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Exercise and Cognitive Bias Modification Training in Adults: Effects on Self-Reported Anxiety

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Abstract:
In the last couple of decades, evidence has gathered that individuals suffering from anxiety tend to interpret ambiguous information as threatening. Taking the causal role of this interpretative bias in anxiety, it has been confirmed that modifying these biases in clinical and non- clinical populations can influence anxiety symptoms and its future vulnerability. The present study was designed to investigate the potential relationship between threat-related biases in anxiety and exercise. It examined the effect of a single session of exercise (walking) and Cognitive Bias Modification (CBM) training on ambiguous interpretive biases. Healthy adult participants were randomly assigned to one of three conditions: exercise and positive CBM training, exercise or a control condition (n = 3 x 12). They attended a single session of exercise and a session of training on the same day. Those in the exercise group were less state and trait-anxious after completion of the experiment on a measure of state and trait anxiety inventory (STAI), compared to both the controls and those in exercise and positive CBM condition. Additionally, no significant effects were observed on state anxiety in the exercise plus CBM group, though they were less trait- anxious after completion of the training. The mixed pattern of findings renders them inconclusive, leaving interpretations of the potential therapeutic benefits of positive CBM training open for future research.

Keywords: *Anxiety, CBM training, Exercise, Threat-related biases*

1. Introduction

Exercise is seen as a universal panacea for physical and mental wellbeing. Everyone indulges in some kind of physical activity to keep fit and be healthy. However, the kind of exercise or physical activity a person yields to and the amount of the same varies from person to person. The premise that a human being's mood state can have a profound effect on the physical state has been written about often in the last couple of decades (Cohen & Herbert, 1996). There is also enough confirmation regarding the benefits of regular physical exercise on human body (Salmon, 2001). Effects of acute and chronic exercise on healthy individuals with anxiety and depression symptoms and those diagnosed with anxiety and depression have been well established (Herring, O' Connor, & Dishman, 2010). It is generally assumed that physical fitness assists in increasing one's mental well -being. Considerable evidence also exists for this relationship to be taken seriously as a therapeutic approach in the treatment of anxiety disorders (Fox, 1999). Studies and experiments in human beings have predominantly focussed on self-reported measures of anxiety and depression symptoms or on clinical psychological assessment scales, to evaluate the effects of exercise after a single bout of exercise, a training programme or affective responses during exercise (Ekkekakis & Lind, 2006; Williams, Dunsiger, Ciccolo, Lewis, Albrecht & Marcus, 2008). These experiments have definitely given insights on benefits of exercise on alleviating moods. But effects of exercise on the processing of threat- related cognitive biases in people with high levels of anxiety and anxiety disorders are less well understood.

Cognitive models of anxiety suggest that there are biased ways of basic information processing running within the cognitive system that probably are not consciously accessible and these play a crucial role in experiencing unwarranted manifestation of anxiety (Mathews & MacLeod, 2005). It is seen that people with anxiety and depression tend towards the negative aspect of ambiguous situations and are also inclined to interpret such conditions negatively instead of positively. Evidence now shows that employing Cognitive Bias Modification (CBM), a group of computer tasks, can alter these negative biases in healthy adults with anxiety and symptoms of depression as well as in clinical populations (Brosan, Hoppitt, Shelfer, Sillence & Mackintosh, 2011).

Currently there seems to be a lack of objective verification on the effects of CBM techniques on reduction of anxiety symptoms. Since clinical anxiety and depression are serious mental health issues around the world that need to be addressed, it has become imperative to think of effective solutions to alleviate the detrimental effects of the same. To address this gap in the literature, the current research study not only examined whether exercise improved on mood states but also if CBM measures proved to be successful in altering negative mood states in people with anxiety.

2. Literature Background

2.1. Anxiety

In the modern world, individuals spend a great deal of money to free themselves of anxiety. According to National Institute of Mental Health (NIMH), one in seven Americans suffers from some kind of anxiety disorder (AD), at a given point of time, making it the most common form of mental illness in the U.S, even more common than depression and other mood disorders (Stossel, 2014). Although some people believe anxiety to be an American problem, that does not seem to be the situation at all. As stated in in a report by the Mental Health Foundation in 2009, 15% of people living in England suffer from anxiety disorders, the number of which is ever increasing (Stossel, 2014). The surprising element is how differently anxiety bestows itself in different cultures. For example, Pa-leng found in China, is called "frightophobia" or "fear of the cold"; symptoms include cold, clammy hands, tachycardia (abnormal increased heart rate), dry mouth and related somatic features (Barlow, 1988). Taijin kyofusho, a Japanese form of social anxiety focuses on an individual's concern over offending others who apparently behave or appear inappropriately (Kleinknecht, Dinnel & Kleinknecht, 1998). In short, some people in every culture seem worried, fearful or apprehensive even though they may differ in the susceptibility in experiencing anxiety. There are those human beings that can go through anxiety symptoms in not so threat full situations while others become anxious in only very stressful circumstances. Whatever form anxiety takes; it is clear that ADs are a universal phenomenon.

