PLACEBO EXPECTANCIES AS A MECHANISM IN THE PSYCHOLOGICAL AND PHYSIOLOGICAL BENEFITS OF PHYSICAL EXERCISE

A Thesis
By
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FOREWORD

This thesis is written in accordance with the style of the *Publication Manual of the American Psychological Association (5th Edition)* as required by the Department of Psychology at Appalachian State University

I would like to thank my thesis chair, Joshua Broman-Fulks, for his patience and advice throughout this thesis process. Additional thanks are warranted to my thesis committee, Dr. Michael and Dr. Huelsman, and the undergraduate research assistants, namely, Carmen Bondy, Kelsey Toomey, Lynsey-Paige McManus, Lindsey Chatfield, Courtney Pfeiffer, & Krystal Trout, serving in our research lab. Special thanks to Chelsey Price for her tireless work in the lab. Finally, I wish to thank my parents Ines and Markus Wullimann for their timeless support and encouragement.

Running head: PLACEBO EXPECTATIONS AND PHYSICAL EXERCISE

Placebo Expectancies as a Mechanism in the Psychological and Physiological Benefits of Physical Exercise

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Abstract

The present research is designed to examine the potential role of the placebo effect in the benefits of physical exercise. To this end, 64 healthy non-exercising young adults were randomly assigned to a positive expectancy, negative expectancy, or no-information control group. Participants were asked to track their level of daily activity by wearing a pedometer for two days and were informed about the physical and psychological benefits of regular exercise. Participants in the positive expectancy group received feedback that their daily level of activity indicated that they were living an active lifestyle according to American College of Sports Medicine (ACSM) recommendations, and thus should be receiving the corresponding physical and psychological benefits associated with regular exercise. Participants in the negative expectancy group were informed that they were not meeting minimum ACSM standards of daily activity, and thus were not receiving the benefits of an active lifestyle. The no information control group did not receive feedback regarding their level of daily activity. Participants completed a battery of psychological and physiological measures during the initial meeting, directly following expectancy manipulations, and at a one-week follow-up appointment. Based on the expectancy model of placebo effects, it was hypothesized that participants receiving the positive expectancy manipulation would show improved scores on psychological and physiological measures, whereas the negative expectancy and control groups would show little or no change in outcomes. Results revealed that participants in the positive expectancy group reported significant increases in perceived level of daily activity and benefits of current level of physical activity on psychological wellbeing. However, these changes in participant perceptions did not correspond with significant effects on any of the psychological or physiological outcome measures.

Placebo Expectancies as a Mechanism in the Psychological and Physiological Benefits of Physical Activity

The word placebo is derived from the Latin word “placare” meaning to please (Rajagopal, 2006). A placebo is a substance or procedure that, despite containing no inherent power to generate a specific effect, produces a genuine psychological or physiological response (Stewart-Williams, 2004). Thus, placebo effects are conceptualized as effects that, though attributable to the administration of a substance or procedure, are not directly caused by the inherent powers of a substance or procedure (Stewart-Williams & Podd, 2004). The effects of placebos are so well-documented that it has become standard practice in drug trials and many therapy outcome studies to compare active treatments with placebos. Although the mechanisms of the therapeutic effects of placebos remain controversial, two prominent theories have emerged to explain the placebo effect: the Expectancy Model and Classical Conditioning Model (Geers, Weiland, Kosbab, Landry, & Helfer, 2005).

Expectancy Model

An expectation can be defined as a belief about the likelihood that a future event will occur (Olson, Roese, & Zanna, 1996). The expectancy model of placebo effects holds that a placebo functions by eliciting an expectation for a specific effect, and that the expectation in turn generates the effect. Thus, if an individual believes that a treatment will be beneficial, the expectation of physical or psychological improvement leads to the beneficial effect of the treatment. Expectancies can be acquired through a variety of mechanisms, such as direct personal experience, observational learning, or verbal suggestion. According to expectancy theory (Kirsch, 1985, 1990, 1997), some of the effects of expectancies are unmediated, and thus the expectation of an effect leads directly to the experience of that effect. In contrast,

other expectancy effects may be mediated by other variables, such as motivation (Geers et al., 2005). For example, research appears to indicate that the strength of the analgesic effect of placebos in studies of pain regulation is related to a combination of desire for reduced pain and expectancy of pain reduction (Vase, Robinson, Verne, & Price, 2003). Thus, expectancy theorists do not necessarily purport that expectancies alone can account for all placebo effects. Rather, expectancies are considered the most important variable involved in the placebo effect (Kirsch, 1999).

A considerable body of research has accumulated supporting the expectancy model of placebo effects. For example, expectancies have been shown to predict placebo analgesia (e.g., Montgomery & Kirsch, 1997; Price et al., 1999) and placebo-induced physiological arousal (Kirsch & Sapirstein, 1998). In one study, Price et al. (1999) manipulated the perceived efficacy of three placebo analgesic creams, thus reducing anticipated levels of pain during the application of a pain stimulus. Results indicated that expected levels of pain accounted for 25% to 36% of pain ratings following the stimulus. In another study, Kirsch and Sapirstein (1998) found that participants who ingested placebo caffeine demonstrated increased heart rates and motor performance, as well as several other effects that were consistent with participants' expectations but inconsistent with the pharmacological effects of caffeine. Thus, expectations regarding the effects of a stimulus appear to have the power to produce real, measureable changes in the experience of the stimulus.

Classical Conditioning Model

The second major approach to explaining the placebo effect is derived from classical conditioning theory. According to the classical conditioning framework, an active treatment or procedure serves as an unconditioned stimulus. The method or techniques used to

administer the treatment become conditioned stimuli, and the placebo effect is the conditioned response to the methods or techniques. Much of the support for classical conditioning as a mechanism of the placebo effect stems from nonhuman animal research (Stewart-Williams & Podd, 2004). For example, Ader and Cohen (1982) demonstrated conditioned immunological responses to placebo stimuli in laboratory mice by pairing a solution of sodium saccharin (a conditioned stimulus) with cyclophosphamide, an immunosuppressive drug as (unconditioned stimulus). Subsequently, the mice showed responses to sodium saccharin alone when cyclophosphamide was removed. More recently, Giang et al. (1996) found similar results of conditioned placebo responses in humans. Multiple sclerosis patients displayed decreased counts of peripheral leukocytes with the intravenous administration of anise-flavored syrup alone, following four treatments with cyclophosphamide paired with the syrup.

Competing or Complementary Models?

Expectancy and classical conditioning models have traditionally been regarded as competing explanations of the mechanisms of the placebo effect, and considerable research has been conducted in an effort to differentiate the two approaches (e.g., Kirsch, 1991; Montgomery & Kirsch, 1997; Voudouris, Peck, & Coleman, 1990). For example, proponents of the expectancy model cite research indicating that although placebo responses generally mimic the effects of the active drug, the placebo response will follow the expected response rather than the drug's pharmacological effect when expectancies are contrary to the effects of the active drug, (e.g., Kirsch, 1985). In contrast, some research indicates that conditioned responses to placebos can occur without the involvement of conscious expectancies. For example, Benedetti and colleagues (1998) found that medical patients who had been

conditioned with an opioid drug, a side effect of which is respiratory depression, subsequently demonstrated respiratory depression in response to a placebo despite never being told that this was a potential side effect and not being aware that it had occurred. Thus, evidence exists to support both the classical conditioning and expectancy approaches to explaining the placebo effect in at least some circumstances where the other approach cannot.

