Combining mental imagery and implementation intentions to increase brisk walking in people with the symptoms of depression

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Thesis declaration form

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signature:

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Overview

Volume one consists of three parts.

Part one is a meta-analytic review investigating the effect of various doses of physical exercise on the symptoms of depression. The quality of twelve Randomised Controlled Trials (RCTs) was assessed. Outcomes from four RCTs were included in a meta-analysis. Results indicated that higher doses of exercise were more effective than no exercise in reducing the symptoms of depression, whereas there was no difference between lower doses of exercise and no exercise. The findings are interpreted with caution and more robust research is required to investigate the relationship between exercise and depression, addressing the methodological limitations discussed in this review.

Part two is an empirical study investigating the extent to which people with the symptoms of depression could generate mental imagery to increase goal attainment. Sixty five students were given the goal of increasing brisk walking over two weeks. According to randomisation participants were either asked to rehearse the goal, to form implementation intentions about the goal or to imagine themselves undertaking the goal. Brisk walking increased with no between-group differences. It was tentatively concluded that being given a goal intention was sufficient to improve attainment. Further research, controlling for research participation effects and natural changes in behaviour, is required to confirm the finding

Part three is a critical appraisal of the meta-analytic review and empirical study. It explores the personal implications the empirical study has had upon clinical work. It also evaluates the empirical study's web-based design, highlighting the methodological and ethical issues that were raised. Finally, the process of undertaking a meta-analysis is discussed, with specific focus on the challenges posed by this methodology.

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Part 1: Literature Review

The effect of exercise dose on the symptoms of depression and anxiety: A systematic literature review and meta-analysis

Abstract

Background: Previous research has demonstrated that physical exercise is an effective treatment for the symptoms of anxiety and depression. It is proposed that exercise delivered at higher doses is more effective than exercise at lower doses.

Aim: To investigate the effect of different doses of exercise on the symptoms of depression and anxiety

Search Strategy: Electronic searches and hand searches from the earliest possible date to December, 2014

Selection Criteria: Randomised Controlled Trials (RCTs), comparing various doses of exercise, that used robust measures of depression and/ or anxiety.

Analysis: Two meta-analyses were undertaken, one comparing exercise at a high dose to no exercise and another comparing exercise at a lower dose to no exercise. Methodological quality was assessed using guidance from the Cochrane Collaboration on the risk of bias.

Results: Thirty studies were assessed for eligibility, 12 met the inclusion criteria and were included in the review. Four studies (*n*=322) provided data for the meta-analysis. There was a significant difference between high doses of exercise compared to no exercise in the reduction of the symptoms of depression. There was no difference between lower doses of exercise and no exercise.

Conclusion: This review tentatively concluded that a higher dose of exercise is more effective than a lower dose of exercise in reducing the symptoms of depression, supporting a dose-response relationship. The effect of exercise on the symptoms of anxiety was not examined due to lack of data and more research is required to investigate this. Future research into exercise should also attempt to address the methodological limitations highlighted in this review.

Introduction

Exercise and depression

Many studies have examined the link between physical exercise and mental health, particularly the symptoms of depression. Several meta-analyses and reviews have synthesised the data in order to offer a consensus on the evidence. In one of the earliest reviews, North, McCullagh and Tran (1990) examined studies that investigated exercise and depressive symptoms using participants with and without clinical depression. They reported an overall moderate effect size of 0.53 with larger effects in studies with clinically depressed patients, anaerobic exercise (as opposed to aerobic exercise) and longer exercise interventions. A narrative review of the same year concluded that exercise was associated with an antidepressant effect in people with mild to moderate depression (Martinsen, 1990). Similar results were found in a review of 10 experimental and two quasi-experimental exercise interventions with people with clinical depression (Martinsen, 1994). Exercise appeared to be effective for mild and moderate depression and was greater than no treatment but not significantly different to other treatments such as psychotherapy. No differences were found between aerobic and anaerobic forms of exercise. A meta-analysis of 30 studies, using only participants diagnosed with clinical depression, reported a moderate to large effect (0.72) for exercise on symptoms of depression (Craft & Landers, 1998). No significant differences were found when exercise was compared to other treatment for depression such as medication or psychotherapy. The characteristics of the exercise (in terms of intensity, frequency and duration) were not found to moderate the effect of exercise. Taken together, these reviews appear to support the effectiveness of exercise as a treatment for depression. However, they have since been criticised for drawing their evidence from observational and quasi experimental studies.

Exercise and depression: Evidence from Randomised Controlled Trials

In an attempt to address these methodological limitations Lawlor and Hopker (2001) performed a meta-regression on 14 randomised controlled trials (RCTs) involving participants who met criteria for depression. Furthermore the researchers explicitly assessed the quality of all the studies they included. They reported that exercise appeared to be effective at reducing the symptoms of depression compared to no exercise with a large effect size (1.1). There were no significant differences between the type of exercise (aerobic vs. anaerobic) or between exercise and other treatments. However, widespread methodological weaknesses were reported including inadequate allocation concealment and blinding and lack of follow-up data. The authors concluded that, due to the lack of good quality research, the effect of exercise could not be determined.

Another meta-analysis including 11 RCTs reported a very large effect size of 1.42 for exercise suggesting that it was very effective at reducing the symptoms of depression (Stathopoulou, Powers, Berry, Smits, & Otto, 2006). A larger meta-analysis of 58 RCTs, including data from clinical and non-clinical samples, also reported a large effect (0.80) for exercise (Rethorst, Wipfli & Landers, 2009). There were no significant differences between exercise and other treatments (psychotherapy and medication). The analysis of moderating variables revealed that there were no significant differences between types of exercise in the clinical population (although in the non-clinical population a combination of aerobic and anaerobic produced larger effects than either type individually). In the non-clinical sample there were larger effects for exercise at low and high-intensity compared to moderate-intensity (no significant differences between intensity were found in the clinical sample). In the clinical sample more frequent exercise was associated with larger effect sizes (but not the non-clinical sample). They concluded that few studies accurately reported characteristics such as intensity and more research

investigating this was needed. In terms of methodological characteristics, studies that used adequate concealment and intent-to-treat analysis produced larger effect sizes than those that did not, in the clinical population.

The most recent Cochrane review of exercise for depression reported a moderate effect (0.62) of exercise when compared to no treatment with no significant differences between exercise and psychological therapy or pharmacological treatments (Cooney et al., 2013). Effects were larger for mixed exercise compared to either anaerobic or aerobic exercise individually. Effects were smaller for studies that provided less than 12 sessions. Lower doses of exercise appeared less effective than higher doses, although there were no differences in effect sizes according to exercise intensity. When the analysis was limited to only studies with robust methodologies (allocation concealment, blinding of outcome assessment, intention to treat analysis) there was no longer an effect of exercise. Due to the risk of bias the authors concluded that more information was needed on the optimum 'dose' of exercise, in regards to intensity, frequency and duration.

Exercise and depression: Evidence from non-clinical samples

Most meta-analyses have only included studies undertaken with clinical samples. Some reviews that have included participants from both clinical and non-clinical samples have estimated smaller effect sizes. In a meta-analysis that only included data from 'healthy' adults, a moderate effect (0.52) was reported for studies using unsupervised exercise interventions (Conn, 2010*a*). There was a smaller effect (0.37) for those using supervised exercise interventions. Supervised low-intensity exercise was associated with larger effects than supervised moderate or high-intensity exercise, casting doubt on the theory that higher intensity exercise leads to greater benefits. Among unsupervised interventions, exercise intensity was not related to outcomes. Smaller effects for exercise were also observed in a meta-

analysis of exercise and mood in older adults (Arent, Landers & Etnier, 2000). An overall effect size of 0.34 was reported, with larger effects associated with shorter frequency (< 3 days per week) and duration (< 12 weeks) of exercise. Interestingly, lower intensity exercise was associated with greater improvements in mood than either moderate of higher intensity. Anaerobic exercise, compared to aerobic exercise, was associated with larger effects.

Exercise and anxiety

There is a broad consensus that exercise is associated with improvements in the symptoms of depression but less is known about exercise and other affective outcomes e.g. anxiety. A meta-analysis of 49 RCTs (Wipfli, Retorst & Landers, 2008) examining the effect of exercise on measures of anxiety, observed a moderate effect size (0.48). Only a small number of studies reported the intensity, frequency and duration of exercise in enough detail to calculate the overall dose and a significant dose-response relationship was not found. Another meta-analysis of 19 studies reported a much smaller effect size (0.22) for exercise on the symptoms of anxiety in 'healthy' participants (Conn, 2010*b*). Larger effects were associated with moderate and higher intensity exercise compared to low-intensity, at least among supervised interventions. Frequency and duration of exercise was not related to outcome.

Exercise and the symptoms of depression and anxiety: a dose-response relationship?