Everyone feels anxious or nervous at some point of time in life; going for an interview, starting college, or meeting someone for the first time. It is quite normal to feel so about these things. What then is anxiety? Humans tend to confuse 'fear' with 'anxiety'. Barlow (2004) proposed a basic distinction between the two. Fear or panic is a basic emotion (shared by many animals) that constitutes activation of "fight – or flight" response of the sympathetic nervous system. It is what humans feel when they are in real danger at that moment. Anxiety on the other hand is a complex mixture of unpleasant emotions and thoughts bent towards the future. It also includes physiological and behavioural components like negative mood, worry about possible threats, self-preoccupation and a sense of being unable to control it if it occurs. Activation of "fight –or flight "response does not occur in anxiety but it prepares a person for it in case of perceived danger. Most individuals can overcome feelings of anxiousness themselves. But sometimes it stays for longer time and can affect their lives. In fact, anxiety in mild or moderate degrees can actually enhance learning and performance (Carson, Butcher, Mineka and Hooley, 2007). For instance, before a match one feels anxious which can help the player play well. However, it becomes maladaptive when anxiety becomes severe and chronic. People with pathological anxiety invariably have over active imaginations and constantly project their thoughts into the future (Neville, 1991). They procrastinate about what might happen instead of what will happen. It completely surrounds the sufferer developing into a chronic condition and the person gets scared of anxiety itself. One thus tends to get caught in a vicious circle difficult to break. This pathological condition has contributed to many unhealthy lifestyles and sometimes develops into clinically significant fears and anxieties. Diagnostic Statistical Manual (DSM) IV-TR (Carson et al, 2007) recognizes ADs as seven main types; phobic disorders of the "specific" type, and "social" type, panic disorder with or without agoraphobia, generalised anxiety disorder (GAD), obsessive -compulsive disorder (OCD) and post -traumatic stress disorder (PTSD). All of these have unrealistic, irrational fears and anxieties that become disabling. These irrational thoughts can be of different types, for example, "I touched a dirty piano, I will become sick" (incorrect belief) or "my mother has not called, I hope she has not had a heart attack" (general worry), "that cockroach may kill me" (phobia). Of course most are subtle fears such as worrying about an essay grade before writing it or worrying about being judged in a party.

Is it then just in the mind? Research shows it may not be so. In the last few years, advances in neuroimaging techniques such as magnetic resonance imaging (MRI), functional magnetic resonance imaging (fMRI), positron emission tomography (PET) and single photon emission tomography (SPECT) have contributed immensely in identifying the neuroanatomy of ADs. One such study conducted by Holzschneider and Mulert (2011) demonstrated that the amygdala seems to be an important structure in the brain for fear and anxiety and has found to be activated in anxiety arousing situations. The research also implicated the insula and anterior cingulate cortex as critical areas in the same, all three referred to as the "fear network". An interesting revelation by an American psychiatrist suggested that 90% of phobias are caused because of an inner –ear dysfunction and not due to emotional illness (Neville, 1991). According to this theory, an integral part of our anxiety- control network is located in the cerebellar-vestibular system, the 'inner ear' system. If this weakens, the whole anxiety control network may get affected making the body incapable of regulating anxiety. The brain stem carries abnormally sensitive CO2 receptors (Nattie, 1999) making many theorists hypothesise that the function or dysfunction of these CO2-sensitive cells considerably increases anxiety and fear and may induce anxiety and panic attacks in panic disorder (PD, Gorman, Liebowitz, Fyer & Stein, 1989). In a study by Griez, Zandbergen, Pols & Loof (1990), an inhalation of 35% CO2 was dispensed to 32 patients with high anxiety scores. This intake of CO2 saw increases in the reported anxiety among patients with PD, seeming specific for PD independent of baseline anxiety.

2.2. Effects of Exercise on Anxiety

Anxiety has slowly pervaded into people's lives effecting their physical and mental health and overall quality of life. In such a scenario, prescriptions for anxiety drugs to reduce symptoms have become common in recent years. Historically anxiety has been treated with a class of drugs called Benzodiazepines; known for their anxiolytic properties these have been also used as hypnotics, anticonvulsants and muscle relaxants (Keable, 1997). Although doctors and psychiatrists often prefer these over other class of drugs as they are less toxic, their addictive and dependence producing effects has become a cause for concern in today's age (O'Brien, 2005). Although many psychotherapeutic interventions such as relaxation techniques, hypnosis, biofeedback and meditation are being

employed to reduce anxiety, interest remains on the effects of physical exercise on mental health (Petruzzelo, Landers, Hatfield, Kubitz & Salazar, 1991).