Rather than focusing on uncovering evidence for the superiority of one model over the other, some researchers have recently begun to work on integrating the expectancy and classical conditioning models. For example, Stewart-Williams and Podd (2004) suggest that expectancy and classical conditioning theories should not be viewed as competing explanations of placebo responses. Rather, conditioning and verbal information both have the ability to shape placebo effects. In some instances, conditioning procedures affect conscious expectancies, which in turn mediate some placebo effects. In other cases, conditioning procedures lead to placebo effects that are not affected by conscious expectations. Stewart-Williams and Podd (2004) propose that when considering classical conditioning and expectancy mechanisms of placebo responses, it is necessary to consider the type of learning and mediation involved in shaping the placebo effect. Placebo responses may follow conditioned responses in certain instances or consciously mediated expectancies in other cases depending on whether the dominant form of learning is consciously mediated.

Research on the Placebo Effect

Although the mechanisms through which placebos exert their effects remain controversial, the existence of the placebo effect is well-documented. In fact, the placebo effect is so well-established that it has become standard practice in modern treatment outcome research to compare the efficacy of new treatments with placebos, and estimates

indicate that more placebos have been dispensed than any other experimental treatment (Kirsch & Sapirstein, 1998). Research has demonstrated that the placebo effect plays a role in the efficacy of a variety of procedures and treatment methods. One construct that has received substantial attention with regard to the role of placebo effects is pain and analgesic treatments (Wager, 2005; Wager et. al. 2004; Montgomery & Kirsch, 1996; Benedetti et al. 2006). Most studies examining placebo analgesic responses have used verbal suggestions of analgesia to alter expectations of pain (Colloca & Benedetti, 2005). For example, Montgomery and Kirsch (1996) applied a topical placebo anesthetic mixture to one of the participants' index fingers and induced identical pain stimuli to participants' right and left index fingers. Significant reductions in pain were reported in the finger that received the placebo treatment. Recent research using brain imaging technology has indicated that placebos can reliably alter pain-related neurological functioning. Wager et al. (2004) used functional magnetic resonance imaging (fMRI) to show that brain regions involved in pain sensitivity have decreased neural activity as a result of placebo manipulation. Specifically, Wager et al. (2004) found decreased activity in the thalamus, insula, and anterior cingulate cortex, brain regions associated with pain-sensitivity, related to placebo analgesia. Additionally, increased activity in the prefrontal cortex was evidenced in anticipation of pain. These results suggest that the experience of pain can be reliably altered by the administration of placebo treatments.

A number of other conditions have also been shown to be amenable to placebos. For example, Khan et al. (2005) studied effects of placebos compared to active psychotropic drugs in several diagnostic groups. Results indicated statistically significant differences in the effects of placebos between groups, with the strongest response among individuals suffering

from generalized anxiety disorder (GAD), panic disorder, and depression. In addition, a recent meta-analysis of over 2,000 antidepressant medication trials has revealed that only 25% of the drug effects could be attributed to active ingredients in the drugs, whereas the placebo effect accounted for approximately half of the noted effects (Kirsch & Sapirstein, 1998). Thus, the potential impact of placebo responses appears to be substantial, and placebo effects have been shown to play a role in a variety of treatment methods.

Exercise

The physical and psychological benefits of regular physical exercise have been well-documented. Regular physical activity has been identified as a significant factor in the prevention and rehabilitation of numerous physical disorders, including heart disease, hypertension, and diabetes (Berlin & Colditz, 1990; Morris, Clayton, Everitt,, Semmence, & Burgess. 1990; Gordon, Scott, Wilkinson, Duncan, & Blair, 1990; Schneider & Ruderman, 1990). Furthermore, physical exercise has been shown to be associated with a variety of psychological benefits, including improvements in mood, anxiety, depression, and self-esteem (e.g., Byrne & Byrne, 1993; Dilorenzo et al., 2000; O'Connor, Raglin, & Martinsen, 2000). Although the benefits of exercise are far reaching and well-documented, the mechanisms through which exercise generates these benefits are not well understood. A variety of physiological and psychological hypotheses have been proposed to explain the effects of exercise on physical and psychological functioning (e.g., Folkins & Sime, 1981), though research does not appear to provide substantial support for any one theory. Recently, some researchers have begun to suggest that the placebo effect may be able to explain the ostensible psychological and physiological benefits of physical exercise (Desharnais, Jobin, Cote, Levesque, & Godin, 1993; Crum & Langer, 2007).

Exercise and the Placebo Effect

In the first empirical study to investigate the potential link between the placebo effect and exercise outcomes, Desharnais et al. (1993) randomly assigned 48 healthy young adults involved in a 10-week supervised exercise program to receive information that the exercise program was designed to improve their psychological well-being or no psychological information. Experimental participants were also reminded of the psychological benefits of exercise throughout the duration of the program and asked to be aware of both biological and psychological improvements. Participants assigned to the control group were told of the biological benefits of participation in the program, though no mention of potential improvements in psychological well-being was made. At post assessment, results indicated that the experimental group perceived their exercise program to be more psychologically beneficial than the control group (Cohen d = 0.60). However, the groups did not differ in their perceptions of physical benefit of the program or actual improvements in aerobic fitness (VO_{2max}). With regard to the effects of the information on psychological functioning, results revealed that the experimental group experienced significantly greater increases in self-esteem scores than the control group. Thus, these findings provide initial empirical support for the notion that placebo expectations may play a role in at least some of the psychological benefits associated with exercise participation.

In a recent study, Crum and Langer (2007) investigated the role of the placebo effect in the physiological benefits of exercise in 84 female room attendants across seven hotels. The room attendants were assigned to experimental or control conditions by hotel and told that the study was designed to acquire information concerning the health of hotel attendants in order to find ways to improve it. All participants were informed of the benefits of exercise;

however, the informed group received additional information regarding the ways in which their occupational activities were beneficial to their health, constituted regular exercise, and actually exceeded the necessary activity level to be physically healthy based on the Surgeon General's recommendations. For example, they were told that vacuuming for 15 minutes resulted in approximately 50 burned calories. In contrast, the control group was not given any information about their current exercise involvement. Results indicated that, though there were no changes in actual levels of activity among either condition during the four week study, the informed group perceived a significant increase in the amount of exercise they were getting ($\eta^2 = .09$) and the degree to which their work involved exercise. Results further indicated that informed participants exhibited significant decreases in weight ($\eta^2 = .13$), percentage body-fat ($\eta^2 = .13$); waist-to-hip ratio ($\eta^2 = .10$), and systolic blood pressure ($\eta^2 = .10$). In contrast, the control group did not evidence statistically significant improvements on any of the outcome measures. Thus, the mere perception of increased exercise appears to produce positive physiological changes independent of changes in actual exercise.

Although research by Desharnais et al. (1993) and Crum and Langer (2007) represent important first steps in understanding the role of placebo expectations in the physiological and psychological benefits of exercise, these studies are limited in several ways. First, the Crum and Langer (2007) study lacked individualized random assignment, thus limiting internal validity and the ability of researchers to rule out possible environmental variables that may have contributed to the physiological improvements in the experimental group. In addition, the Desharnais et al. (1993) and Crum and Langer (2007) studies did not implement a double blind design, thus leaving open the possibility that experimenter biases may have influenced study outcomes. This design issue is particularly notable in the Desharnais et al.

study, which used the same two group exercise leaders (who were knowledgeable of group assignment) to run both the experimental and control groups. Furthermore, although Desharnais et al. (1993) claimed that their findings indicate that enhanced expectancies regarding the psychological benefits of exercise resulted in significant improvement in psychological functioning, self-esteem was the only measure of psychological outcomes included in the study. Thus, whether the benefits of placebo expectancies are specific to the construct of self-esteem or representative of a broader effect on psychological functioning is unknown. In addition, Desharnais and colleagues required participants to take part in a 90-minute supervised group exercise program three times per week for 10 consecutive weeks, thus potentially limiting the external validity of their research.