A narrative review by Dunn, Trivedi and O'Neil (2001) concluded that there was little evidence of the dose-response relationship between exercise and the symptoms of depression and anxiety. They suggested that this was probably due to a lack of suitable studies addressing the relationship. Dunn et al (2001) reported that much of the existing evidence came from observational and quasi experimental

studies and they did not find any RCTs that had combined the effects of varying the dose (including intensity, frequency or duration) of exercise whilst controlling for overall energy expenditure. They identified two studies that compared different intensities of exercise (Sexton, Maere & Dahl, 1989; Veale, Le Fevre, Pantelis, de Souza, Mann & Sargeant, 1992). They both found that symptoms of depression and anxiety were reduced by exercise but did not find any significant differences between the intensities. However, neither of these studies used procedures to quantify the overall energy expenditure across different groups and therefore it was possible that both conditions were exercising at the same intensity. Dunn et al (2001) suggested that studies should attempt to quantify the overall energy expenditure in each dose of exercise in order to increase methodological robustness.

In a review of reviews Daley (2008) concluded that the available evidence for exercise as a treatment for depression was encouraging. Despite wide variation in the quality of evidence, Daley reported that there was consensus that exercise is more effective than no treatment and as effective as some established treatments. However, Daley (2008) advised caution when interpreting these findings due to methodological limitations, despite recent studies and reviews attempting to use more stringent criteria. In particular, it was suggested that more research was needed to investigate the optimum characteristics of exercise programmes, particularly the dose of exercise required to treat depression and whether this is different from the dose prescribed to achieve general health benefits.

Whilst the underlying mechanisms of action of exercise may not be fully understood Daley (2008) has summarised the main explanations of how exercise may improve mood. This includes neurobiological models that have suggested that physical activity stimulates the production and activation of endogenous chemicals and brain neurotransmitters which have been associated with reductions in

depression and improved mood. Alternatively psychological models have stated that physical activity may improve mood through a number of mechanisms including distraction from rumination, enhancing self-esteem, providing a sense of mastery and achievement and as a form of behavioural activation (Daley, 2008). It is assumed that these proposed mechanisms of action are influenced by the dose of exercise, however, more research is needed to investigate these mechanisms and in particular how they are affected by dose.

Exercise and physical health: a dose-response relationship?

Evidence from observational and epidemiological studies have been demonstrated a dose-response relationship between exercise and a number of physical health outcomes including cardiovascular disease (Khol, 2001), weight loss (Ross & Jenssen, 2001), type 2 diabetes, some forms of cancer and all-cause mortality (Kesaniemi, Danforth, Jensen, Koppelman, Lefebvre & Reeder, 2001; Lee & Skerrett, 2001; Löllgen, Böckenhoff & Knapp, 2009). The American College of Sports and Medicine and the American Heart Association recommend that improvements in physical fitness and reduction in the risk of chronic disease is associated with increased physical activity (Haskell et al., 2007). Currently in the UK the National Health Service recommend that in order to stay healthy adults should be active daily and undertake at least 150 minutes of moderate-intensity exercise or 75 minutes of high-intensity exercise per week ('Physical activity guidelines for adults', 2013). However, it remains unclear whether the dose-response relationship also exists for exercise and mental health.

Summary

In previous meta-analyses and reviews physical exercise has been observed to be an effective intervention in the treatment of depression and anxiety. For depression, moderate to very large effects have been observed, with effect sizes

ranging from 0.62 to 1.42 in clinical samples and smaller effect sizes (0.52) in non-clinical samples. By comparison, effect sizes for anxiety have been in the small to moderate range (between 0.22 and 0.48). Generally exercise is as effective as other established treatments for depression and anxiety (including psychological therapies and pharmacological treatments). However all reviews, even those that have only included RCTs, have highlighted methodological limitations which may inflate the observed effects. Limitations include inadequate randomisation and allocation concealment, lack of blinding on outcome assessment, selective reporting and failure to use intent-to-treat analysis.

Furthermore there is a lack of clarity on the optimum characteristics of exercise in the treatment of depression and anxiety. Higher doses of exercise (greater intensity, frequency and duration of intervention) have been associated with greater improvement in the symptoms depression and anxiety. However, this has not been consistently observed and some reviews have found no evidence of a dose-response relationship and in two reviews low-intensity exercise produced greater effects than higher intensity. Furthermore characteristics of exercise programmes have often been poorly reported, casting doubt on conclusions drawn from previous research.

Aim of the Review

The aim of this meta-analytic review was to investigate the proposed dose-response relationship between exercise and symptoms of depression and anxiety. This was achieved by synthesising studies that addressed the dose-response relationship in their design by directly comparing the effects of various doses of exercise on depression and anxiety. In order to overcome the short comings of previous reviews this data was extracted from studies that used random assignment

of participants, appropriate control conditions and robust measures of depression and anxiety.

METHOD

An electronic search of published articles was conducted using the Cochrane library (CENTRAL), Medline, PsycINFO, and Web of Science from the earliest date to December, 2014. Reference lists of relevant reviews and articles were also hand searched. Searches were conducted using MESH terms and full text searches and were combined using Boolean operators. Truncation operators were used to include variant spellings and plural forms of the search terms. A number of preliminary 'scoping' searches were carried out initially in order to decide which search terms would be most appropriate. The terms entered in the main searches included 'exercise', 'depression', 'dysthymia', 'anxiety', 'intensity', 'dose-response' and variants of these terms (see Appendix 1 for complete search terms). Proximity operators, where available, were used in order to limit the number of results to studies that included 'dose' and 'response' within five words of each other. The '*Cochrane highly sensitive search strategy for identifying randomised controlled trials in Medline: sensitivity maximising version (2008 version); Ovid format'* (Lefenvre, Manheimer & Glanville, 2011) was used when searching Medline to filter out trials other than RCTs. Similar search strategies were not used when searching PsycINFO and Web of Science due to lack of appropriate filters. CENTRAL only searches RCTs. Results from these searches were entered into EndNote (version X7).

Screening and Selection

All studies were reviewed by title and abstract and were included if they referred to any exercise intervention for depression and/or anxiety. More detailed checks were then carried out of the full text articles against the inclusion and exclusion criteria.

Inclusion Criteria

Studies were included if they contained at least two levels of exercise 'dose' (not including control groups) that were independent of each other, used random assignment to conditions and measured mood (symptoms of depression and/or anxiety) as a dependent variable. Only studies that involved adults (aged 18 and upwards) were included. Studies that compared or combined exercise with other established treatments for depression and anxiety (e.g. pharmacological, psychotherapy) were included.

Exclusion Criteria

Studies were excluded if they used a single bout of exercise rather than an exercise programme or if the levels of exercise 'dose' and control group were not independent of each other (e.g. participants provided data in more than one condition). Studies were also excluded if they were published in languages other than English.

Data Extraction

Data were extracted from reviewing full text articles that met the inclusion criteria. The data extracted included study design, characteristics of exercise intervention, characteristics of comparison group, sample size, age and gender of participants and type of outcome measure used.

Study Quality

All studies included in the final analysis were assessed for risk of bias using the Cochrane risk of bias tool (Higgins, Altman & Sterne, 2011). This involved assessing the risk of bias across seven areas; selection bias due to inadequate generation of randomised sequence, selection bias due to inadequate concealment of allocation to participants and study personnel, performance bias due to knowledge of the allocation by participants and personnel during the study, detection bias due to knowledge of allocation by outcome assessors, attrition bias due to amount, nature or handling of incomplete data, reporting bias due to selective reporting of outcomes and other potential biases. Each source of bias was assessed by the researcher as either 'high risk', 'low risk' or 'unclear risk' based on the information available for each study.

Data Synthesis

Review Manager (version 5.3) was used to quantitatively synthesis the data and to calculate overall estimates of treatment effects (with 95% confidence intervals). The standard mean difference (SMD) was used in order to standardise the continuous data from different psychometric measures of depression and anxiety into a uniform scale. Separate post-treatment comparisons were undertaken for the high exercise dose and low exercise dose conditions, each compared to control.

Unit of Analysis

Data from the measures of depression and/or anxiety were used. When studies used multiple measures of symptomatology (e.g. multiple measures of depression) the meta-analysis included the primary measure as reported by the study's authors. In studies that used multi-dimensional measures of mood

symptomatology (e.g. the Profile of Mood States) data from the most appropriate sub-scale (e.g depression/ dejection) was included.

In studies that used three or more exercise arms, data were collected from the arms that contained the highest and lowest dose of exercise and from the comparison (control) arms.