Physical activity and physical exercise are terms generally used interchangeably. However, they are different concepts. Physical activity is any bodily movement resulting in expending energy (such as domestic work, sports) whereas physical exercise is a subset of physical activity that is regular and structured with an objective to improve health (Casperson, Powell & Christenson, 1985). Research has generally focused on formal exercise programmes in terms of its psychological benefits, though recently cross sectional studies have consistently shown high self-reported levels of habitual physical activity with better mental health (Salmon, 2001). Benefits of physical exercise in a range of physical disorders including diabetes, renal disease and osteoporosis, has been clearly established (Fentam, 1994). Despite worldwide awareness that regular and relatively strenuous exercise improves health, people are reluctant to do the same; possibly cause of lack of self -motivation, false health beliefs or a general lack of self -belief. However, literature on psychological effects of exercise to the extent that even reviews of reviews are now being written (Petruzzello et al, 1991), people are getting drawn to adhering to this approach in dealing with anxiety.

Research in the area of physical exercise such as aerobics and yoga, indicating effects of alleviating anxiety, has generally taken three approaches (Fox, 1999). First, the effect of a single bout of exercise on state anxiety ('right now' or acute feelings) has been addressed indicating average results for decrease in anxiety post exercise. Most studies have tested the consequences of aerobic forms of exercise (running etc.) in this approach. Second way observes the effects of engaging in many weeks of an exercise regime on state and trait anxiety (tendency to react nervously). In this method too, only moderate reduction of state and trait anxiety was apparent. Fox's (1999) third perspective talks about the effect of single sessions of exercise & training programmes. This has been tested on people's psycho social & psycho-physiological reactivity to a psychological stressor (e.g. public speaking task or a difficult mental task). Only half of the studies using this method showed some benefits from exercise training or better fitness possibly because of difficulties in measurement.

According to Salmon (2001), attention to aerobic exercise has outweighed focus given to non -aerobic exercises where muscle activity is brief, intense and cannot be maintained. Aerobic exercise can be defined as an activity involving large muscles such as in swimming, running and aerobic dancing. Psychological research thus uses this as measure of fitness. According to a meta- analysis, there were no significant differences between the various types of aerobic exercise; however significant differences were indicated between aerobic and nonaerobic exercises with the effect of exercise on mood only taking place for aerobic activities (Petruzzello et al, 1991). These studies generally show an improvement in mood after participating in an aerobic exercise routine. A study by Netz & Lidor (2003) demonstrates that nonaerobic mindful activities can also have positive mood changes. 147 females general -curriculum and physical education teachers voluntarily enrolled in a one-year enrichment programme at a physical education college in Israel. The purpose of this study was to examine the effectiveness of four different physical activity modes (dance aerobics, Feldentrais, swimming and yoga) on changes in mood of these participants. Feldenkrais or somatic education is a pedagogic method that focuses on a learning process of an individual's own experience, body consciousness and body movement (Olsson, Armelius & Armelius, 2001). Physical activity modes were compared with a non-activity computer class. Results showed that there was an enhancement in mood through these low exertion activities in a single session of exercise.

A study by Gupta, Khera, Venupati, Sharma & Bijlani (2006) focussed its aim on the short –term impact of an all-encompassing but a short lifestyle intervention programme, based on yogic exercises, on the levels of anxiety in normal participants and those with various diseases. These included people with hypertension, diabetes, obesity, psychiatric disorders such as depression and anxiety, coronary artery disease, gastrointestinal and thyroid problems. Yoga intervention consisted of asanas (yogic postures), pranayams (breathing techniques), relaxation techniques, group support, lectures and films on yoga, stress management and knowledge of illness. Results indicated a significant reduction in both state and trait anxiety scores after measuring anxiety scores on the first and last day of the programme. Broocks, Bandelow, Pekrun, George, Meyer, Bartmann, Vogel & Ruther (1998) conducted a study to examine the benefit of aerobic exercise in the treatment of panic disorder and agoraphobia. This particular research was designed to compare presumed therapeutic effects of exercise with a treatment of high efficacy drug and with placebo. Forty -six outpatients diagnosed with moderate to severe panic disorder with or without agoraphobia were randomly assigned to a 10-week of regular aerobic exercise (running), clomipramine drug or placebo pills. Although the dropout rate was 31% for the exercise group, 27% for the placebo group and 0% for the drug administered group, both exercise and the drug groups saw a significant decrease in anxiety symptoms. Depressive symptoms were also significantly reduced by exercise and the drug treatment. These results suggested that regular aerobic exercise on its own when compared with placebo is associated with significant improvement in symptoms in patients suffering from panic disorder. It however showed to be less effective than treatment with the drug.

