Feelings about Exercise: Protocol

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Background and objectives
Despite the numerous health benefits of regular physical activity (PA), >50% of adults are insufficiently active. Understanding why some individuals choose to engage in PA while others do not is important for informing the development of future PA interventions. Previous research has demonstrated that those who have more positive affective responses to exercise (i.e., the pleasure or displeasure experienced with PA) are more likely to exercise in the future. However, an interesting paradox is that most people generally 'feel good' post-exercise This begs the questions, if exercise makes people feel good, why don't more people exercise? The answer may lie in one's memory of how exercise makes them feel.

This study seeks to compare exercisers and non-exercisers on their affective responses to exercise, which includes pre-, during, and post-exercise affect, memory of during and post-exercise affect, and anticipated affect towards a future exercise session. It is hypothesized that compared to regular exercisers, non-exercisers will have a more negative memory of how exercise made them feel, and as a result, also have more negative anticipated affect towards a future exercise session. Further, this study seeks to pilot an intervention to improve affective response to exercise among the group of non-exercisers. It is hypothesized that non-exercisers randomized to an affect-based intervention will have a more favorable affective response to exercise following the intervention compared to those randomized to the control intervention (e.g., basic PA recommendations).

Participants
A total of 59 individuals with overweight/obesity (BMI 25-40 kg/m^2), who were weight loss seeking, and between the ages of 18-60 were recruited via self-referral from Internet advertisements. Interested individuals completed a phone screen questionnaire to determine initial eligibility. During this screening, trained research assistants queried potential participants on their moderate-to-vigorous intensity PA (MVPA) over the previous 6 months and a recent 'typical' week. If average MVPA was <30 min/week, the individual was classified as a 'non-exerciser', if average MVPA was ≥150 min/week, the individual was classified as an 'exerciser'. Individuals reporting an intermediate amount of MVPA (30 to <150 min/week) were ineligible for this study as the goal was to target distinctive groups of exercisers vs. non-exercisers. Exclusion criteria included conditions limiting ability to exercise, history of coronary artery disease (i.e., myocardial infarction), stroke, diabetes, pulmonary disease (e.g., COPD), uncontrolled hypertension (i.e., resting BP ≥140/90 mmHg), use of any medication that would affect heart rate (HR; e.g., beta blocker), current enrollment in a weight loss treatment program, history of bariatric surgery, or women who were nursing/pregnant,

Study overview
Individuals deemed eligible based upon the phone screen attended an in-person orientation session in order to learn about the study in greater detail and to provide informed consent in accordance with guidelines set forth by the Internal Review Board of the Miriam Hospital. Upon consenting, participants completed a baseline assessment, which included measures of BMI, fitness, and 1 week of objective physical

activity (PA) monitoring. Participants then returned to the laboratory for Exercise Session 1, in which they walked on a treadmill for 30 minutes at a moderate intensity. Prior to exercise they reported on anticipated affect (i.e., how they expect the upcoming exercise bout to make them feel), and momentary affect was assessed before, during, and after exercise. In days 1, 3, and 7 following the exercise session, participants were asked to report on their recalled affect via text messaging. They then returned to the laboratory to complete an identical exercise session (Exercise Session 2). Following the completion of the final post-exercise affect measurement, 'non-exercisers' randomly received 1 of 2 PA interventions and then completed additional study measures (described in detail below), while 'exercisers' did not complete any additional study procedures beyond this point.

***Baseline Visit: BMI, Fitness Test, Objective PA Measurement*:** Prior to participating in Exercise Sessions 1 and 2, participants completed the following baseline assessment measures.

BMI. Weight was measured to the nearest 0.1 kg using a calibrated digital scale and height was measured to the nearest 0.1 cm using a wall-mounted stadiometer. Body mass index (BMI) was calculated as kg/m^2.

Fitness Test. Fitness was measured via a sub-maximal graded exercise test (GXT). Participants walked on the treadmill at 3.0 mph and the speed and incline were increased every three minutes until 75% of age-predicted maximal HR was achieved. Total time spent on the treadmill (in seconds) was used as an indicator of fitness. The purpose of this GXT was to allow participants to gain familiarity with walking on a treadmill and assist in determining the starting treadmill grade for the following exercise visit.

Objective PA Measurement. While participants were deemed eligible for this study based upon self-report measures of PA, direct PA monitoring was also performed to confirm that 'exercisers' and 'non-exercisers' significantly differed on MVPA. All participants wore a previously validated activity monitor (Sensewear Armband, Body Media Inc., Pittsburgh PA) for 1 week and were asked not to alter their activity levels during this period. The monitor is worn on the upper arm and assesses movement and energy expenditure, however the device does not provide any information or feedback to participants. Minute-by-minute data were collected, and using proprietary algorithms, MET values were computed for each minute the device was worn. Exercise groups were compared on time spent engaging in bout-related MVPA (≥ 3 METs, ≥10 min).

Exercise Session 1

Exercise Protocol. Following completion of all assessment measures, participants returned to the laboratory for Exercise Session 1. Upon arrival, participants were given a detailed description of the upcoming exercise protocol and were equipped with a HR monitor. Immediately prior to the start of the exercise bout, participants were asked to report their pre-exercise *momentary* affect using the Feeling Scale and their *anticipated*

affect towards the upcoming exercise bout using a visual analogue scale (see below for additional detail on affect measures). They then completed the exercise protocol which consisted of a 2-minute warm-up, followed by 30 minutes of moderate-intensity walking (70-75% of age-predicted maximal HR), and a 2-minute cool-down. This exercise duration and intensity was chosen because it is consistent with the American College of Sports Medicine's exercise guidelines, and is feasible for individuals with overweight/obesity. Starting exercise intensity was estimated using HR data from the baseline fitness test. Heart rate was monitored every minute and the treadmill grade or speed was adjusted by trained research staff if the subject's HR fell outside the target range for two consecutive minutes. Affect was assessed every 5 minutes during exercise, immediately post-exercise, and 15 minutes following the completion of the exercise bout.