Assessment of Heterogeneity

Heterogeneity between studies was statistically assessed using the Chi Squared test, included in the forest plots. Guidance from the Cochrane handbook (Deeks, Higgins & Altman, 2011) suggests that a low *p* value or a high Chi squared value (relative to its degrees of freedom) may indicate evidence of heterogeneity. However, non-significant *p* values ($p > .05$) cannot necessarily be taken as evidence of no heterogeneity. Forest plots also calculate an I^2 statistic which describes the percentage of variability in the effect estimate that is due to heterogeneity rather than sampling error. The Cochrane Collaboration suggests that I^2 between 0 to 40% may not be important but I^2 of 50% and larger may represent substantial to considerable heterogeneity (Deeks, Higgins & Altman, 2011).

Assessment of Publication Bias

It was decided that, if sufficient studies were available, funnel plots would be examined for asymmetry, which can be an indicator of publication bias and other sources of bias.

RESULTS

A total of 1160 studies were retrieved from electronic searches and hand searches after deduplication (see Figure 1). The 1130 studies that were excluded from the search either did not use exercise ‘dose’ as an independent measure, did not measure mood as an outcome, did not use random assignment or were review articles. Eighteen studies were read in full and excluded for the following reasons: fifteen used a single bout of exercise rather than an exercise programme, two did not use exercise ‘dose’ as an independent variable and one was described as a pragmatic RCT but was found to have not used random assignment. This left 12 eligible studies that were included in the review.

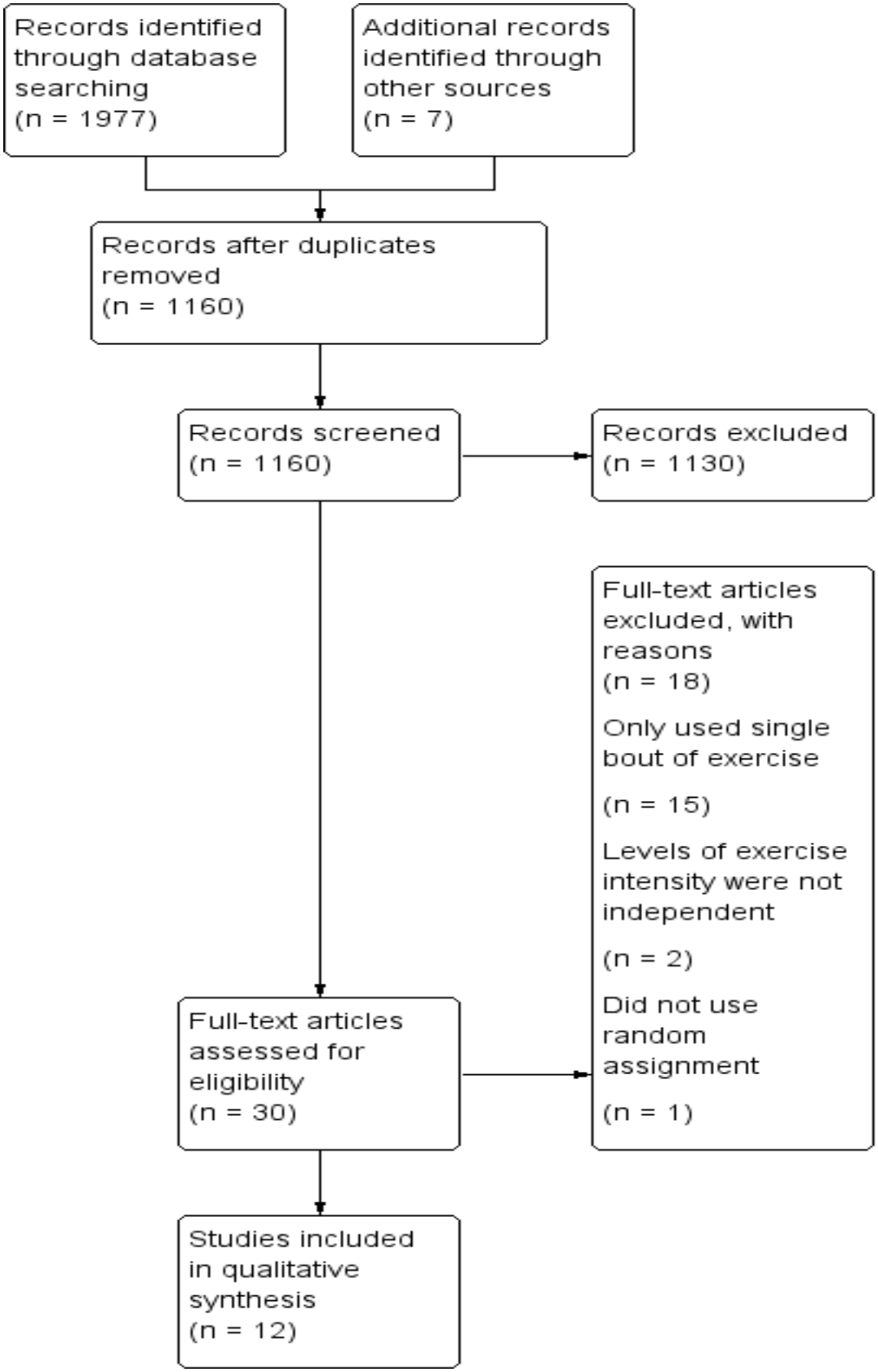


Figure 1: *Flow diagram of electronic search strategy*

Characteristics of Studies

Participant characteristics. The total number of participants included from the 12 studies was 1,419. Full details of the included studies can be found in Table 1.

Seven out of the 12 studies included only 'healthy' participants without any psychiatric/psychological problems. Five studies included only participants who were 'living with depression' (descriptions of how these studies classified 'living with depression' can be found in Table 2).

All studies recruited participants from the adult population (with five studies only recruiting participants from the older adult population, described as ≥ 50 years).

11 studies assessed differences on psychological measures between groups at baseline and two found some significant differences (Legrand & Heuzé, 2007; Moses, Steptoe, Matthews & Edwards, 1989). One study did not report baseline characteristics of psychological measures (Martin, Church, Thompson, Earnest & Blair, 2009).

Seven studies reported at least some information on the retention of participants and seven studies also reported information on participants' adherence to the intervention. Retention rates ranged from 70-100% with a median retention rate of 87.5 %. No significant differences between groups on retention rates were reported. Adherence to the interventions ranged from 63-100% with two studies reporting no significant differences between groups (Chu, Buckworth, Kirby & Emmery, 2009; Moses et al., 1989) and one study reporting significantly higher adherence in the lower dose of exercise group (Trivedi et al., 2011). Information on retention and adherence rates across the studies can be found in Table 3.

Table 1
Study characteristics

Study	Study type	Intervention details	Experimental conditions	Comparison	Sample	Psychological Outcomes	When were outcomes measured?	Baseline differences on psychological measures?	Main findings
Brown et al (1995)*	RCT	16 weeks of aerobic exercise (30-50 min session x 3 p/w) Total of 48 sessions Completed in group.	1.Moderate-intensity (MI), n=24 2.Low-intensity, (LI), n=34 3.Low-intensity + relaxation response(LI+RR), n=28 4.Mindful exercise(ME), n=18	Non exercising control group, n=31	Healthy adults (51% women, mean age: 52.7, SD:8.2) Total n=135	POMS†, PANAS, STAI, RSES	Pre/ post intervention	No differences	Women in ME showed reductions in Total Mood disturbance and depression (POMS sub-scales) Men in ME experienced increased positive affect (PANAS). No other differences observed.
Cassilhas et al (2007)	RCT	24 weeks of resistance exercise (60 min session x 3 p/w) Completed in group (pairs of two).	1.High-intensity (HI), n=20 2.Moderate-intensity (MI), n=19	Stretching exercise control group, n=23	Healthy older adults (mean age: 68.2, SD:0.77, range: 65-75) Total n=62	GDS, POMS, SF-36 (Quality of life sub-scale)	Pre/ post intervention	No differences	HI and MI both showed reductions in Total mood disturbance and depression (POMS sub-scales) with no differences between HI and MI. No differences between HI, MI and control on GDS.