What are the motivational factors then that can encourage people to engage in more exercise programmes and physical activity? One factor proposed for the same is the affective response produced by exercise (Ekkekakis, Hall & Petruzzello, 2004).Measuring emotional responses pre and post exercise has generally been the preferred way of demonstrating that exercise can improve affect, irrespective of its intensity (Gupta et al, 2006). However, when affect is measured during exercise, responses may differ between levels of intensity; as intensity increases, affect during exercise becomes more negative (Ekkekaki et al, 2004). Their research consisted of 30 young and healthy volunteers who participated in graded treadmill tests until volitional exhaustion with different protocols, one had longer stages of running and more increases in speed from one stage to the other, compared with the second group. This was done to determine if any emerging patterns were specific to a particular protocol. Heart rate, self -ratings of affective valence (feelings of positive or negative emotions), perceived activation and exertion were recorded every minute. Ventilator threshold was used as an index of the transition from aerobic to anaerobic metabolism. The main finding from this study indicated a decline in

affective valence in exercise that is beyond the point of transition from aerobic to anaerobic metabolism. Rose and Parfitt (2007) tested 19 women in a twenty -minute treadmill exercise bout at different intensities. These were below –lactate threshold (LT), at LT and above LT. Affective valence and activation were monitored pre, during and post exercise. Participants also were questioned about why they felt the way they did during each level of intensity. Results suggested that affect was least positive during the LT condition and the most positive during the self-selected and below LT states. This study thus demonstrated that factors such as focus of concentration, ability perceptions, exercise intensity and outcomes underpin an effective response to exercise, contributing to the individual differences in emotional responses to exercise.

2.3. Cognitive biases in Anxiety and CBM

Although ADs are often differentiated by the specific symptoms of their fears, the basic foundation of vulnerability and general mechanisms of these disorders apparently are common (Mineka, Watson & Clark, 1998). According to Beck, Emery & Greenberg (2005), 'vulnerability' is an individual's perception of self that is subjected to internal and external dangers over which he has no or little control to provide a sense of safety. The cognitive dimension in anxiety focuses on this notion of vulnerability (Clark & Beck, 2011). Also, in the last three decades or so, cognitive models of ADs and unipolar depression have greatly highlighted the crucial role of selective information processing in the development and maintenance of emotional psychopathology (Beck & Clark, 1997).

It is now well established that negative mood states in anxiety are associated with increased attention to threat-related cognitive biases, and anxious and depressed individuals frequently show a greater likelihood of interpreting the negative or threatening meaning of ambiguous situations instead of a positive or neutral one (Brosan et al, 2011). The attentional bias has been assessed in many ways. For example, the modified emotional stroop task requires subjects to ignore the emotionally distracting stimuli while performing a task and attention to these distractors is measured by the degree of their presence hampering the performance in the task (Williams, Mathews & MacLeod, 1996). Anxiety patients in this task tended to be often slower in naming the colour of a word that is related to their clinical condition. Ray (1979) tested 38 students who were approaching exams in naming the colours of words associated with this situation. Results showed that students in a pre-examination time showed longer colour naming latencies for words related to exam anxiety than for neutral words. This effect was seen strongest in students with high state anxiety (feelings of "right now"). Interestingly in contrast, anxious subjects tended to shift their attention toward emotionally threatening stimuli in their visual surrounding, while controls tended to shift attention away from these stimuli (MacLeod, Mathews & Tata, 1986). It seems thus that anxiety is responsible for slowing down performance when a task requires ignoring threatening conditions or cues, whereas performance speeds up relatively when attention to threat helps in identifying a target (Mathews & Mackintosh, 1998).