The Present Study

The current study aimed to build on previous research and improve our understanding of the role of the placebo effect in the psychological and physiological benefits of exercise. Specifically, a double-blind experimental design was used to minimize the potential influence of experimenter biases on study outcomes. In addition, participants were randomly assigned to experimental conditions to minimize the potential influence of error variability on study outcomes. The present study also assessed the potential effects of exercise-related placebo expectancies in a variety of psychological outcomes that have been shown in previous research to be affected by exercise participation, including measures of depression, anxiety, anxiety sensitivity, stress, and positive and negative affect. The current study also represents the first investigation to assess both physiological and psychological outcomes in the same study of placebo effects in exercise. Finally, this study is the first to include a negative expectancy group, in addition to positive expectancy and no expectancy groups,

thus helping to clarify whether negative beliefs about the effects of exercise affect physical and psychological outcomes.

If placebo expectations are demonstrated to play a role in the perceived physiological and psychological benefits of exercise, such findings would have important implications for mental health clinicians, physicians, personal trainers, and other health care professionals. Specifically, health care professionals may be able to increase the physical and psychological well-being of their clients by emphasizing the positive outcome expectations associated with physical exercise. Furthermore, if the placebo effect is shown to play a role in the improvement of specific areas of psychological functioning (e.g., anxiety), future research will be needed to determine whether the inclusion of exercise and positive expectancy manipulations in treatment for particular psychological disorders would provide additional benefits.

Based on the findings of previous research, it was hypothesized that:

(1) Participants' assigned to the positive expectancy manipulation group would demonstrate a significant increase in perceived exercise participation and physical fitness, and corresponding physiological and psychological outcomes, from baseline to post and follow-up.

(2) Participants assigned to the negative expectancy manipulation or no-information control group would not demonstrate significant changes in perceived exercise participation and physical fitness, and corresponding physiological and psychological outcomes, from baseline to post and follow-up.

Method

Participants

To be included in the study, participants had to be: not experiencing any health conditions that would preclude exercise, not currently taking psychiatric medications, and not involved in a regular exercise regimen. Regular exercise participation was defined as more than one exercise session per week. An a priori power analysis revealed that a sample size of 63 (at least 21 per group) would be required to detect a medium effect size (d = .6) with 60% power (alpha = .05, one-tailed). To obtain 63 participants who completed the study, 639 prospective participants were screened (see Appendix A and Appendix B for screening instruments), of which 112 qualified for the study and agreed to participate. Upon completion of the step monitoring process, 66 participants qualified to continue in the study ($5{,}000 \leq$ steps $\geq 10{,}000$), 64 of which completed. Thus, the final sample included 64 male (n = 25) and female (n = 39) undergraduate students who received course credit in exchange for their participation. Participants ranged in age from 18 to 46 (M = 19.53, SD = 4.67), and racial/ethnic distribution included: 81% Caucasian, 9% African American, 3% Asian, 3% Hispanic, and 2% American Indian. The consent process was reviewed and approved by the Institutional Review Board at Appalachian State University on September 15, 2008 (see Appendix C).

Instruments

The *Depression Anxiety Stress Scales* (DASS) is a self-report measure composed of 42 items designed to measure levels of depression, anxiety, and stress over the span of the previous week (Lovibond & Lovibond, 1995). The measure contains 14 items for each of the three scales. Items are scored on a four-point Likert-type scale ranging from 0 to 3, with 0, *Did not apply to me at all,* to 3, *Applied to me very much, or most of the time*. Administration

of the DASS takes approximately 5-10 minutes, and results in a total negative affect score and depression, anxiety, and stress subscale scores (Lovibond & Lovibond, 1995). Internal consistency for the DASS has been demonstrated in student populations (α range from .81-.91; Lovibond & Lovibond, 1995) and clinical samples (*α* range from .88 to .96; Brown, Chorpita, Korotitsch, & Barlow, 1997). Construct validity of the three scales has been demonstrated by findings of significant correlations between the Anxiety scale and other measures of anxiety (*r*s = .81 to .84) and Depression scale and measures of depression (*r*s = .74 to .79; Brown et al., 1997). Two week temporal stability in a clinical sample ranged from .71 to .81 (Brown et al., 1997).

The *Rosenberg Self Esteem Scale* (RSES) is designed to measure global self esteem (Rosenberg, 1989). The RSES is composed of 10 self-report items that are rated on a four point Likert scale, ranging from 0, *Strongly Agree*, to 3, *Strongly Disagree*. The RSES has demonstrated good internal consistency (α = .77-.88) across numerous sample groups (e.g., Fleming & Courtney, 1984), and good test-retest reliability with correlations between .82 and .85 for one-week and two-week intervals respectively (Blascovich & Tomaka, 1993; Rosenberg, 1986).

The *Four-Dimensional Mood Scale* (4DMS) is a 20-item self-report measure designed to assess pleasant activation (PA, 4 items), unpleasant deactivation (UD, 5 items), unpleasant activation (UA, 6 items), and pleasant deactivation (PD, 5 items). Respondents are asked to rate how they feel about a set of adjectives "at this moment" on a five point Likert-type scale ranging from 1, *Slightly or not at all,* to 5, *Extremely*. The 4DMS produces separate scores for PA, UD, UA, and PD, obtained by summing items within each scale and dividing by the number of items on the scales. The 4DMS has demonstrated good internal

consistency, with alphas of .87 for the PA scale, .93 for the UD scale, .91 for the UA scale, and .88 for the PD scale (Huelsman, Nemanick, & Munz, 1998). The 4DMS subscales can be combined to form two bipolar scales, PA-UD and UA-PD, consistent with the familiar two-factor model of affect. The PA-UD and UA-PD scales of the 4DMS demonstrated good internal consistency, with alphas of .83 for the PA-UD scale and .85 for the UA-PD scale (Huelsman, Furr, & Nemanick, 2003).

The *Anxiety Sensitivity Index -3* (ASI-3) is an 18-item self-report measure designed to assess anxiety sensitivity along the 3 factors of: Physical, Cognitive, and Social Concerns. Six items comprise each scale and range from 0, *Very Little*, to 4, *Very Much* (Taylor et al. 2007). The ASI-3 was developed to address the unstable factor structures associated with the original measure, the Anxiety Sensitivity Index (ASI; Peterson & Reiss, 1992). Internal consistency estimates have yielded alphas ranging from .76 to .86 for Physical Concerns, .79 to .91 for Cognitive Concerns, and .73 to .86 for Social Concerns (Taylor et al. 2007). The test-retest reliability of the ASI-3 remains to be studied.

Procedure

Participants were asked to complete an informed consent form upon arrival at the first session (see Appendix D). They were also asked to sign a document agreeing not to make significant changes to their health-related behaviors (e.g., exercise participation, diet) for the duration of the study. Participants were told that the purpose of the research project was to study the typical level of physical activity among college students and asked to sign a document agreeing not to discuss their participation or the purpose of the study with anyone until the completion of the study.

Participants were asked to complete a demographic questionnaire inquiring about their age, gender, race/ethnicity, as well as factors pertinent to inclusion into the study. The demographic questionnaire inquired about participants' current level of exercise and use of psychiatric medication.