Chu et al (2009)*	RCT	10 weeks of aerobic exercise (30-40 min session x 1 p/w) Completed in group.	1.High-intensity(HI), n=18 2.Low-intensity(HI), n=18	Stretching exercise control group, n=18	Adults with depression (100% women, mean age: 25.9, SD:6.2, range:18-46) Total n=54	BDI-II†	Pre, 5 weeks, post intervention	No differences	Reduction on BDI-II in all groups at 5 & 10 weeks. Controlling for baseline BDI-II scores HI showed greater reduction than LI & control at weeks 5 & 10. No differences on BDI-II between LI and control.
Dunn et al (2005)*	RCT	12 weeks of aerobic exercise 3 or 5 x p/w Completed individually.	1.High-intensity(HI) 5 x p/w, n=16 2.High-intensity (HI) 3 x p/w, n=17 3.Low-intensity LI) 5 x p/w, n=18 4.Low-intensity (LI)3 x p/w, n=16	Stretching exercise control group x 3 p/w , n=13	Adults with depression (75% women, mean age:35.9, SD:6.4) Total n=80	HRSD†(Response and Remission)	Pre/post intervention	No differences	Reduction on HRSD at 12 weeks for all groups. HI showed greater reduction on HRSD than LI and control. There were no differences on HRSD between exercise 3xp/w or 5xp/w.
King et al (1993)	RCT	12 months of aerobic exercise training (60 min sessions x 3 p/w)	1.High-intensity (HI), n=74 2.High-intensity at home(HI+H), n=77 3.Low-intensity at home(LI+H), n=74	Assessment only control group, n=75	Healthy older adults (45% women, mean age:56.6, SD: 42, range: 50-60) Total n=300	BDI-II, TMAS, PSS	Pre/ post intervention	No differences	HI, HI+H and LI+H showed reductions on PSS and TMAS compared to control, with

									no differences between exercise groups. No differences between exercise groups and control on BDI-II.
Legrand et al (2007)	RCT	8 weeks of aerobic exercise High frequency = 30 min session x 3-5 p/w. Low frequency =30 min session as often as possible.	1.High frequency(HF), n=8 2.High frequency + group intervention (HF+G), n=8 3.Low frequency(LF), n=7	No control group	Adults with depression (70% women, mean age:34.5, SD:10.6) Total n=23	BDI-II	Pre, 4 weeks, post intervention	Yes – at baseline participants in the control group had significantly higher BDI-II scores that participants in the exercise groups	HF and HF+G showed greater reduction on BDI-II than LF and control at 4 weeks and study exit. No differences were observed between the HF and HF+G BDI-II.
Martin et al (2009)	RCT	6 Months of aerobic exercise 3 or 4 sessions p/w (duration not reported) Completed in group	1.High-intensity(HI), n=95 2.Moderate-intensity(MI), n=96 3.Low-intensity(LI), n=147	Non exercising control group, n=92	Healthy adults (100% women, mean age:57.4, SD:6.5, range: 45-75) Total n=430	SF-36 (Quality of life)	Pre/ post intervention	Not reported	LI & HI showed improvements in mental health & general health (SF- 36 sub-scales) compared to MI & control. A regression analysis found dose was a predictor of

									change in all scales of SF-36 (other than bodily pain).
Moses et al (1989)	RCT	10 weeks of aerobic exercise (4 sessions p/w, duration not reported). Completed in group	1.High-intensity(HI), n=18 2.Moderate-intensity(MI), n=19	1.Attention placebo, n=18 2.Non exercising control, n=20	Healthy adults (27% women, mean age:39, range:37-39) Total n=75	POMS	Pre/ post intervention, 3 month follow-up.	Yes – at baseline participants in the high-intensity exercise group had significantly higher depression score than in the moderate-intensity and attention placebo group.	MI showed reduced tension/ anxiety (POMS sub-scales). No other differences were observed on the POMS sub-scales.
Singh et al (2005)*	RCT	8 weeks of resistance exercise (60 min session x 3 p/w) Completed in group.	1.High-intensity(HI), n=20 2.Low-intensity(LI), n=20	Non exercising control group (Usual GP care), n=20	Older adults with depression (55% women, mean age:69.3, SD:6.3) Total n=60	GDS†, HRSD	Pre/ post intervention	No differences	Greater reduction on GDS in HI compared to LI and GP care. Greater clinical response (classified as at least 50% reduction on HRSD) for HI. No differences in HRSD response between LI & GP care.

Trivedi et al (2011)	RCT	12 weeks Aerobic exercise (Duration and frequency not reported) Completed individually	1.High-intensity + SSRI therapy (HI), n=61 2.Low-intensity + SSRI therapy (LI), n=61	No control group	Adults with depression (82% women, mean age:47, SD:10.0) Total n=122	IDS-C, HRSD	Pre/ post intervention	No differences	No differences between HI and LI in IDS-C remission rates. Number Needed to Treat (NNT) of 7.8 for HI vs LI.
Tsutsumi et al (1997)	RCT	12 weeks of strength training exercise (3 p/w, duration not reported) Completed in group	1.High-intensity/low volume(HI), n=14 2. Low-intensity/ high volume(LI), n=14	Non exercising control group, n=14	Healthy older adults (80% women, mean age:68.8, SD:5.7, range:61-86) Total n=42	POMS, STAI	Pre/ post intervention	No differences	HI and LI showed reduction in tension and improvement in vigor (POMS sub-scales) HI and LI showed reduction on STAI.
Tsutsumi et al (1998)	RCT	12 weeks of strength training exercise (3 p/w, duration not reported) Completed in group	1.High-intensity(HI), n=12 2.Moderate-intensity(MI), n=12	Non exercising control group, n=12	Healthy older adults (100% women, mean age:65.5, SD: 6.1, range:60-86) Total n=36	POMS, STAI	Pre/ post intervention	No differences	HI and MI showed improvement in vigor (POMS sub-scale) and MI showed reduction on STAI. No differences observed in depression (POMS sub-scale).

Note.
*Included in meta-analysis.
† Primary outcome measure used in meta-analysis.
POMS = Profile of Mood States, PANAS = Positive and Negative Affect Scale, STAI = State-Trait Anxiety Scale, RSES = Rosenberg Self-Esteem Scale, GDS = Geriatric Depression Scale, SF-36 = Short Form Health Survey, BDI-II = Beck Depression Inventory 2nd Edition, HRSD = Hamilton Rating Scale for Depression, TMAS = Taylor Manifest Anxiety Scale, PSS = Perceived Stress Scale, IDS-C = Inventory of Depressive Symptomatology – Clinician Rated.

Table 2
How 'living with depression' was classified

Study	How 'living with depression' was classified
Chu et al (2009)*	Beck Depression Inventory score of ≥14
Dunn et al (2005)*	Hamilton Rating Scale for Depression score between 12 – 25 and diagnosed with major depressive disorder (MDD) using Structured Clinical Interview for Depression (SCID) for DSM-IV.
Legrand et al (2007)	Beck Depression Inventory score of ≥16
Singh et al (2005)*	Geriatric Depression Scale score of ≥14 and DSM-IV diagnosis of major depression, minor depression or dysthymia
Trivedi et al (2011)	Diagnosis of nonpsychotic major depressive disorder (MDD) based on the Structured Clinical Interview (SCID) for DSM-IV.

Note.
*Included in meta-analysis.

Table 3
Retention and adherence rates with tests of statistical difference (where reported).

Study	**Retention rate?**	**Adherence rate?**
Brown et al (1995)*	Not reported	Not reported
Cassilhas et al (2007)	100% retention	75% adherence
Chu et al (2009)*	70% retention (no significant differences between groups)	80-100% adherence (no significant differences between groups)
Dunn et al (2005)*	Not reported	Not reported
King et al (1993)	84% retention	75% adherence

Legrand et al (2007)	Not reported	Not reported
Martin et al (2009)	85% retention	88-94% adherence
Moses et al (1989)	Not reported	Not reported (no significant differences between groups)
Singh et al (2005)*	90% retention	100% adherence
Trivedi et al (2011)	97% retention	63-94% adherence (adherence was significantly higher in the low dose of exercise group)
Tsutsumi et al (1997)	100% retention	Not reported
Tsutsumi et al (1998)	Not reported	Not reported

Note.
*Included in meta-analysis.

Exercise intervention characteristics. In line with the exclusion criteria, all studies contained at least two levels of exercise dose. The method that each study used to quantify exercise dose can be found in Table 4. All exercise interventions consisted of between 52 weeks (12 months) and eight weeks of sessions, with a median of 12 weeks. Eight studies used exercise interventions that were completed by participants in groups, in two studies participants completed the exercise interventions individually and two studies compared exercise interventions completed individually versus completed in a group.

Eight studies used aerobic exercise interventions and four studies used anaerobic (strength training/ resistance training) interventions. None of the studies used a combination of aerobic and anaerobic interventions.

In line with the inclusion criteria three studies were included that combined an exercise intervention with other interventions. Brown et al (1995) randomised participants to moderate-intensity exercise, low-intensity exercise, low-intensity exercise combined with relaxation or mindful exercise ('Tai Chi type activity'). Trivedi et al (2011) randomised participants to either high-intensity exercise or low-intensity exercise whilst Selective Serotonin Reuptake Inhibitor therapy was held at a constant. Legrand and Heuzé (2007) assigned participants to a low frequency exercise condition, a high frequency exercise condition or a high frequency exercise plus group-based intervention condition. The group-based intervention used team building activities to develop participant's perception of group cohesiveness. The remaining nine studies did not combine their exercise interventions with any other interventions.

Table 4
How exercise was quantified across studies.