Many researchers further argue that variations in how people process information are reflected also in the way they interpret these stimuli. In line with this theory, overwhelming evidence suggests that anxiety is associated with a maladaptive impulse to interpret ambiguous information in a threatening way (Amir, Foa & Coles, 1998; Eysenck, Mogg, May, Richards & Mathews, 1991). A technique used by Eysenck et al (1991) to assess anxiety-related interpretative bias made subjects read descriptions of some equivocal situations, and give them a recognition memory test that included disambiguated versions of these situations. Results showed that participants with a clinically diagnosed anxiety were more likely than normal controls and recovered anxious individuals, to interpret ambiguous sentences in a threatening way rather than in a non -threatening way. This finding seems consistent with Beck's (Clark & Beck, 2011) schema theory, which proposes that threat-relevant schemata controls cognitive processing in anxious individuals.Studies with these conclusions however compared anxious participants with non-anxious control groups. As a result, nothing could be known about the issue of causality. Is it the interpretative bias that leads to anxiety or does anxiety cause the interpretative bias? For the purpose of answering this question of causality, Mathews & Mackintosh (2000) developed a programme designed for the modification of interpretative bias: Cognitive Bias Modification of Interpretation (CBM-I). The idea that flawed patterns of thinking may be a factor contributing to anxiety pathology has steered the development of cognitive behaviour therapy (CBT) for clinical anxiety disorders (Clark, beck, 2011). Current CBT interventions focus on altering thoughts and behaviours that are interfering with someone's functioning and enjoyment of life. They thus a) aim to impart patients of ADs with insight into the roles and nature of their thought patterns that play a part in generating and maintaining anxiety symptoms, b) help in identifying these disagreeable thoughts that trigger anxiety symptoms, and c) encourage and empower individuals to challenge these thoughts in a way that can reduce their power thus mitigating the effect on emotions.

CBM on the other hand is not devised to modify the way in which people respond to unhelpful thoughts but it assists in directly changing the cognitive processes that give rise to such thinking patterns (MacLeod & Mathews, 2012). Even though this approach is still in the nascent stage and developing, Koster, Fox & MacLeod (2009) have identified two key characteristics of CBM methodologies. First, the target to be modified in each case is a cognitive bias, which describes either a clinical disorder, a clinically relevant symptom or an individual's personality trait analogous with vulnerability to clinical dysfunction. Since this bias represents a pattern of processing selectivity that appears to function automatically without a conscious thought, it is not easily accessible to volitional control. Second, the method of manipulating the cognitive bias does not primarily depend on instruction, but involves extensive practice on a cognitive task made to encourage and ease the path for a desired change. In most cases, this is a reconfigured version of a cognitive experimental task that has earlier been engaged in to assess the specific cognitive bias and that can demarcate participants who differ in terms of anxiety vulnerability or dysfunction (MacLeod & Mathews, 2012). This reconfiguration requires introducing a training contingency in the task of which participants are not aware and so usually are unable to report it.Koster et al (2009) further argue that though CBM approach carries some peripheral similarities with some other training interventions used in cognitive rehabilitation programmes, these training modules basically function to enhance a more generic class of cognitive

functioning that has been neuro psychologically impaired. CBM in contrast typically assists in altering a specific pattern of processing selectivity that acts as a risk factor for clinical disorders mostly associated with emotional dysfunction. The nature of CBM depends on the particular type of cognitive bias (attentional and interpretive) that the training programme intends to change.

Not many studies have compared the effects of both exercise and CBM-I training on modifying cognitive biases in anxiety. Using experimental methodology, the present research aims to investigate the following research questions: 1) whether exercise is effective as an anxiety reducing measure, 2) whether CBM-I training is more (or less) effective, if at all, than exercise in reducing cognitive biases and symptoms of anxiety. In general, it was hypothesised that both exercise and CBM training approaches would reduce negative interpretive biases in clinical and non- clinical populations, so that anxiety symptoms and future vulnerability to stress is subsequently reduced.

3. Method

3.1. Participants

A total of thirty-six healthy adults in the age range of 18-60 years old (mean age=29.11; S.D=6.9, men and women) were recruited for the study. The participants were from the University of Essex, Colchester town and London, U.K. The recruitment was through course announcements in the department of psychology, via flyers posted on campus and in surrounding areas in the town, and also through various society group emails and other Internet social media. Healthy individuals who were regularly physically active as ascertained by self-report were included in this experiment. High anxious people were preferred but not an essential requisite. Also, they would not have exercised at least for 12 hours or more before the experiment session. Keen participants who had exercised before coming for the study were rescheduled. English was either their first language or they spoke in English from childhood.

Criteria for exclusion from this study accounted for current or previous heart disease, cancer and any other associate organic disease and neurological disorders. In addition, people with self-reported psychiatric disorders or who were taking antidepressants, antianxiety, or psychoactive medications were excluded. Inclusion of people with clinical diagnoses into current sample would have led to a greater heterogeneity such as comorbid conditions, previous and current treatment history, complicating the analysis and interpretation of training results.

