785-230-5331 or jessica.barron@washburn.edu.

At least one form of communication is required to schedule times to meet with a member of the research team. Additionally, the lead researcher will send reminders to the participants a day before their meeting time.

Please mark at least one option below you agree, or write “no” if you do not agree: I grant permission to:

I grant my permission to receive text messages related to my participation in this study on my personal cell phone

Please write your cell phone number here: _____

I grant my permission to receive email messages related to my participation in this study at my personal email address.

Please write your email here: _____

Participants Name (Print): _____ **Pin #:** _____

Participant Signature: _____ **Date:** _____

Appendix G

Demographic Measure

Exercise Facility: _____

Age: _____

Gender:

- ____ Male
- ____ Female
- ____ Not listed (please specify) _____

Race/Ethnicity:

- ____ Caucasian/White
- ____ African American/Black
- ____ Asian/Pacific Islander
- ____ Hispanic or Latino
- ____ Native American
- ____ Biracial
- ____ Multi-racial or Mixed Ethnicity
- ____ Not listed

Additional Questions:

Answer the following questions using the following scale: (mark the box)

	0 days	1 day	2 days	3 days	4 days	5 days	6 days	7 days
What is the average number of days per week you exercised in the <u>past month</u> ?	○	○	○	○	○	○	○	○
How many days per week do you intend to take part in regular physical activity over the <u>next four weeks</u> ?	○	○	○	○	○	○	○	○

Answer the following questions using the following scale: (please choose a number 1-7)

	Very Strongly Agree	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Very Strongly Disagree
I intend to exercise frequently...	7	6	5	4	3	2	1
I want to exercise regularly...	7	6	5	4	3	2	1
I will try to exercise regularly...	7	6	5	4	3	2	1

Appendix H

Think back to how you felt during today's workout, choose 3 or more words that best describe positive feelings you experienced during today's workout. What positive feelings do you remember?

Upbeat	Enthusiastic
Blissful	Ecstatic
Calm	Excited
Brave	Encouraged
Energetic	Confident
Capable	Great
Peaceful	Pleasant
Cheerful	Happy
Relaxed	Beautiful
Determined	Wonderful

Think back to how you felt during today's workout, choose 3 or more words that best describe negative feelings you experienced during today's workout. What negative feelings do you remember?

Tired	Crummy
Disappointed	Pain
Miserable	Aggravated
Distracted	Strange
Worn-out	Annoyed
Frustrated	Tense
Fatigued	Defeated
Irritated	Terrible
Discouraged	Diminished
Lazy	Burdened

Appendix I

Debriefing Form

Thank you for your participation in this study. The goal of the study is to investigate the impact of remembered affect on adherence to exercise behavior and exercise-related affect. Remembering the positive feelings about your workout might positively influence your mood and therefore increase your adherence to exercise. On the other hand, remembering negative feelings about your workout might negatively influence your mood and therefore decrease your adherence to exercise. Therefore, the present study is seeking to determine whether or not remembered affect about exercise would influence a person's adherence to exercise. Additionally, exercise has been shown to decrease depression. Another goal of this study is to examine the impact of remembered affect and exercise adherence on depressive symptoms.

If you feel especially concerned about questions relating to depression, please feel to notify the researcher. There are also resources listed below if you later experience distress based on your participation.

If you have any comments, concerns or questions please feel free to contact the principal investigator, Jessica Barron (785-230-5331), or the faculty supervisor, Dave Provorse (785-670-2562)

Washburn University Resources:

Washburn Psychological Services Clinic (very small charge, open to students and others in the community) Henderson 111: 785-670-1750

Counseling Services (free to students):

Kuehne 200, 785-670-3100

Student Health Services: Morgan 140, 785-670-1470

Community Resources:

Stormont-Vail Behavioral Health Services:
(785) 270-4600

Valeo Behavioral Health Care: (785) 234-3300