Study	How was exercise dose measured?	Doses of exercise included
Brown et al (1995)*	HRR (Heart Rate Reserve)	1.Moderate-intensity (65-75% HRR) 2.Low-intensity (45-55% HRR)
Cassilhas et al (2007)	1RM (Repetition Maximum)	1.High-intensity (80% 1RM) 2.Moderate-intensity (50% 1RM)
Chu et al (2009)*	$V0_2R$ (Oxygen Uptake Reserve)	1.High-intensity(65-75% $V0_2R$) 2.Low-intensity (40-55% $V0_2R$)
Dunn et al (2005)*	Kcal/kg/week (Weekly Energy Expenditure in Kilocalories)	1.Low dose (7 kcal/kg/week) x 3 times p/w 2.Low dose (7 kcal/kg/week) x 5 times p/w 3.Public health dose (17.5 kcal/kg/week)x 3 times p/w 4. Public health dose (17.5 kcal/kg/week)x 5 times p/w
King et al (1993)	PHR (Peak Heart Rate)	1.High-intensity in a group (73-88% PHR) 2.High-intensity at home (73-88% PHR) 3.Low-intensity at home (60-73% PHR)

Legrand et al (2007)	Frequency	1.High frequency (3-5 session p/w) 2.High frequency + group intervention (3-5 sessions p/w) 3.Low frequency (as often as possible)
Martin et al (2009)	KKW (Kilocalories per gram of body weight)	1.High-intensity (12 KKW) 2.Moderate-intensity (8 KWW) 3.Low-intensity (4 KKW)
Moses et al (1989)	HRmax (Maximal Heart Rate)	1.High-intensity(60-90% HRmax) 2.Moderate-intensity (60% HRmax)
Singh et al (2005)*	1RM (Repetition Maximum)	1.High-intensity (80% 1RM) 2.Low-intensity (20% 1RM)
Trivedi et al (2011)	KKW (Kilocalorie per gram of body weight)	1.High-intensity (16 KKW) 2.Low-intensity(4 KKW)
Tsutsumi et al (1997)	1RM (Repetition maximum)	1.High-intensity (75-85% 1RM) 2.Moderate-intensity (55-65% 1RM)
Tsutsumi et al (1998)	1RM (Repetition maximum)	1.High-intensity (75-85% 1RM) 2.Moderate-intensity (55-65% 1RM)

Note.
*Included in meta-analysis.

Comparison (control) group characteristics. Ten of the studies used a control group as a comparison. Of these, five studies used control groups that did not require the participants to exercise (non-exercising controls), three studies used a control group that required the participants to engage in stretching exercise (stretching controls), one study used two control groups; an attention placebo consisting of strength, mobility and flexibility exercises and a non-exercising control. Finally one study used an assessment only control condition where participants were asked not to change their exercise habits for the duration of the intervention. Two studies did not include a control group (Legrand & Heuzé, 2007 & Trivedi et al., 2011).

Outcome measure characteristics

Depression. Nine studies used self-reported measures of depression, two used clinician-rated measures and one study used both self-reported and clinician rated measures. There was variability between the primary measures used; seven studies used single-scale measures of depression (Beck Depression Inventory; Beck, Steer & Brown, 1996., Geriatric Depression Scale; Yesavage et al., 1983., Hamilton Depression rating Scale; Hamilton, 1960., Inventory of Depressive Symptomology; Rush, Gullion, Basco, Jarrett & Trivedi, 1996). The other five studies used multi-dimensional measures of mood and/ or quality of life that contained sub-scales of depressive symptomatology (Profile of Mood States; McNair, Lorr & Droppleman., Short Form Health Survey; Ware & Sherbourne, 1992).

Anxiety. Six studies measured anxiety symptoms. This included four studies that used single-scale measures of anxiety (State-Trait Anxiety Inventory; Spielberger, 2010., Taylor Manifest Anxiety Scale; Taylor, 1953), two studies only used a multi-dimensional measure of mood (Profile of Mood States) that contained

several sub-scales measuring elements of anxiety symptomatology (tension-anxiety sub scale)

Other psychological measures. Two studies used the Short Form Health Survey, one study used the Rosenberg Self Esteem Scale (Rosenberg, 1965) and one study used the Perceived Stress Scale (Cohen, Kamarck & Mermelstein, 1983).

All of the psychological outcome measures used can be found in Table 1.

Study Quality

Methodological quality was investigated by assessing sources of bias using the Cochrane risk of bias tool. Risk of bias was assessed across six areas, as described in the method section. A risk of bias summary is presented in Figure 2 and a risk of bias graph in Figure 3.

Random sequence generation. Five studies were assessed as low risk of bias due to their adoption of appropriate methods of random sequence generation (Chu et al., 2009; Dunn, Trivedi, Kampert, Clark & Chambliss, 2005; Martin et al., 2009; Singh, Stavrinos, Scarbek, Galamos, Liber & Singh, 2005 & Trivedi et al., 2011). The remaining seven studies may have contained bias but were rated as unclear due to insufficient information to assess whether an important risk of bias existed.

Allocation concealment. Five studies were assessed as low risk of bias due to their use of appropriate methods to conceal allocation from study personnel (Dunn et al., 2005; King, Taylor & Haskell, 1993; Martin et al., 2009, Singh et al., 2005 & Trivedi et al., 2011). The risk of bias for the remaining seven studies was rated as unclear as there was insufficient information available.

Blinding of participants and personnel. None of the studies attempted to blind the participants to the intervention they received as this is generally not possible for studies using interventions other than medication.

Blinding of outcome assessment. Only two studies successfully concealed the intervention allocation to outcome assessors and were assessed as low risk for detection bias (Dunn et al., 2005 & Singh et al., 2005). Nine studies used only self-reported measures and as such the participants could not be blinded as to which intervention they received therefore they were subsequently assessed as high risk of detection bias. One study used both clinician rated outcomes (using allocation concealment) and self-reported measures and therefore the risk of bias was assessed as unclear for this study (Trivedi et al., 2011).

Incomplete outcome data. Four studies were assessed as low risk of attrition bias due to the appropriate reporting of attrition rates, reasons for attrition and use of intention-to-treat analysis (Cassilhas, Viana, Grassmann, Santos, Santos, Tufik & Mello, 2007; Chu et al., 2009; Martin et al., 2009 & Tsutsumi, Don, Zaichkowsky & Delinzonna, 1997). One study was assessed as high risk due to only reporting results from the 'as treated analysis' rather than an intention-to-treat analysis (Dunn et al., 2005). Another study was assessed as high risk due to failing to meet the sample size needed to find a statistical effect (Legrand & Heuzé, 2007). For the remaining six studies the risk was assessed as unclear due to insufficient information.

Selective reporting. Five studies were assessed as low risk of selective reporting (Brown et al., 1995; Chu et al., 2009; Dunn et al., 2005; Legrand & Heuzé, 2007 & Singh et al., 2005). The remaining seven studies were assessed as high risk due to the incomplete reporting of outcome variables (means and standard deviations) so that they could not be included in a meta-analysis. In addition, one of

these studies did not report outcomes of secondary measures that had been pre-specified in the protocol (Trivedi et al., 2011). Two studies only reported data from selected sub-scales of the main outcome measure (Profile of Mood States), despite specifying in the protocol that all sub-scales were administered to participants (Tsutsumi et al., 1997 & Tsutsumi, Don, Zaichkowsky, Takeneka, Oka & Ohno, 1998).

Other bias. No other forms of bias were identified in these studies and therefore they were all assessed as low risk of other forms of bias (not previously specified).