Assessment of momentary affect. The Feeling Scale (FS; Hardy & Rejeski 1989) was used to assess momentary affect before, during and after exercise. This single-item measure asks participants to rate how they feel 'at the present moment' on an 11-point scale ranging from -5 (very bad) to +5 (very good). *Pre-exercise* affect was assessed as individuals stepped onto the treadmill but before the exercise was started. *During* exercise affect was assessed every 5 minutes during the exercise bout (excluding warm-up), and *post-exercise* affect was assessed immediately after the conclusion of the exercise protocol and exactly 15 minutes later.

Assessment of anticipated affect. Prior to the exercise sessions *anticipated affect* was assessed using a 100mm visual analog scale (VAS). This method for assessing anticipated affect requires participants to denote their response on a continuous line (anchored by 'very bad' and 'very good' similar to the Feeling Scale used for measuring current affect) but does not quantify affect with a numerical response (e..g, "2"), thereby eliminating potential for participants to provide subsequent affect ratings that are simply repetitions of their predictions. Participants were specifically asked "How do you anticipate feeling during exercise?" and "How do you anticipate feeling after exercise?".

Affective Recall and Memory Bias

In the week following Exercise Session 1, all participants were asked to maintain their typical daily routines of either exercising or not exercising and respond to an online questionnaire assessing their recall of their own affective responses to the exercise session. These questionnaires were completed 1, 3, and 7 days following the exercise session, and participants responded to the questionnaire by clicking on a link provided via text message. In order to avoid direct recall of responses provided on the Feeling Scale, a VAS was used. On days 1, 3, and 7, participants were asked to reflect upon their Exercise Session 1 by responding to following question; "How do you remember feeling overall?" and this was considered an indicator of *global* affective recall. Following this response on day 7 only, participants were asked to further delineate how they remembered feeling during exercise, and post-exercise. Memory bias was assessed by converting VAS recall values to corresponding FS values and then taking the discrepancy between recalled and actual FS values during and post-exercise (e.g., recalled during exercise affect [assessed 7 days post-exercise] minus actual during

exercise affect [average of Feeling Scale scores every 5 minutes during exercise]. A negative number indicates that participants remembered feeling less positive during exercise than they actually felt. Memory bias for post-exercise affect was computed in a similar manner.

Exercise Session 2

In order to collect data on anticipated affect after participants had experienced one laboratory exercise session, all participants were asked to return to the laboratory for a second exercise session at least 1 week following Exercise Session 1. Exercisers were compensated $50 for participation in the study, while non-exercisers were randomized, and received a brief PA intervention (described below).

Randomized Controlled Trial for Non-Exercisers

Immediately following Exercise Session 2, all non-exercisers were randomized to a brief, affect-based PA intervention (INT; n=15) or an educational PA intervention, which served as the control condition (CON; n=15).

Components common to both the Affect Intervention and Control Condition. Participants in both arms were informed of the national PA guidelines (150 min/wk of MVPA) and were encouraged to meet these guidelines. They were also provided with general information regarding the physiological and psychological health benefits of regular exercise. They were educated on what types of activities were considered moderate-intensity and how to gauge this intensity on their own. Finally, they were asked to reflect on their reasons for wanting to become more physically active.

Affect Intervention. In addition to the educational content described above, participants assigned to this group received a brief, affect-based intervention with a PhD-level interventionist in which they were taught cognitive strategies designed to make their affective recall more positive. First, each participant was shown a graph of normative data from studies using the Feeling Scale during and post-exercise. This was used in the current study specifically to normalize the experience of reductions ("dips") in positive affect during exercise and to highlight the general positive affect produced by moderate-intensity exercise. The interventionist then shared a graph illustrating the participant's own affective trajectory from Exercise Session 1. The interventionist discussed this trajectory with the participant, pointing out the moments that were most positive, and using open-ended questions to probe the participants' feelings about these moments and these data. Participants were then shown on the graph their recalled affect for the same exercise session. Time was spent pointing out discrepancies or biases in recalled affect and actual affect. Participants were asked specific questions aimed at increasing their awareness of their recall (e.g., why do you think you remembered exercise in this way? When you report on how you remember feeling in response to exercise, what do you think sticks out most in your mind and contributes to your response? Do you think you are focusing more on how you felt during or after exercise?). Third, adopting strategies from positive psychology to draw participants' attention to positive outcomes from a bout of exercise, participants were asked to write down any positive feelings they experienced during or as a result of the previous

exercise session (e.g., improved mood, feeling energized, feeling accomplished/proud, or feeling good about doing something beneficial for the body). They then shared their responses with the interventionist and participants were encouraged to think about these positive experiences, feelings, and motivations for engaging in exercise often, and specifically during the next exercise session.

Post-intervention assessment

Non-exercisers in both arms were informed they could increase their PA following Exercise Session 2 if they desired, and they were given the Sensewear armband to wear for 1 week to objectively assess whether there was an intervention effect on bout-related MVPA. Further, during the week following Exercise Session 2, all non-exercisers were asked to complete recalled affect questionnaires for Exercise Session 2 at 1, 3, and 7 days following the session, as was done previously.

Exercise Session 3

One to two weeks following Exercise Session 2, non-exercisers from both the control and intervention groups returned to the laboratory for a third exercise session (Exercise Session 3). This session was identical to the previous exercise sessions and measures of anticipated affect, pre-, during, and post-exercise affect were obtained. All non-exercisers attending Exercise Session 3 (INT and CON) were compensated $50 for their time.