Participants were randomly assigned to one of three conditions: positive expectancy manipulation, negative expectancy manipulation, or a no-information control group. All participants completed a battery of baseline psychological questionnaires, including measures of depression, anxiety, stress, anxiety sensitivity, self-esteem, and positive and negative affect. In addition, baseline physiological measures, including resting heart rate, blood pressure, and weight were taken. Participants were also asked to complete a short questionnaire inquiring about their perceived physical activity and perceived benefits gained from physical activity. These questions served as a manipulation check for the placebo manipulation. Subsequent to completing these psychological and physiological measures, participants were provided with a pedometer and instructed to wear it for two full days. Participants were asked to begin wearing the pedometer upon getting up in the morning and wear it for the entirety of the day. They were given a brief tutorial about wearing the correctly to ensure accurate step monitoring. They were instructed to record their total number of steps at the end of each day and enter their results in an online survey prior to a second session, which was scheduled for three to five days later. Participants that failed to enter their number of steps were asked to do so if they had gathered this information. Participants that failed to wear their pedometer on a given day or could not remember their number of steps were asked to restart the two day step monitoring process. To be included in

the second portion of the study (placebo manipulation) participants must have averaged between 5000 and 10,000 steps per day over the two day monitoring period.

The placebo manipulation was performed in the second session. Participants were shown a video that explained the physical and psychological benefits of regular physical exercise. In addition, participants received a written statement containing their average number of steps taken over their two days of step monitoring and one of three types of written feedback regarding their activity level based on group assignment. To ensure a double-blind research design, the written feedback forms were provided to participants in sealed envelopes and the research assistant administering the session was never aware of the participant's condition assignment.

Participants assigned to the positive manipulation group received feedback instructing them that they exceeded the recommended number of steps necessary to live a healthy lifestyle, placing them in the "Active" range according to standards established by the American College of Sports Medicine (ACSM; http://www.acsm.org). They were informed that their daily amount of walking, with little to no additional exercise, should provide them with the physiological and psychological benefits of regular exercise participation. Conversely, participants in the negative manipulation group received information indicating that their average number of steps per day was insufficient to maintain good physical health and that they were not leading an "active lifestyle" according to ACSM standards. Participants were told that they were not receiving the physiological and psychological benefits of regular exercise participation. Participants assigned to the no information control condition were informed of their average number of steps, but did not receive any feedback regarding the health-related implications of their activity level. Participants in each group

were also provided with a handout discussing the physical and psychological benefits of physical exercise. Participants were asked to read the handout prior to completing psychological and physiological measures.

Following collection of the pedometers and application of the various manipulations, participants were asked to complete the psychological and physiological measures, as well as the manipulation check a second time. Participants were then scheduled for a one-week follow-up appointment and reminded not to change their exercise habits until the completion of the study. At the one-week follow-up appointment, participants completed the psychological and physiological measures and the questionnaire inquiring about their perceived physical activity and perceived benefits gained from physical activity a third time. Upon completion of the study, participants were provided with a full debriefing of the study. All participants were provided with a list of campus counseling resources to comply with IRB recommendations.

Results

Study hypotheses were tested using separate 3 x 3 (group x assessment session) mixed-model analyses of variance (ANOVAs) for each of the dependent measures. If violations of the sphericity assumption were detected, significance tests were conducted using the Greenhouse-Geisser correction method. Significant interactions were analyzed by examining within-group simple effects, followed by post hoc mean comparisons. Tukey's HSD procedure was used for mean comparisons. All significance tests were conducted two-tailed. Additionally, post-hoc planned comparisons of the positive and negative manipulation groups were performed at post on all psychological and physiological variables.

Demographics Characteristics

Chi Square analyses indicated that the three treatment groups were comparable at baseline on gender χ^2 (2, N = 66) = 2.14, p = .34 and race χ^2 (12, N = 66) = 9.88, p = .63. One way ANOVA's indicated that the groups did not differ in age, F(2, 63) = 0.44, p = .65 or average number of steps walked during the step monitoring period, F(2, 63) = 1.20, p = .31.

Manipulation Check

Participants were asked to rate four statements assessing the extent to which the manipulations affected their beliefs regarding their current level of exercise and the effect that their current level of exercise is having on their health (see Appendix E). Participants rated the statements at baseline, post, and follow-up on nine point Likert-type scales. The first inquiry was "please rate your current level of daily physical activity using the following scale," with response options ranging from "very low" to "very high." Results of a 3 X 3 mixed model ANOVA indicated a significant main effect for time, F(2, 120) = 4.91, p = .01, η^2 = 0.08. Post hoc analyses indicated that the overall mean score of participants significantly increased from baseline (M = 4.43) to follow-up (M = 4.81), though scores at post (M = 4.63) were not significantly different from baseline or follow-up. The main effect of group was not significant, F(2, 60) = 0.06, p = .94, η^2 < 0.01 (see Table 1).

Results indicated a significant group by time interaction, F(4, 120) = 2.49, p = .05, η^2 = 0.08. A simple effects analysis for the positive manipulation group was significant, F(2, 40) = 6.92, p < 0.01, η^2 = 0.26. Post hoc analyses revealed that the positive manipulation group's scores increased significantly from baseline (M = 4.19) to post (M = 4.90), with scores remaining significantly higher at follow-up (M = 4.76). However, scores did not significantly change from post to follow-up. Simple effects analysis for the negative

manipulation group, $F(2, 42) = 2.16$, $p = .13$, $\eta^2 = 0.09$, and no information control group, $F(2, 38) = 1.08$, $p = .35$, $\eta^2 = 0.05$, were non-significant.

On the statement, "please rate the extent to which you believe that your current level of physical activity benefits your psychological wellbeing," results of a 3 X 3 mixed model ANOVA indicated a significant main effect for time, $F(2, 120) = 7.72$, $p < 0.01$, $\eta^2 = 0.11$. Post hoc analyses indicated that the overall mean score of participants significantly increased from baseline ($M = 4.70$) to follow-up ($M = 5.37$) and from post ($M = 5.00$) to follow-up, though scores at post were not significantly different from baseline. The main effect of group was not significant, $F(2, 60) = 0.96$, $p = .39$ (see Table 1).

Results indicated a significant group by time interaction, $F(4, 120) = 2.72$, $p = .03$, $\eta^2 = 0.08$. A simple effects analysis for the positive manipulation group was significant, $F(2, 40) = 8.14$, $p < 0.01$, $\eta^2 = 0.29$. Post hoc analyses revealed that the positive manipulation group's scores increased significantly from baseline ($M = 4.57$) to post ($M = 5.71$), with scores remaining significantly higher at follow-up ($M = 5.57$). However, scores did not significantly change from post to follow-up. Simple effects analysis for the negative manipulation group, $F(2, 42) = 1.80$, $p = .18$, $\eta^2 = 0.08$ and no information control group, $F(2, 38) = 3.00$, $p = .06$, $\eta^2 = 0.14$, were non-significant.

No significant effects were found for time, $F(2,120) = 1.54$, $p = .22$, $\eta^2 = 0.03$, condition, $F(2,60) = 0.06$, $p = .94$, $\eta^2 < .01$, or group by time interaction, $F(4,120) = 1.14$, $p = .34$, $\eta^2 = 0.04$, for the statement, "please rate the extent to which you believe that your current level of physical activity benefits your physical wellbeing" (see Table 1).

For the statement "Please rate how physically fit you believe you are," no significant effects were found for time, $F(2,120) = 0.53$, $p = .59$, $\eta^2 < 0.01$, condition, $F(2,60) = 0.02$, p

= .98,) $\eta^2 < 0.01$, or group by time interaction, $F(4,120) = 1.91$, $p = .11$ $\eta^2 = 0.06$, (see Table 1).