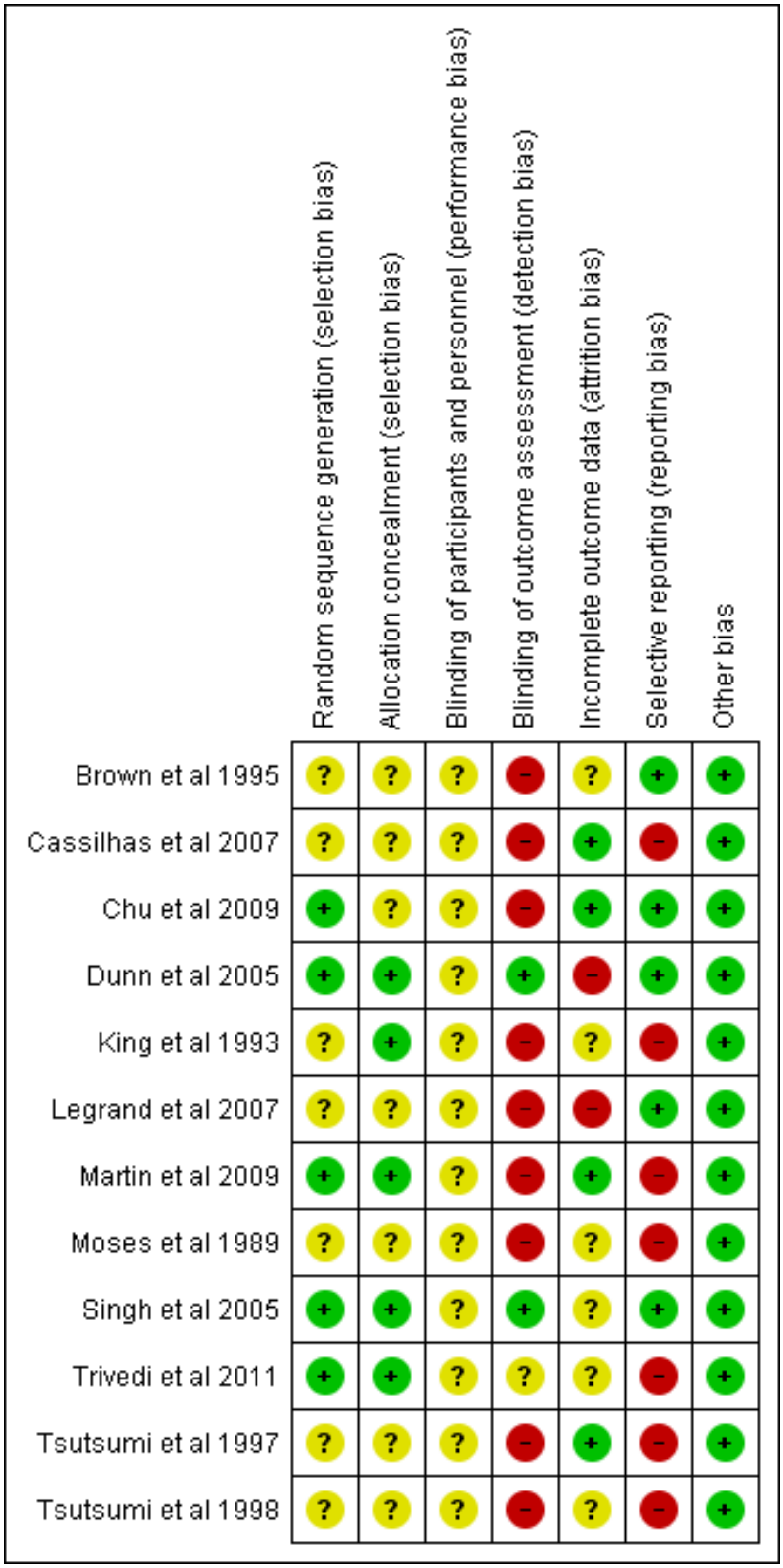


Figure 2: *Risk of bias summary*

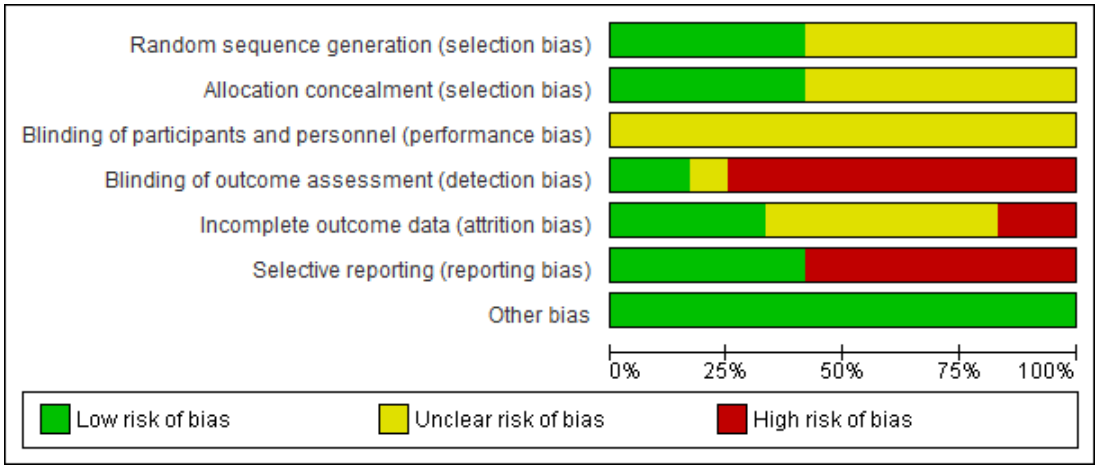


Figure 3: *Risk of bias graph*

Effect of Intervention

Seven studies (Cassilhas et al., 2007; King et al., 1993; Martin et al., 2009; Moses et al., 1989; Trivedi et al., 2011; Tsutsumi et al., 1997 & Tsustsumi et al 1998) did not report their data in sufficient detail to be included in the meta-analysis. This included failure to report the post intervention means and standard deviations (or standard error). Another study was excluded from the meta-analysis as it did not use a control group (Legrand & Heuzé, 2007). Therefore data from four studies were included in the analysis of post-treatment outcomes (Brown et al., 1995; Chu et al., 2009; Dunn et al., 2005 & Singh et al., 2005).

All four studies used primary outcome measures of depression (see Table 1) with lower scores on all measures representing lower levels of symptoms. The four studies did not report secondary measures of anxiety consistently and therefore it was decided that there was not enough data to warrant a post-treatment effect estimate on anxiety symptoms.

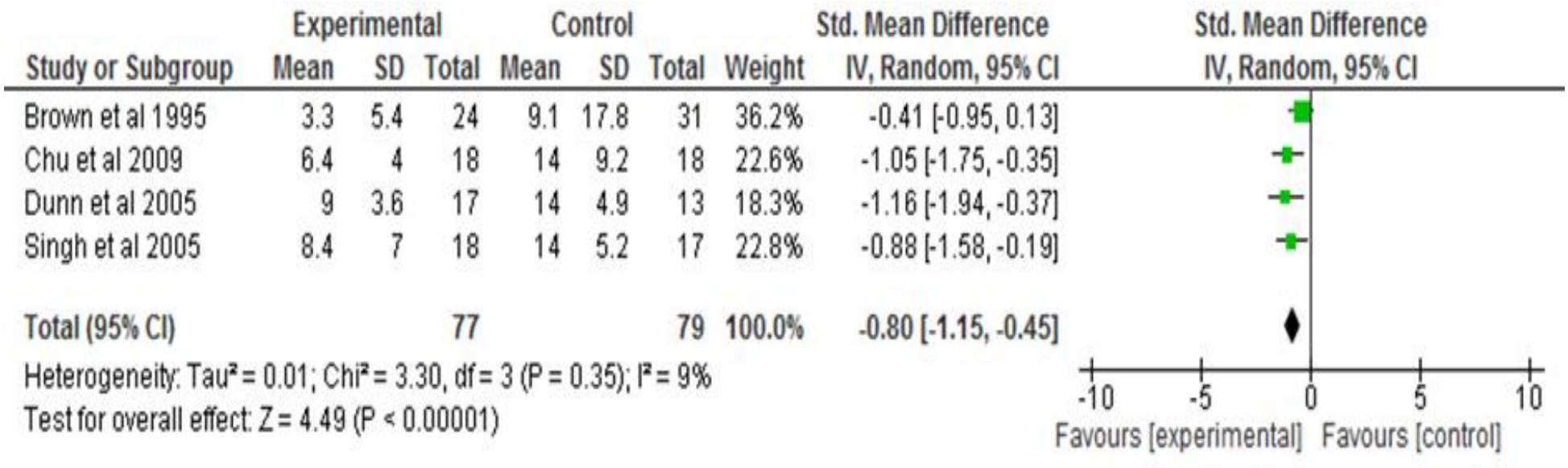
The analysis used standardised mean difference (Hedge's *g*) which transforms all effect sizes into a common metric, enabling the inclusion of different outcome measures in the same analysis.

The analysis used a random effects model as there was an assumption that the true effect size could vary from study to study depending on sources of heterogeneity. In particular, heterogeneity due to mixing 'healthy' participants and participants 'living with depression', and participants of different ages (Borenstein, Hedges, Higgins & Rothstein, 2009).

One study combined exercise with another intervention (Brown et al., 1995) and therefore only data from the moderate-intensity exercise, low-intensity exercise and control conditions were included in the analysis (excluding conditions that combined exercise with another intervention).

