1. **Title of PhD Project**
   Attention, Mood, and Response to Acute Exercise

2. **Supervisor(s) Details**
   Dr Mark Campbell & Dr Matthew Herring

3. **Aims of the Research**
   The aim of this research project
   The primary aim of this research is to examine the association of attentional bias, quantified using eye tracking software, with mood, including state and trait anxiety, worry symptoms, and depressive symptoms, before and after a 30-minute acute bout of treadmill running or a 30-minute bout of seated quiet rest.

   Secondary, exploratory aims of this research include: (i) the investigation of associations between attentional bias and feelings of fatigue and vigor (energy) before and after either a 30-minute acute bout of treadmill running or a 30-minute bout of seated quiet rest; and, (ii) the exploration of how associations between attentional bias and mood may vary based on self-reported sleep quality.

4. **Short Justification/Rationale/Background to the Project**
   Though exercise improves mood among healthy adults (Conn, 2010), chronically-ill patients (Herring et al., 2010; 2012a), and persons with an anxiety and/or depressive disorder (Herring et al., 2011; 2012b; Dunn et al., 2001), the mechanisms underlying the positive effects of exercise are not well known. Anxious and/or depressed persons show a bias in attention toward negative stimuli, including negative or threatening words and pictures of angry faces (Bar-Haim et al., 2007; Mogg & Bradley, 2005; Hettema, 2008; Mogg et al., 2004; Isaac et al., 2014). However, though exercise can improve attentional biases and may thereby improve mood, the influence that reduced attentional bias may have on exercise-induced changes in mood are unknown. This project could yield exciting pilot data to be published and used to generate future funding proposals.

5. **Study Design**
   A within-subjects, repeated measures design will be used in which each participant will serve as his/her own control.

6. **Participants & Procedures/Methods**
   Participants: Young adult men and women aged 18-35 y will be recruited from the University staff and student population. Interested potential participants will provide written informed consent prior to participation and complete a medical history screening question. Potential participants who are free of any medical contraindication to safe participation in aerobic exercise and who are not pregnant or lactating will be randomized to one of two counterbalanced conditions: an acute 30-min bout of vigorous treadmill running or 30-min of seated quiet rest.
   Measures

i) **Anxiety Symptoms**: State and trait anxiety will be measured with the State (STAI-Y1) and Trait (STAI-Y2) subscales of the State-Trait Anxiety Inventory (Speilberger et al., 1983). The 20-item subscales have shown strong psychometric properties and are sensitive to change. State anxiety will be measured immediately before and 10-min following the completion of each condition. Trait anxiety will be measured immediately before each condition (as trait anxiety would not be expected to change in response to acute exercise).

ii) **Worry Symptoms**: Worry symptoms will be assessed using the 16-item Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990). Favorable psychometric properties support the PSWQ (Brown et al., 1992), and scores have been shown to be sensitive to change in response to exercise (Herring et al., 2012b). Worry symptoms will be assessed immediately before and 10 min following the completion of each condition.

iii) **Depressive Symptoms**: The 16-item Quick Inventory of Depressive Symptomatology (QIDS-SR16; Rush et al., 2003) will be used to assess the nine core symptom domains of depression. The QIDS has demonstrated strong psychometric properties. The QIDS will be completed before and 10-min following each condition.

iv) **Feelings of Energy and Fatigue**: The intensity of feelings of energy and fatigue will be measured using the well-validated subscales of the Profile of Mood States - Brief Form (POMS-B; McNair et al., 1992). The POMS-B will be completed immediately before and 10-min following the completion of each condition.

v) **Sleep Quality**: The well-validated Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) will be used to examine self-reported sleep quality and sleep disturbance. The PSQI will be completed before each condition only (as it queries sleep during the prior month).

vi) Procedures & Conditions

Attentional Bias: Attentional bias will be quantified using an eye tracking procedure given evidence that eye tracking data may be more precise and ecologically reliable than other measures (i.e., dot probe) because of the ability to record multiple facets of attention (Van Rensburg et al., 2009; Field et al., 2004).