Psychological Measures

Depression Anxiety Stress Scale. Separate mixed-model ANOVAs were performed on mean DASS subscale scores. Results of a 3 X 3 mixed model ANOVA indicated non-significant main effects for time, $F(2,116) = 3.02$, $p = .05$, $\eta^2 = 0.05$, group, $F(2, 58) = 1.11$, $p = .34$, $\eta^2 = 0.04$, or group by time interaction, $F(4, 116) = 1.79$, $p = .14$, $\eta^2 = 0.06$ for the Depression subscale (see Table 2).

Results of a 3 X 3 mixed model ANOVA for the Anxiety subscale indicated a significant main effect for time, $F(2, 114) = 10.02$, $p < .01$, $\eta^2 = 0.15$. Post hoc analyses indicated that the overall mean score of participants significantly decreased from baseline ($M = 4.88$) to post ($M = 3.43$) and from baseline to follow-up ($M = 3.03$). Scores were not significantly different from post to follow-up. The main effects of group, $F(2, 57) = 0.65$, $p = .53$, $\eta^2 = 0.02$, and group by time interaction, $F(4, 114) = 1.23$, $p = .30$, $\eta^2 = 0.04$ were not significant (see Table 2).

Results of a 3 X 3 mixed model ANOVA for the Stress subscale indicated a significant main effect for time, $F(2, 118) = 5.26$, $p < .01$, $\eta^2 = 0.08$. Post hoc analyses indicated that the overall mean score of participants significantly decreased from baseline ($M = 8.42$) to post ($M = 6.71$) and from baseline to follow-up ($M = 6.65$). Scores were not significantly different from post to follow-up. The main effects of group, $F(2, 59) = 1.70$, $p = .19$, $\eta^2 = 0.05$, and group by time interaction, $F(4, 118) = 0.67$, $p = .62$, $\eta^2 = 0.02$, were not significant (see Table 2).

Rosenberg Self-Esteem Scale. A 3 X 3 mixed-model ANOVA performed on mean RSES scores revealed no significant effect of time, $F(2, 116) = 0.41$, $p = .66$, $\eta^2 = 0.01$, group, $F(2, 58) = 1.78$, $p = .18$, $\eta^2 = 0.06$ or group by time interaction, $F(4, 116) = 0.42$, $p = .80$, $\eta^2 = 0.01$ (see Table 2).

Four-Dimensional Mood Scale. Separate mixed-model ANOVAs were performed on the means of the two 4-DMS sub-scale scores. A 3 X 3 mixed-model ANOVA performed on mean UA-PD subscale scores indicated that the main effects for time, $F(2, 120) = 2.02$, $p = .14$, $\eta^2 = 0.03$, and group, $F(2, 60) = 0.35$, $p = .71$, $\eta^2 = 0.01$, were nonsignificant, and the group by time interaction also failed to reach significance, $F(4, 120) = 1.77$, $p = .14$, $\eta^2 = 0.06$ (see Table 2). Similarly, analysis of mean PA-UD subscale scores revealed no significant main effect of time, $F(2, 116) = 1.13$, $p = .32$, $\eta^2 = 0.02$, or group ($F(2, 58) = 1.10$, $p = .34$, $\eta^2 = 0.04$, or a group by time interaction, $F(4, 116) = 0.30$, $p = .86$, $\eta^2 = 0.01$ (see Table 2).

Anxiety Sensitivity Index. Results of a 3 X 3 mixed model ANOVA performed on mean ASI-3 scores indicated a significant main effect for time, $F(2, 112) = 18.45$, $p < .01$, $\eta^2 = 0.25$. Post hoc analyses indicated that the overall mean scores of participants significantly decreased from baseline ($M = 13.68$) to post ($M = 10.25$) and from baseline to follow-up ($M = 9.37$). Scores were not significantly different from post to follow-up. The main effect of group, $F(2, 56) = 2.26$, $p = .11$, $\eta^2 = 0.08$, and group by time interaction, $F(4, 112) = 0.56$, $p = .70$, $\eta^2 = 0.02$, were not significant (see Table 2).

Physiological Measures

Separate mixed-model ANOVAs were performed on mean scores of each physiological variable. A 3 X 3 mixed model ANOVA analysis of weight revealed no

significant main effect of time, $F(2, 114) = 0.91$, $p = .38$, $\eta^2 = 0.02$, group, $F(2, 57) = 1.87$, $p = .16$, $\eta^2 = 0.06$, or a group by time interaction, $F(4, 114) = 0.40$, $p = .81$, $\eta^2 = 0.01$ (see Table 3). Similarly, a 3 X 3 mixed model ANOVA revealed no significant main effect for time, $F(2, 120) = 1.70$, $p = .19$, $\eta^2 = 0.03$, or group, $F(2, 60) = 0.87$, $p = .42$, $\eta^2 = 0.03$, or a group by time interaction, $F(4, 120) = 0.87$, $p = .48$, $\eta^2 = 0.03$, for heart rate (see Table 3).

Separate analyses were performed for diastolic and systolic blood pressure (see Table 3). Results of a 3 X 3 mixed model ANOVA performed on diastolic blood pressure scores indicated a significant main effect for time, $F(2, 120) = 4.49$, $p = .01$, $\eta^2 = 0.07$. Post hoc analyses indicated that the participants' diastolic blood pressure significantly decreased from baseline ($M = 75.68$) to post ($M = 73.13$) and remained decreased at follow-up ($M = 73.46$). Scores were not significantly different from post to follow-up. The main effect for group, $F(2, 60) = 0.49$, $p = .62$, $\eta^2 = 0.02$, and the group by time interaction ($F(4, 120) = 0.26$, $p = .90$, $\eta^2 = 0.01$) were not significant.

Results of a 3 X 3 mixed model ANOVA performed on systolic blood pressure scores indicated a significant main effect for time, $F(2, 120) = 5.48$, $p = .01$, $\eta^2 = 0.08$ (see Table 3). Post hoc analyses indicated that the participants' systolic blood pressure significantly decreased from baseline ($M = 112.70$) to post ($M = 109.32$) and remained lower at follow-up ($M = 108.68$). Scores did not significantly differ from post to follow-up. The main effect for group, $F(2, 60) = 0.62$, $p = .54$, $\eta^2 = 0.02$, and the group by time interaction, $F(4, 120) = 1.29$, $p = .28$, $\eta^2 = 0.04$, were not significant.

Discussion

The purpose of the present study was to investigate the role of the placebo effect in the psychological and physiological benefits of exercise. Based on previous research, we

hypothesized that participants assigned to a positive expectancy manipulation group would show significant increases in perceived exercise participation and physical fitness with corresponding changes in physiological and psychological outcomes. Further, we hypothesized that participants assigned to the negative expectancy manipulation or no-information control group would not demonstrate significant changes in perceived exercise participation, physical fitness, or physiological or psychological outcomes. A manipulation check revealed that participants in the positive expectancy group reported significant increases in perceived level of daily activity and benefits of current level of physical activity on psychological wellbeing. However, these changes in participant perceptions did not correspond with significant effects on any of the psychological or physiological outcome measures.

Previous studies have reported significant group differences on psychological and physiological measures as a result of expectancy manipulations (Crum & Langer, 2007; Desharnais et al., 1993). Specifically, Desharnais et al. (1993) found a significantly greater increase on a measure of self-esteem among exercise participants who were provided with information regarding the psychological benefits of exercise compared to exercise participants who were not told of these benefits. However, the present research failed to replicate this finding, as the expectancy manipulation did not affect self-esteem scores. Furthermore, although some psychological and physiological variables changed over time, none of the outcome variables demonstrated an effect of group manipulation. Thus, the results of the present study generally suggest that changing individuals' beliefs regarding their level of physical activity may not be sufficient to affect physiological and psychological variables.