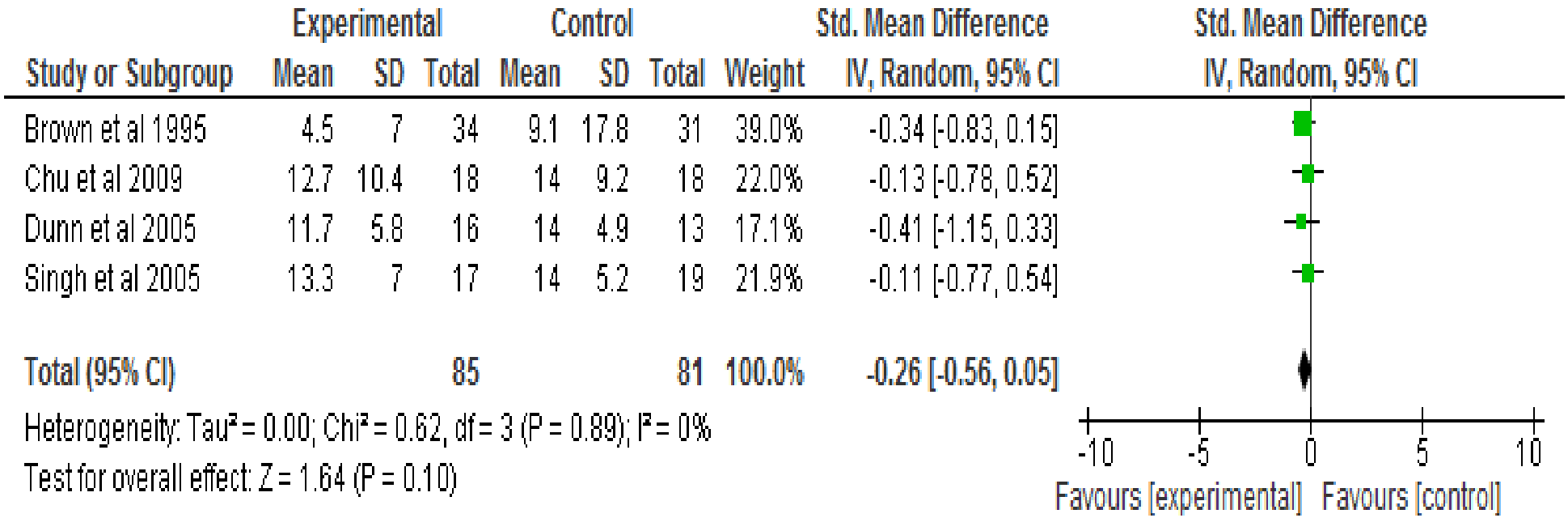
Comparison one: Post-treatment comparison of high exercise dose versus no exercise (control) on depressive symptomatology. It appeared that the effect of heterogeneity was non-significant (X^2 = 3.30; *df* = 3; *p* = 0.35; I^2 = 9%). Post-treatment there was a significant difference between high exercise dose and control for depressive symptomatology (*K* = 4, *n* = 156, *SMD (g)* = -0.80, *95% CI* [-1.15, -0.45], *p* < 0.00). See Figure 4 for forest plot.

Figure 4: *Forest plot (high exercise dose vs. control)*



Comparison two: Post-treatment comparison of low exercise dose versus no exercise (control) on depressive symptomatology. There was no evidence of heterogeneity (X^2 = 0.62; *df* = 3; *p* = 0.89; I^2 = 0%). Post-treatment there was no significant difference between lose dose exercise and control (*K* = 4, *n* = 166, *SMD (g)* = -0.26, *95% CI* [-0.56, 0.05], *p* = 0.10). There was a trend towards low exercise dose efficacy which nearly reached significance. See Figure 5 for forest plot.

Figure 5: *Forest plot (low exercise dose vs. control)*



Publication bias

Funnel plots were not prepared for either of the comparisons due to the small number of studies included in the analysis. It is advised that funnel plots should not be used when there are fewer than 10 studies in a meta-analysis because the test power is likely to be too low to distinguish chance from real asymmetry (Sterne et al., 2011). The implications of this are explored in the discussion.

DISCUSSION

The aim of this review was to investigate the dose-response relationship between exercise and symptoms of depression and anxiety. Twelve RCTs, with 1,419 participants, that compared at least two levels of exercise dose in the treatment of the symptoms of depression and anxiety were identified. Four studies, with 322 participants, that compared at least two doses of exercise to a control condition, were included in the meta-analysis. Both exercise at a high dose and a low dose was compared to no exercise (control) in two separate analyses. There was a significant post-intervention difference, favouring exercise at a high dose over control as a treatment for the symptoms of depression. However, there was no significant post-intervention difference between exercise at a low dose and control as a treatment for the symptoms of depression.

The findings tentatively suggest that higher doses of exercise produce greater responses, in terms of a reduction in depressive symptoms, compared to no exercise. Exercise at lower doses appeared to produce a smaller response which was not significantly different to no exercise. These findings support the dose-response relationship between exercise and depression which states that exercise is more effective when it is delivered in higher doses. The estimated Standardised Mean Difference between a high dose of exercise and no exercise was 0.80, which

could be interpreted as a large effect (Cohen, 1988). This is broadly in line with previous research that has estimated moderate to very large effect sizes for exercise, compared to no exercise.

It seems that dose affects the underlying mechanisms of physical exercise leading to greater improvement in mood. It could be the higher the doses of exercise are associated with increased chemical activity in the brain which has an antidepressant affect (Daley, 2008). Alternatively higher doses of exercise might be related to increased distraction from negative thoughts, greater mastery of one's own behaviour or more opportunities to receive positive reinforcement which in turn reduce feelings of depression (Daley, 2008). Currently there is no consensus on the precise mechanisms underlying exercise and future research could begin to investigate models of how higher doses of exercise affect these mechanisms of action.

Originally the review was set to investigate the dose-response relationship between exercise and symptoms of anxiety. Unfortunately this was not investigated by the meta-analysis as the symptoms of anxiety were not consistently reported using robust measures. Findings from the narrative review appear to suggest that exercise was associated with reductions of measures of anxiety symptomatology. However, there is still a need to investigate this association quantitatively. Therefore the question of whether higher doses of exercise leads to a greater reduction in anxiety remains unanswered and this could be addressed in the future when more data are available to researchers.

Although all studies investigated the effect of exercise dose on the symptoms of depression there were variations in the characteristics of the participants, exercise interventions and outcome measures included. Therefore a random effects model was applied to the analysis to take into account the likelihood of heterogeneity between the studies. Out of the four studies, three included only participants that

were living with depression and one study included only older adult participants. Neither of the analyses found any statistical evidence of heterogeneity, suggesting that there was low variability between the included studies. As heterogeneity appeared to be low it may imply that the observed difference between high dose of exercise and no exercise can be interpreted with greater confidence.

Out of the 12 studies included in this review 10 concluded that exercise was associated with significant improvements in the symptoms of depression compared to control and five of these studies concluded that higher doses of exercise appeared to be more effective than lower doses (Brown et al., 1995; Chu et al., 2009; Dunn et al., 2005; Legrand & Heuzé, 2007 & Singh et al., 2005). Only two studies concluded that they found no significant differences between any doses of exercise and control (King et al., 1993; Tsutsumi et al., 1998). Overall this appears in be in line with the findings from the meta-analysis that exercise, particularly at higher doses, is effective in reducing the symptoms of depression. It is also appears to be supportive of the proposed dose-response relationship between exercise and depression.

However, the two studies that concluded that exercise was not effective were excluded from the meta-analyses as they did not report their data in sufficient detail. It is possible that the exclusion of these two studies inflated the overall difference observed in the analyses. It is not known whether the inclusion of these two studies in to the analyses would have reduced the overall mean difference or the significance of the difference.

One of the studies that found no effect of exercise compared to control (King et al., 1993) also had the longest duration of any study included, lasting for 12 months (compared to the median of 12 weeks). This may suggest that exercise is less effective as a treatment for the symptoms of depression over a longer duration, casting some doubt on the effectiveness of exercise as a long term intervention for

depression. However, it should also be noted that this study included only participants who did not meet criteria for depression. Therefore it may be that in this group of 'healthy' participants exercise reduced depressive symptomatology to a lesser extent as levels of depressive symptomatology were already low at baseline, therefore restricting room for improvement.

The number of participants who completed the interventions was generally high (retention rates in the range of 70-100%). Adherence to exercise interventions was also generally high (in the range of 63-100%), with only one study reporting that adherence was significantly lower in the high dose intervention. Such rates are comparable, and perhaps even greater than, other established treatments for depression such as pharmacology. One review reported dropout rates in the range of 21-33% and adherence rates between 30 and 97% (median: 63%) for pharmacological treatments of depression (Pampallona, Bollini, Tibaldi, Kupelnick & Munizza, 2002). This suggests that exercise programmes, even at a high dose, are an acceptable form of treatment to the majority of participants. High adherence to treatment is important because it thought to correspond to greater responses. However, caution should be used when comparing retention and adherence rates in this review to rates reported in larger reviews which may report poorer rates. Furthermore, not all of the studies reported this information fully and future research should aim to report both retention and adherence rates and any significant differences in the rates between interventions.