3.2. Measures and Procedure

The experiment took place in the psychology labs for a period of four weeks. Participants read and signed an informed consent form that was approved by the department of psychology, University of Essex. All three groups completed the state and trait anxiety inventory, Form Y (STAI, Spielberger, 1983) and the Scrambled Sentence Test (SST, Wenzlaff & Bates, 1998). Descriptions of these measures is as follows:

3.3. State and Trait Anxiety Inventory, Form Y (STAI, Spielberger, 1983)

STAI- this is a self-report measure that includes separate evaluation of state and trait anxiety. State -anxiety has been referred to as transitory unpleasant feelings of nervousness, worry, tension or apprehension often occurring with an activation of the autonomic nervous system. Trait- anxiety is an individual's personal disposition of perceiving proneness to anxiety. Depending on the nature of the stressors, people experience different levels of anxiety related to their level of trait anxiety. The current study used the most popular version, form Y, to assess state and trait anxiety levels. It consists of two subscales including 20 items each. State anxiety form includes statements such as "I am tense; I am worried" and "I feel calm; I feel secure." Trait anxiety form includes statements such as "I worry too much over something that really doesn't matter" and "I am content; I am a steady person." These are statements that individuals use to describe themselves. The main qualities assessed are feelings of apprehension, tension, nervousness and worry. Both subscales use a 4- point Likert scale (e.g., from "Almost Never" to "Almost Always"). Higher scores indicate greater anxiety. The STAI is appropriate for those who have at least a sixth-grade reading level. It takes 20 minutes at the maximum thus reducing fluctuations in state anxiety that may occur if it takes too long.

3.4. The Scrambled Sentences Test (SST, Wenzlaff & Bates, 1998)

SST is a measure of processing bias used to measure participants' tendency toward interpreting ambiguous information (e.g., "winner born I am loser a") either as positive ("I am a born winner") or negative ("I am a born loser"). In this task, participants are presented with a list of scrambled sentences and instructed to rearrange them to form grammatically correct sentences. It involves two blocks of twenty sentences and is timed thus they are encouraged to complete them as fast as possible. In its original form, the task is considered to be a measure of negative cognitive bias; people with depressive disorders have shown to create more negative sentences than the non -depressed controls. To assess thought suppression and cognitive bias, a cognitive load procedure is used where subjects are asked to unscramble two sets of sentences: one set while remembering a six-digit number (cognitive load condition) and the other set without this load.

3.5. Procedure

Participants were randomly assigned to one of the three experimental groups: exercise plus positive CBM training (group 1; n = 12), exercise (group 2; n = 12), and the control group (group 3; n = 12). In the first session of the experiment, group 1 completed the STAI-form Y. Examples of unscrambled sentences in SST were then shown, followed by two practice questions. They were instructed to

unscramble five words in each sentence by placing a number over each of the five words indicating the correct order of the sentence, for example

3 2 1 5 4
has green child the eyes blue

The correct sentence would be either 'the child has green eyes' or 'the child has blue eyes'. Participants were presented with four sets of 20 sentences and given four minutes to complete each set. They were instructed to finish as many sentences as possible during this period. A cognitive load condition was employed with the order of the cognitive load and no-load conditions counterbalanced by group session. In the cognitive load condition, all subjects were shown the same 6-digit number for a few seconds and asked to keep it in their memory. They were asked to write the number in a separate sheet at the end of the 4 minutes. A 'negativity' score for each set was measured by calculating the ratio of negative sentences over the total sentences completed (of 20 possible). 42 % of the participants reported both the numbers with perfect accuracy while 25 % of the participants got one number correct.Participants were then made to sit in front of a computer for the modified version of the original CBM paradigm for adults (Mathews & Mackintosh, 2000). A CBM positive training programme comprising 80 ambiguous scenarios in 4 blocks was used for the current study. Participants were asked to read the instructions carefully imagining themselves in each situation presented. Before the main task they were given two practice paragraphs. During the training phase they were presented with a series of ambiguous situations each ending with a word fragment. Participants were asked to read each line which was self-paced but with a 10s time limit. This they did by pressing the advance key (arrow down) on the keyboard. After each third line in the scenario being described, they were asked to complete a word fragment as quickly as possible by typing in the first missing letter of the word. Completing this fragment resolved the ambiguity of the situation, which led them to draw positive interpretations. After each item, they were presented with a comprehension question that signified the emotional meaning of the situation and could only be answered correctly if the ambiguity was interpreted in the intended direction. They answered the question by pressing the left arrow on the keyboard for 'no' and right arrow for 'yes'. An immediate feedback was displayed. An example of one scenario is: *A housebound neighbour asks you to get a present for her niece's birthday. She asks you to choose something suitable. When you give it to her to wrap up, you can see that she thinks it is …*A positive word fragment followed this: *per--- t* (*perfect*). The comprehension question related to this item was: *Did you get the idea that your neighbour liked your choice?* The correct answer was 'yes' which was followed by a feedback about its correctness ('*correct*' or '*wrong*').