Several potential reasons exist for the discrepancy between the present findings and those of previous research. For example, the frequency of the manipulation and duration of the study may have contributed to the lack of significant findings. Desharnais et al. (1993) reminded participants of the psychological benefits of exercise throughout the duration of a 10-week exercise program and asked participants to be aware of both biological and psychological improvements. Similarly, participants in the month long study by Crum and Langer (2007) were provided with verbal information regarding the benefits of exercise and their current exercise levels, and written information was posted on a bulletin board in an area frequented by the room attendants. Thus, the placebo manipulation information was made available to participants in both studies on multiple occasions over the period of a month or more. In contrast, the current study provided feedback regarding the psychological benefits of exercise and the adequacy of the participants' current level of physical activity on one occasion, and follow-up assessment sessions were conducted only one week later. Thus, it is possible that had the current study been longer in duration and included more frequent reminders about the benefits of exercise and participants' exercise status, significant group differences may have emerged.

The significant group by assessment time differences in perceived level of daily activity and benefits of current physical activity on psychological wellbeing suggest that a single positive manipulation succeeded in increasing perceived physical activity, as well as psychological benefits gained from physical activity. However, the effects of the manipulation did not generalize to the specific variables assessed by the various measures. According to the expectancy model of placebo effects, a placebo functions by eliciting an expectation for a specific effect, which then generates that effect. The significant group by

assessment time interaction effects in manipulation check items, with improvements by positive manipulation group participants, may reflect an expectation that overall psychological wellbeing should benefit from an increase in perceived daily activity in accordance experimenter suggestion. However, no specific suggestions were available for individual items on the various psychological measures, resulting in a lack of change on these measures. It is conceivable that a stronger manipulation, such as those utilized in the Crum and Langer (2007) and Desharnais et al. (1993) studies, would have allowed for greater generalization of perceived benefits to factors assessed by the various outcome measures.

Interestingly, no changes in perceived benefits of daily physical activity on physical wellbeing or increased perceived physical fitness were endorsed. This may be due to the characteristics of the study population, self-reported non-exercisers, who possessed well formed, static beliefs regarding their physical fitness and health. It is commonly known that exercise affects physical wellbeing and fitness; it is not surprising then that the single manipulation was not successful in affecting these variables. These results point to a failure of the manipulation to convince positive manipulation participants that their daily level of physical activity constitutes physical exercise and should provide them with the physical benefits of regular physical exercise. Further, these findings suggest that perceived psychological benefits of physical activity may be more malleable than perceived physical benefits.

The lack of change in perceived activity or psychological benefits gained from current physical activity from baseline to post or follow-up assessment among negative manipulation and control participants, suggests that feedback provided to the negative manipulation group merely reflected preconceived beliefs regarding their physical activity

and wellbeing. Again, this is to be expected among a population of self-reported non-exercisers, whose belief regarding their physical activity and fitness is likely to be poor.

The current study possesses some methodological advantages to previous research. First, it employed a double-blind experimental design, ensuring that experimenter bias did not affect results. A double-blind design was not possible in either the Desharnais et al. (1993) or Crum and Langer (2007) studies. Second, participants were randomly assigned to experimental conditions to minimize the potential influence of error variability on study outcomes. This was not the case in the Crum and Langer (2007) study, where participants were assigned to groups dependent on employment site. Third, the present study assessed the effects of exercise-related placebo expectancies on a variety of psychological and physiological outcomes, whereas previous research has focused on either psychological or physiological outcomes independently, and in the Desharnais et al. (1993) study, the only psychological outcome measure was self-esteem. Finally, this study is the first to include a negative expectancy group, in addition to positive expectancy and no expectancy groups, thus helping to clarify whether negative beliefs about the effects of exercise affect physical and psychological outcomes.

As noted, previous research illustrated psychological and physical benefits of health related expectancy manipulations. These results may have important implications for health care providers. The results of the current study suggest that expectancy manipulations can have an effect on perceived level of physical activity and perceived benefits gained from physical activity. However, these changes do not necessarily translate to significant changes on psychological and physiological variables. Additional research is needed to further clarify whether expectancy manipulations can generate or enhance the psychological and

physiological benefits associated with exercise, and if so, document the specific circumstances (e.g., duration, type) under which such manipulations exert an effect.

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Appendix A

Brief Screening Consent

Dear Prospective Participant:
We are conducting a study and looking for people with a variety of characteristics to participate in this study. To find people with these characteristics, we are asking participants to complete a brief screening questionnaire. If you are selected to participate in the study, we will contact you and provide you with further information about the study. If you are not selected, all identifying information will be removed from these forms. All information you provide will be kept confidential.
You may ask the researcher any questions related to this research project, or you may contact Simon Wullimann at (828)262-8641 or Dr. Joshua Broman-Fulks at (828)262-2726. This project has been reviewed by the Institutional Review Board, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about your rights as a research participant should be directed to the Administrator for the IRB, Jay W. Cranston, M.D. at (828)262-2692 or Graduate Studies and Research, Appalachian State University, Boone, NC 28608.
Your consent to participate in the screening portion of this study is implied if you elect to complete the screening questionnaire.
Thank you for your participation.

Appendix B

Demographic Information Questionnaire

DEMOGRAPHIC QUESTIONNAIRE

First Name:_____ e-mail_____ Phone #_____

Age: _____ **Gender: _____** Male **_____** Female

Academic Status: ___ Freshman ___ Sophomore ___ Junior ___ Senior

Major:_____

Race/Ethnicity: ___ White or Caucasian ___ American-Indian or Alaskan Native
___ Black or African-American ___ Hispanic or Latino
___ Asian ___ Native Hawaiian or Other Pacific Islander
___ Other (please specify) _____

Do you currently use any of the following substances:

- Alcohol Yes No If yes, how many drinks per week? _____
- Caffeine (soda, coffee, tea, etc.) Yes No If yes, how many caffeine drinks per day?_____
- Cigarettes Yes No If yes, how many cigarettes per day? _____
- Other Illicit Drugs Yes No If yes, please specify _____
  If yes, how often? _____

Are you currently involved in a regular exercise program? Yes No

- If yes, how many times per week do you exercise on average?
  _____
- If yes, how many minutes do you spend exercising each time you exercise?_____
- If yes, which type(s) of exercise do you participate in each week (check all that apply):
  _____ Aerobic (walking, jogging, aerobics, stair stepping, cycling, swimming, etc.)
  _____ Resistance Training (weight lifting, nautilus, etc.)
  _____ Sports (basketball, football, tennis, dance, etc.)
  _____ Yoga/Pilates
  _____ Other (please specify): _____
- How many times have you exercised in the past 2 weeks?_____

During your lifetime, have you ever had a panic attack? Yes No

- If yes, how many panic attacks have you had? (circle 1): 1-2 3-5 5-10 10-25 >25

Have you ever been diagnosed with <u>OR</u> received treatment for any psychiatric or substance use problems? Yes No

- If yes, briefly specify the general nature of the problem, WHEN the problem occurred, and any treatment received:

  Diagnosis:_____ When:_____

  Treatment:_____

Are you currently taking any psychiatric medications? Yes No

- If yes, please specify the name(s) and or type(s) (anti-anxiety, antidepressant, etc) of medication you are taking:

  _____

  _____

Appendix C

Institutional Review Board Approval

To: Joshua Broman-Fulks
Psychology ASU
Boone, NC 28608

From:_____
Jay Cranston, MD, Chair, Institutional Review Board

Date: 9/15/2008

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)

Study #: 09-0016 **Study Title**: Physical Activity in College Students
Submission Type: Initial
Expedited Category: (7) Research on Group Characteristics or Behavior, or Surveys, Interviews, etc.