Eye Tracking Procedure: The eye tracking protocol will be completed before and 20-min following completion of each condition. Each participant will be seated approximately 60cm in front of a computer screen where he/she will view a series of 45 color photographs depicting positive (n=15); neutral (n=15, and negative (n=15) facial expressions. Photographs are selected based on valence and emotion from a selection of 675 photographs included in the NimSim series. Positive images will be chosen based on the highest valence rating among "Happy" faces. Neutral images will be selected based on the highest valence rating among "Neutral" faces. Negative images will be selected based on the highest five valence ratings among each category of "Anger," "Disgust," and "Fear." A fixation cross will be presented to begin the procedure. Each image will then be presented for 1000ms, and a central fixation cross will be presented before the beginning of the test and between each image presentation. Participants will be asked to focus on the fixation point before the next image appears. This procedure will require approximately 90 seconds.

Exercise: During the exercise condition, each participant will complete a 30-min bout of treadmill running at 65% of maximal heart rate reserve (HRR). %HRR will be calculated for each participant using the normative values for resting HR for this population age-group (i.e., 63bpm for males; 73bpm for females) based on the formula: [(0.65*(Age-predicted MHR-RHR))+RHR]. Prior to the beginning of the exercise session, each participant will be provided a Polar HR monitor to be worn during the exercise bout to regulate intensity. Each participant will be instructed to set the lower HR limit of the HR monitor to correspond to 65%HRR. Standard instructions for how to rate perceived

exertion (RPE) will be provided. Each participant will then be instructed to perform a 5-min warm-up, progressively increasing the speed of the treadmill to achieve 65%HRR. Then each participant will be required to complete 30-min of treadmill running at >65%HRR. The HR monitor will track minutes completed at or above the target HR. Once 30 min at or above 65%HRR has been completed, each participant will be asked to walk until he/she feels sufficiently cooled down. Each participant will then provide a session RPE using Borg's 6-20 RPE scale.

Quiet Rest: During the control condition, each participant will complete a 30-min bout of seated quiet rest. Prior to beginning the quiet rest session, each participant will be provided instructions for rating perceived exertion and a Polar HR monitor to be worn during the bout of seated rest, consistent with the exercise session. Each participant will then be seated in an upright chair in a quiet area for 30 min. HR will be monitored throughout the bout of seated rest, and each participant will be asked to provide a session RPE using Borg's 6-20 scale. Consistent with the exercise session, extraneous conversation will be limited during the quiet rest session given the potential for mood effects of social interaction (McNeil et al., 1991). Participants will not be allowed to read, study, or listen to music given the potential for altered mood.

Testing Day 1: On arrival to the Sport and Exercise Psychology laboratory in the PESS building, interested potential participants will be informed of the procedures, risks, and benefits of participation. Each potential participant will then provide written informed consent using a form approved by the Ethics Committee prior to participation and complete a medical history screening questionnaire. Potential participants who are free of any medical contraindication to safe participation in aerobic exercise and who are not pregnant or lactating will be randomized to one of two counterbalanced conditions: an acute 30-min bout of treadmill running or 30-min of seated quiet rest. Each participant will then complete a battery of self-report questionnaires including a seven-day physical activity recall, the STAI, PSWQ, QIDS, POMS-B, and PSQI. Each participant will then complete the Eye Tracking Procedure described above. Following the eye tracking procedure, each participant will complete a 30-min bout of either exercise or seated rest, as described in the sections above. At 10-min following the completion of the bout of either exercise or seated rest, each participant will again complete the STAI-Y1, QIDS, and POMS-B. At 20-min following the completion of the experimental condition, each participant will again complete the Eye Tracking Procedure. Following completion of the Eye Tracking Procedure, each participant will be free to leave.

Testing Day 2: Day two testing will involve the experimental condition that was not completed on testing day 1, and will be performed according to the exact same protocol as testing day 1 ~48h later.

7. Data Collection and Analysis

Multivariate Regression, t-test, and Repeated Measures ANCOVA will be used to analyze these data, and effect sizes will be derived to quantify the magnitude of change and group difference.