Although the CBM training was directed towards a positive interpretation, there were two situations in each block leading to a negative interpretation. These 'distractor' scenarios included were to make the purpose of the training less explicit. After completing this computer- training task, participants were taken for a 30 -minute walking exercise that was medium to fast -paced. The starting point for each person was the same and the experimenter walked along for the desired duration. The second session of the experiment took place immediately after the exercise bout. The two remaining blocks of SST were then completed in the same way with one load and one no load condition. Lastly, they again filled in the STAI questionnaire to ascertain the difference in anxiety scores. Group 2 participants followed the exact same procedure except there was no CBM training for them. Group 3 were the controls so they neither took part in the 30-minute walking session nor did they do the CBM training. The 30-minute period thus was spent in the way they liked (having tea, coffee, reading a book or doing absolutely nothing) without venturing out of the experiment lab. In the end of the experiment, each participant in all groups was debriefed.

4. Results

To explore the changes, if any, in the pre and post exercise STAI scores, a two-tailed paired t-test was administered with group as the between-subjects factor and time (before and after induction) as the within-subject factor.

4.1. Questionnaire scores

- Group I - Those exposed to the CBM positive training and exercise paradigm showed a non significant decrease in the mean state anxiety score from 32.42 to 29.92, t (11) = 1.792, p> 0.05, whereas the score for trait anxiety decreased significantly from 40.67 to 38.50, t (11) = 2.545, p < 0.05.

The mean difference between the trait anxiety score was 2.17 and the 95% confidence interval for the estimated population mean difference is between 0.293 and 4.040. The effect size was small (d = 0.17).

- Group II - The mean state anxiety score for those who were in the exercise training group, reduced significantly from 37.58 to 30.58, t (11) = 3.230, p< 0.05

The mean difference between the state anxiety conditions was 7.00 and the 95% confidence interval for the estimated population mean difference is between 2.23 and 11.77. The effect size was large (d = 0.78).

The mean score of trait anxiety also decreased significantly from 44.0 to 39.58, t (11) = 3.060, p < 0.05

The mean difference between the trait anxiety scores was 4.42 and the 95% confidence interval for the estimated population mean difference is between 1.24 and 7.59. The effect size was small (d = 0.30).

- Group III- For the control group, mean state anxiety score decreased non significantly from a mean of 33.25 to 31.08, t (11) =1.103, p > 0.05. Similarly, trait anxiety score showed a non -significant reduction in the mean from 38.50 to 38.17, t (11) = 0.321, p> 0.05.

Group			Mean	N	Std. Deviation
1	Pair 1	stai-S1	32.42	12	8.06
		stai -S2	29.92	12	7.82
	Pair 2	stai-T1	40.67	12	13.22
		stai-T2	38.50	12	12.21
2	Pair 1	stai-S1	37.58	12	9.23
		stai -S2	30.58	12	8.70
	Pair 2	stai-T1	44.00	12	13.78
		stai-T2	39.58	12	15.47
3	Pair 1	stai-S1	33.25	12	9.88
		stai -S2	31.08	12	9.41
	Pair 2	stai-T1	38.50	12	9.51
		stai-T2	38.17	12	11.18

Table 1

4.2. Effects of Cognitive Load on SST Negative bias

The purpose of the cognitive load manipulation was to disable participants' tendency towards a negative bias on the SST. Hence, we anticipated that, for high-anxious participants, the SST score would be higher (more negative) under load than without load. ANOVA was used to compare SST scores under load versus no load (a within subject's factor) and group (a between subject's factor).

Group		Mean	Std. Deviation	N
load sess 1	1	16.38	16.99	12
	2	35.20	32.49	12
	3	19.68	16.39	12
	Total	23.75	24.00	36
load sess 2	1	22.41	19.34	12
	2	26.98	21.50	12
	3	14.93	17.66	12
	Total	21.44	19.65	36
no load sess 1	1	20.62	17.99	12
	2	28.36	27.48	12
	3	22.65	12.83	12
	Total	23.88	20.04	36
no load sess 2	1	13.17	12.86	12
	2	29.39	25.30	12
	3	19.42	23.49	12
	Total	20.66	21.74	36

Table 2

- There was a non-significant effect of the cognitive load condition, F (1,33) = 0.051, $p > 0.05$.

Its effect on group was also non significant, F (2,33) = 1.944, $p > 0.05$.

- Effect of time factor (session 1 and 2) was not significant, F (1,33) = 1.946, $p > 0.05$.

The effect of time factor in groups was not significant, F (2,33) = 0.056, $p > 0.05$.

- The effect of the load manipulation and time was not significant, F (1,33) = 0.056, $p > 0.05$.

The effect of load and time manipulation within groups was also not significant, F (2,33) = 3.024, $p > 0.05$.