Approval Date: 9/15/2008
Expiration Date of Approval: 9/14/2009

This submission has been approved by the Institutional Review Board for the period indicated. It has been determined that the risk involved in this research is no more than minimal.

Investigator's Responsibilities:

Federal regulations require that all research be reviewed at least annually. It is the Principal Investigator's responsibility to submit for renewal and obtain approval before the expiration date. You may not continue any research activity beyond the expiration date without IRB approval. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.

You are required to obtain IRB approval for any changes to any aspect of this study before they can be implemented. Should any adverse event or unanticipated problem involving risks to subjects or others occur it must be reported immediately to the IRB.

Appendix D

Informed Consent Form

Appalachian State University

Consent Document for Research Participation

Title of study: Physical Activity in College Students

Investigators: Simon Wullimann and Joshua J. Broman-Fulks, Ph.D.

Participant Name: _____

I. Purpose of the study:

The purpose of this study is to examine physical activity in college students. In this study, you will be asked to wear a pedometer and record your steps for two full days. You will also be asked to complete a battery of psychological and physiological measure on three separate occasions.

II. Procedures:

Who can participate?

You must be 18 years old, in good physical health, and not currently taking psychiatric medication to participate in this study.

Description and Explanation of Procedures:

If you choose to take part in this study, you will be asked to complete a series of questionnaires, including a demographic questionnaire inquiring about your psychiatric history, illicit drug use, and substance use. Additionally, you will be asked to wear a pedometer to record your steps for two full days. You will be asked to complete the questionnaires a second time upon completion of the two days of recording your steps. You will then be asked to participate in a brief information session, and will be asked to return for a third appointment to complete the questionnaires a final time.

When the study is complete and the results have been analyzed, the researcher will attempt to contact all participants of the study to invite them to come in for a debriefing session. In this session, participants will be informed of the findings of the study and given the opportunity to ask questions concerning these findings.

At any time for any reason, you may decide to withdraw from the study without penalty.

III. Risks and Discomforts:

You will be asked not to change your daily routine during the time of your participation in the study; therefore, you should not experience any additional risks or discomforts as a result of your participation in the study.

IV. Benefits:

The information that you provide in this study may enable researchers to improve their understanding of typical daily activity, physiological functioning, and psychological functioning of college students in the United States. This will be discussed with you further after you complete the study. You will receive course credit for your participation in this study. Other research and non-research options for obtaining course credit are available. Please see your class instructor for more information.

V. Extent of Anonymity and Confidentiality

All information obtained during this study is confidential. That is, we protect the privacy of participants by withholding their names and other identifying information from all persons not connected with this study. The researcher will code all questionnaires and data by number and store them in a locked and secure area. Data that we may report in scientific journals or presentations will not include any information that identifies you as a participant in this study. Five years after the final publication of this study, all information and records will be destroyed.

VI. Compensation:

You will receive course credit for your participation in this study. You will receive 2 hours of research credit for completing this study. It is important that you complete the entire study, including the follow-up appointment, in order to receive credit for your participation. Credit slips will be handed out at the completion of the follow-up appointment. You will not be penalized if you choose not to participate in or withdraw from

this study.

VII. Freedom to Withdraw

Participation in this research is completely voluntary. Therefore, at any time for any reason, you may choose to stop and withdraw from the study without penalty.

Liability Statement:

The University does not have a mechanism to provide medical care for physical or emotional injuries experienced from participation in this study. If you experience physical or emotional problems because of your participation, please notify a lab assistant or Dr. Broman-Fulks immediately. You will be provided with information about local treatment services, if desired. However, there are fees involved for services at these other sites, for which you will be responsible.

Other Considerations:

If significant new information relating to this study becomes known which may relate to your willingness to continue to take part in this study, this information will be given to you by the investigator.

VIII. Approval of Research

This research project has been approved, as required, by the Institutional Review Board of Appalachian State University.

_____ _____

IRB Approval Date Approval Expiration Date

X. Subject's Permission

I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____Date_____

Subject signature

_____ Date _____

Witness (Optional except for certain classes of subjects)

Should I have any questions about this research or its conduct, I may contact:

Simon Wullimann, (828) 989-2535, ss79668@appstate.edu
Graduate Student, Clinical Health Psychology, Appalachian State University, Boone, NC 28608

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Assistant Professor, Psychology Department, Appalachian State University, Boone, NC 28608

Jay W. Cranston, M.D., Chair, Institutional Review Board
Administrator, IRB, Graduate Studies and Research, Appalachian State University, Boone, NC 28608

Appendix E

Manipulation Checks

MC

Please rate your current level of daily physical activity on the following scale:

Very Low		Low		Average		High		Very High
1	2	3	4	5	6	7	8	9

Please rate the extent to which you believe that your current level of physical activity benefits your psychological wellbeing:

Very Little		A Little		Somewhat		Much		Very Much
1	2	3	4	5	6	7	8	9

Please rate the extent to which you believe that your current level of physical activity benefits your physical wellbeing:

Very Little		A Little		Somewhat		Much		Very Much
1	2	3	4	5	6	7	8	9

Please rate how physically fit you believe you are:

Not at all Physically fit				Somewhat Physically fit				Extremely Physically fit
1	2	3	4	5	6	7	8	9

Table 1

Manipulation Check Means and Standard Deviations by Intervention Condition at Baseline, Post and Follow-up

Session	Measure	Positive Manipulation Mean *(SD)*	Negative Manipulation Mean *(SD)*	No Intervention Control Mean *(SD)*	Overall Means *(SD)*
Baseline	MC-1	4.19 *(1.17)*	4.55 *(1.44)*	4.55 *(1.00)*	4.43 *(1.20)*
Post	MC-1	4.90 *(1.18)*	4.36 *(1.22)*	4.65 *(1.09)*	4.64 *(1.16)*
Follow-up	MC-1	4.76 *(1.04)*	4.82 *(0.96)*	4.85 *(1.09)*	4.81 *(1.03)*
Baseline	MC-2	4.57 *(1.86)*	4.59 *(1.44)*	4.85 *(1.63)*	4.67 *(1.64)*
Post	MC-2	5.71 *(1.55)*	4.55 *(1.68)*	4.75 *(1.41)*	5.00 *(1.55)*
Follow-up	MC-2	5.57 *(1.60)*	5.05 *(1.21)*	5.50 *(1.57)*	5.37 *(1.46)*
Baseline	MC-3	4.62 *(2.25)*	5.14 *(2.08)*	5.50 *(1.76)*	5.09 *(2.03)*
Post	MC-3	5.38 *(2.29)*	4.73 *(2.00)*	4.95 *(1.76)*	5.02 *(2.02)*
Follow-up	MC-3	5.48 *(1.63)*	5.14 *(1.32)*	5.40 *(2.11)*	5.34 *(1.69)*
Baseline	MC-4	4.76 *(1.49)*	4.95 *(1.29)*	5.10 *(1.48)*	4.94 *(1.42)*
Post	MC-4	5.00 *(1.38)*	4.64 *(1.68)*	4.80 *(1.15)*	4.81 *(1.40)*
Follow-up	MC-4	4.76 *(1.34)*	4.86 *(1.28)*	4.75 *(1.33)*	4.79 *(1.32)*

Note. MC = Manipulation Check

Table 2

Psychological Measures Means and Standard Deviations by Intervention Condition at Baseline, Post and Follow-up

		Positive Manipulation	Negative Manipulation	No Intervention Control	Overall
Session	Measure	Mean *(SD)*	Mean *(SD)*	Mean *(SD)*	Means *(SD)*
Baseline	DASS-D	6.16 *(6.35)*	3.33 *(3.44)*	4.76 *(5.33)*	4.75 *(5.04)*
Post	DASS-D	3.73 *(4.11)*	3.57 *(4.03)*	4.57 *(5.46)*	3.96 *(4.53)*
Follow-up	DASS-D	4.58 *(5.60)*	1.81 *(3.59)*	4.24 *(4.99)*	3.54 *(4.73)*
Baseline	DASS-A	4.25 *(4.72)*	4.40 *(3.52)*	6.00 *(3.99)*	4.88 *(4.08)*
Post	DASS-A	2.45 *(2.76)*	3.90 *(3.82)*	3.95 *(3.83)*	3.43 *(3.47)*
Follow-up	DASS-A	3.05 *(3.83)*	2.75 *(3.74)*	3.30 *(3.79)*	3.03 *(3.79)*
Baseline	DASS-S	7.30 *(6.77)*	8.14 *(5.97)*	9.76 *(6.57)*	8.40 *(6.44)*
Post	DASS-S	5.05 *(4.49)*	6.10 *(5.55)*	8.90 *(6.29)*	6.68 *(5.44)*
Follow-up	DASS-S	6.10 *(7.48)*	5.33 *(4.78)*	8.48 *(7.11)*	6.64 *(6.46)*
Baseline	RSES	13.75 *(1.89)*	14.90 *(2.66)*	14.20 *(2.12)*	14.28 *(2.22)*
Post	RSES	13.90 *(1.45)*	14.90 *(2.36)*	14.55 *(2.42)*	14.45 *(2.08)*
Follow-up	RSES	14.20 *(1.91)*	15.19 *(2.16)*	14.15 *(2.23)*	14.51 *(2.10)*
Baseline	4DMS-UA-PD	22.75 *(4.50)*	22.68 *(3.92)*	23.10 *(5.05)*	22.84 *(4.49)*
Post	4DMS-UA-PD	22.55 *(3.59)*	21.64 *(3.59)*	21.14 *(4.13)*	21.78 *(3.77)*
Follow-up	4DMS-UA-PD	21.65 *(3.79)*	21.05 *(3.77)*	23.43 *(3.59)*	22.04 *(3.72)*
Baseline	4DMS-PA-UD	17.95 *(4.49)*	19.24 *(3.67)*	20.19 *(4.46)*	19.13 *(4.21)*
Post	4DMS-PA-UD	18.68 *(3.94)*	18.57 *(4.91)*	19.67 *(5.45)*	18.97 *(4.77)*

Follow-up	4DMS-PA-UD	17.53 *(4.71)*	18.05 *(3.71)*	19.33 *(4.86)*	18.30 *(4.43)*
Baseline	ASI-3	12.67 *(10.83)*	10.95 *(8.32)*	17.14 *(10.24)*	13.59 *(9.80)*
Post	ASI-3	9.39 *(8.81)*	8.10 *(6.76)*	13.05 *(9.58)*	10.18 *(8.38)*
Follow-up	ASI-3	7.17 *(9.59)*	7.65 *(7.85)*	12.90 *(11.98)*	9.24 *(9.81)*

Note. DASS-D = Depression Anxiety Stress Scale – Depression Subscale; DASS-A = Depression Anxiety Stress Scale – Anxiety Subscale; DASS-S = Depression Anxiety Stress Scale – Stress Subscale; RSES = Rosenberg Self-Esteem Scale; 4-DMS-UA-PD = Four-Dimensional Mood Scale – Unpleasant Activation-Pleasant Deactivation Subscale, 4-DMS-PA-UD = Four Dimensional Mood Scale – Pleasant Activation-Pleasant Deactivation; ASI-3 = Anxiety Sensitivity Index–3

Table 3

Physiological Measures Means and Standard Deviations by Intervention Condition at Baseline, Post and Follow-up

		Positive Manipulation	Negative Manipulation	No Intervention Control	Overall
Session	Measure	Mean *(SD)*	Mean *(SD)*	Mean *(SD)*	Mean *(SD)*
Baseline	Weight	177.10 *(61.32)*	155.48 *(38.97)*	150.05 *(38.42)*	160.88 *(46.24)*
Post	Weight	178.80 *(64.50)*	155.40 *(37.93)*	150.68 *(38.32)*	161.63 *(46.92)*
Follow-up	Weight	178.25 *(64.50)*	155.25 *(38.11)*	150.45 *(37.51)*	161.32 *(46.71)*
Baseline	Heart Rate	79.81 *(8.48)*	80.09 *(12.81)*	86.75 *(15.59)*	82.22 *(12.29)*
Post	Heart Rate	79.24 *(9.73)*	79.91 *(14.45)*	80.70 *(12.84)*	79.95 *(12.34)*
Follow-up	Heart Rate	78.90 *(10.35)*	78.27 *(12.97)*	82.40 *(16.04)*	79.86 *(13.12)*
Baseline	BP-Diastolic	76.24 *(8.32)*	75.23 *(9.32)*	75.60 *(8.33)*	75.69 *(8.66)*
Post	BP-Diastolic	74.24 *(8.04)*	71.59 *(6.46)*	73.65 *(6.94)*	73.16 *(7.15)*
Follow-up	BP-Diastolic	73.95 *(9.36)*	72.23 *(5.18)*	74.30 *(5.81)*	73.49 *(6.78)*
Baseline	BP-Systolic	113.24 *(11.89)*	114.95 *(14.80)*	109.65 *(11.53)*	112.61 *(12.74)*
Post	BP-Systolic	111.29 *(11.80)*	108.05 *(10.59)*	108.65 *(12.58)*	109.33 *(11.66)*
Follow-up	BP-Systolic	108.95 *(12.49)*	110.73 *(9.63)*	106.15 *(9.35)*	108.61 *(10.49)*

Note. Diastolic BP = Diastolic Blood Pressure; Systolic BP = Systolic Blood Pressure

BIOGRAPHICAL SKETCH

Simon Mathias Wullimann was born in Sion, Switzerland, on October 18, 1982. He attended elementary school in Botyre, Switzerland, where he lived until 1994, at which time his family relocated to McDonough, Georgia. Mr. Wullimann graduated from Henry County High School in 2001. The following autumn, he entered Queens University of Charlotte, earning the Bachelor of Science degree in Biochemistry in May, 2005. Mr. Wullimann was a part of Queens University's men's soccer program, earning the Men's Student Athlete of the Year award his senior year. Mr. Wullimann worked at CooperRiis, a mental health facility in western North Carolina, for two years following his college graduation, inspiring him to enroll in post-graduate studies in psychology. He began his studies at Appalachian State University in the fall of 2007, working towards a Master of Science in Clinical Health Psychology. In addition to the two years of coursework required by his program, he had the opportunity to complete a research assistantship with a faculty member and teach two introductory level courses in psychology for the university. Mr. Wullimann completed an internship at Swannanoa Valley Youth Development Center after completing his coursework. He graduated with his Master's degree from Appalachian State University in the spring of 2010.

Mr. Wullimann currently resides in Asheville, NC. His parents, Markus and Ines Wullimann, live in Columbus, NC. Mr. Wullimann's older brother David and his family live in Alabama; his two younger siblings, Corinne and Philipp, live in North Carolina.