Thus, the time course of anxiety reduction in the present study suggests that an acute bout of walking as an exercise intervention has a significant effect on both state and trait anxiety. The CBM positive training programme too seems to have a small effect on trait anxiety if not on state anxiety. However, sitting quietly (control group) does not have an effect on state or trait anxieties.

5. Discussion

The purpose of the study was to better understand the relationship between exercise anxiety -reduction. Specifically, the aim was to investigate whether a session of acute exercise (a 30-minute walk) and CBM positive training would benefit healthy adults in reducing self-reported state and trait anxiety as measured by STAI. Additionally, the research focussed on the effects of a cognitive load manipulation on the direction of statements formed in the SST. Findings show mixed effects. Individuals in the exercise group demonstrated beneficial effects of exercise on anxiety benefitting from an acute bout of walking. The effect on state anxiety was very large, which significantly reduced from baseline to post exercise session. There was a decline in trait anxiety scores post exercise as well, though effect of the change was not as significant as seen in state anxiety scores. While, exercise combined with CBM positive training proved to be a little favourable in reducing trait anxiety, it did not show any significant changes in baseline state anxiety

levels. This finding indicates that CBM training did not have much impact on modifying people's negative thought process. The control group, as predicted did not show significant changes on anxiety responses, suggesting that being in a state of rest in comparison with engaging in physical exercise, does not affect mood states.

Even though more research studies focus on aerobic exercise and effects of engaging in long term exercise training programme, as mentioned in the literature earlier, single session exercise have shown benefits, though average results, in terms of reducing anxiety post exercise. Results from this investigation are supportive of the anti-depressant, anti-anxiety mood enhancing effects of physical exercise. The current study employed a positive CBM computer training that is relatively a new approach applied in therapeutic settings to alleviate anxiety. In the result expected, consistent with earlier findings (Mathews & Mackintosh, 2000), participants who completed a single session of CBM positive training should have reported lower state anxiety levels. Results as to effects of CBM positive training with exercise were equivocal. While no significant difference was found on state anxiety measure, trait anxiety dropped approximately 2.2 points in this paradigm. Is it possible that participants learned to respond in a positive way to tests even though anxiety need not be changed? But as seen state anxiety did not decrease significantly which makes this explanation less likely. Analyses of these findings thus rendered conclusions difficult as exercise was assigned as a part of the training procedure. It could not be interpreted if the small effect was a combined one or due to the exercise session or only as a result of CBM training. An interesting facet worth noticing was the significant decrease in trait anxiety under both treatment conditions. Here, the study suggests that both exercise and CBM training have potential in modifying an individual's anxious nature as a personal trait. This is a positive sign for the future of clinical interventions in the field of psychopathology. It takes an effort to remember the 6-digit number, reducing the cognitive power available for distracting attention from disturbing thoughts. It has therefore been hypothesised that people attempting to suppress negative thoughts would find it more difficult to do so in the cognitive load condition. This will lead to creating more negative sentences in cognitive load than in the no-load scenario. However, the cognitive load manipulation administered in the experiment did not statistically effect the participants' interpretation of statements formed in SST.

Results of the present study are valuable from many perspectives. They offer further insight into the exercise-anxiety reduction relationship by virtue of the fact that regardless of the exercise regimen invoked (acute, chronic), there seems to be a continuous link between exercise and anxiety reduction. For CBM positive training to have clinical potential, it is crucial that the effects on clinical measures improve. Also, here it was only a single session employed which would not give its real potential as a therapeutic measure. Perhaps adapting it to individual needs may improve its effectiveness. They might benefit from customised therapy as those used in standard CBT procedures. Stories could include real names, participants' jobs, and their emotional situations. It is possible that the pace of the situations presented were not conducive for everyone, so that is another criterion to be seen.

The current research employs normal healthy individuals without any diagnosed psychiatric condition, and so the extent to which these findings are generalised is limited. Also, gender differences in thought processing, and age, as a factor was not measured in the current investigation. However, its within-subject's nature of design served to give sufficient statistical ability for the purpose of the study. It was designed as an analogue study, so it becomes important for future research to simulate this study in a clinical population with anxiety disorders. There could be a greater improvement in these patients as the scope for reduction would be more. Whether subsequent studies employing similar methodologies are able to replicate these findings or larger sample sizes differences in responses across conditions become more pronounced, remains to be resolved.

This research study has touched upon some of the clinical potentials of exercise and positive cognitive bias modification in groups of healthy individuals. Perhaps, this methodology and extensions of it may be advantageously applied to determine the time course and nature of acute exercise on other psychological variables, considered to alter by physical activity. Results are thus only suggestive and not conclusive, leaving enough scope for exciting useful new research.

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