Limitations

Although 12 studies were identified for inclusion only four of those studies, with 322 participants, were included in the analysis due to lack of sufficient data. Therefore the findings from the analysis should be interpreted with caution as there is an increased risk that the observed effects may be due to sources of bias rather than actual differences

In line with guidance from the Cochrane Collaboration this review used the Cochrane tool for assessing risk of bias as opposed to scales for assessing study quality and risk of bias which can be unreliable and are not supported by evidence (Higgins, Altman & Sterne, 2011). However, it was difficult to fully assess the risk of bias due to lack of sufficient information for many of the studies. For example, the majority of the studies did not report information on the randomisation process or whether allocation was concealed and if so how was this achieved. The majority of the studies used self-reported psychological outcomes and therefore blinding of outcome assessment was largely inappropriate. There were issues around incomplete data reporting (particularly of attrition rates) and selective data reporting (specifically primary aims not being reported in the results and discussion and reporting data in insufficient detail to be included in a meta-analysis). In addition, one study did not achieve the sample size required to detect a statistically significant effect (Legrand & Heuzé, 2007). More generally, the selection of studies into this meta-analytic review and the risk of bias assessment was conducted by only one researcher furthering the risk of potential bias. Overall, the risk of bias across the 12 studies remains unclear due to lack of clear reporting and these implications should be considered when interpreting the findings. This also gives some indication of the areas which future research could aim to address in their methodology.

This review did not produce funnel plots to investigate publication bias as it is not advised in meta-analyses where there are less than 10 studies. It has been suggested that in such cases there is no statistical solution that can be applied (Egger, Smith, Schneider & Minder, 1997). In addition, publication bias is more likely in studies with smaller sample sizes which can inflate the effect sizes estimated in meta-analyses. As this meta-analytic review included data from small *n* studies and did not use funnel plots to investigate bias it should be concluded that the risk of

publication bias in this review is unknown and as result its findings should be treated with caution.

Little is known about the long term effects of exercise as an intervention for the treatment of depression and anxiety. It is a significant limitation that the majority of studies in this review did not contain any follow-up measures and the only study to contain a follow-up reported the outcome in very brief detail (Moses et al., 1989). It makes the true effect of exercise hard to decipher compared to other comparative treatments for depression and anxiety such as pharmacology and psychological therapy, where follow-up data does exist and has been largely supportive of longer term effects (Cuijpers, Hollen, van Straten, Bockting, Berking & Andersson, 2013). In order to address this, future research should attempt to include follow-up measures to investigate whether exercise interventions have any beneficial long-term effects on psychological outcomes and whether participation in exercise is maintained after the end of the intervention.

Despite exercise appearing to be an effective intervention for improving the symptoms of depression, there was a lack of information regarding any risks associated with the exercise. Few of the studies reported information on the safety of participants, although those that did include this information did not report any adverse effects. The general lack of monitoring of adverse outcomes is concerning for a number of reasons. Firstly, many of the studies drew their sample from older adult populations where the risks associated with exercise may be greater, yet only one of these studies measured this. Singh et al (2005) did not find any adverse effects of exercise, compared to control. Secondly, this review found that higher doses of exercise were favourable to lower doses and to no exercise in the treatment of depression. However, this must be balanced against the increased risk of mortality associated with high-intensity exercise over a prolonged period of time (Guasch & Mont, 2014; Schnohr, O'Keefe, Marrot, Lange & Jensen, 2015). Whilst

there is no evidence to suggest that high-intensity exercise is detrimental to mental health, it may present a risk to physical health under some circumstances. This also represents a wider issue in psychological research, reflecting the need for greater monitoring of potential adverse outcomes of psychological treatments ('AdEPT: 'Understanding and Preventing the Adverse Effects of Psychological Therapies', n.d).

Conclusion

The narrative and statistical findings from this review suggest that physical exercise is effective at improving the symptoms of depression in both adults who are depressed and adults who are not experiencing depression. Furthermore, the analysis suggested that exercise at higher doses was more effective at reducing the symptoms of depression than exercise at lower doses, and no exercise at all. These findings appear to support the dose-response relationship between exercise and depression. However, even though this review used stringent inclusion and exclusion criteria, many of the studies still contained methodological limitations which may have increased bias and inflated effect size estimates. Therefore findings from this meta-analytic review should be interpreted with caution. Future research in this field should address the methodological limitations highlighted in this review and expand on the current research by investigating the longer term effects of exercise and the potential adverse outcomes that may be associated with exercise, particularly at higher doses.

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Part 2: Empirical paper

Combining mental imagery and implementation intentions to increase brisk walking in people with the symptoms of depression.

ABSTRACT

Background: Goal attainment can be increased by combining mental imagery and implementation intentions as they are thought to use similar cognitive mechanisms. However, there is evidence to suggest that the ability to generate mental imagery may be reduced in people experiencing the symptoms of depression.

Aim: The aim of this study was to investigate the extent to which people experiencing the symptoms of depression could generate prospective mental imagery about their implementation intentions in order to increase their goal attainment, specifically brisk walking.

Method: Sixty-five Students with the symptoms of depression were recruited to a web-based experiment and given the goal of increasing brisk walking. They were randomly assigned to one of three conditions; goal rehearsal (control), implementation intentions or implementation intentions plus mental imagery. Participants completed measures of brisk walking and symptoms of depression at baseline and after 7 and 14 days.

Results: Brisk walking increased ($\eta_p^2 = 0.18$) and depressive symptoms decreased ($\eta_p^2 = 0.33$) from baseline, with no significant differences between the conditions. The majority of participants in all conditions (94%) generated goal-related mental imagery and there were no differences between conditions on the quality, clarity or vividness of mental imagery.

Conclusion: It was tentatively concluded that being provided with a goal intention, a feature of all conditions, was sufficient to improve goal attainment, and there appeared to be no extra benefit of forming implementation intentions or combining implementation intentions with targeted mental imagery. However, it was possible that differences between conditions on measures of brisk walking and depressive

symptoms did exist but were not detected due to small sample size. Furthermore ‘research participation effects’ and natural fluctuations in brisk walking and mood were not controlled for as there was not a ‘no-intervention’ control group.

INTRODUCTION

Imagery and depression

Common psychological models of depression have tended to emphasise the role of verbal rather than imagery based cognitions. However, research has suggested that imagery based cognitions may have a more powerful impact on emotions than their verbal counterparts (Holmes & Matthews, 2005; Holmes, Lang & Deeprose, 2009). In particular, depression has been linked with the occurrence of intrusive negative imagery (e.g. Williams, Watts, MacLeod, & Mathews, 1988). A range of cognitive therapy interventions have been developed to address problematic imagery in emotional disorders, particularly interventions targeting intrusive negative imagery about past events. Cognitive techniques such as imagery rescripting have been applied across many disorders (Holmes, Arntz & Smucker, 2007). Imagery rescripting has been shown to be an effective stand-alone treatment for depression, demonstrating a large treatment effect (Brewin, Wheatley, Patel, Fearon, Hackmann, Wells, Fisher & Myers, 2009).

Whilst negative imagery may contribute to depression, less research has investigated the role of positive imagery. Holmes, Lang and Shah (2009) compared the effects of imagining positive events to thinking about them verbally. They found that increases in positive mood were greater in the imagery than in the verbal reappraisal condition. Holmes, Lang, Mould and Steele (2008) examined the relationship between dysphoric mood and the subjective experience of emotion in imagined events, specifically prospective imagery. They found that, compared to those with low levels of dysphoria, highly dysphoric individuals reported more vivid negative prospective imagery and less vivid positive prospective imagery. Holmes et al (2008) suggested that an imbalance between positive and negative imagery may reduce tendency for optimistic information processing. This might suggest that depression is not only associated with a surfeit of negative imagery but also deficits

in availability of positive imagery, particularly positive future-directed imagery. This has implications as positive imagery about the future has been linked with increased optimism which itself is associated with a range of physical and mental health benefits (Blackwell et al., 2013).

Cocude, Charlot and Denis (1997) found that people with depression generated less prospective imagery than a healthy control group but the two groups did not differ in the duration of images that were generated. This suggests that depression is associated with a reduction in the generation of imagery rather than a deficit in its maintenance.

There is a growing interest in the role of mental imagery, particularly prospective imagery, in clinical research. In a review of mental imagery measures, Pearson, Deeprose, Wallice-Hadrill, Burnett-Heyes and Holmes (2012) suggested that therapeutic strategies that address positive and prospective imagery could hold promise for innovations in the treatment of depression. They suggested that this should be a key area for further investigation by future research.

Imagery and goal attainment

In other areas of psychological research the role of imagery in goal attainment and behaviour change has been studied. This has involved encouraging individuals to form mental representations to simulate future goal-directed behaviour using a variety of senses. According to the theory of functional equivalence, mentally imagining an action is thought to be equivalent to actually performing that action (Finke, 1985). This may be because the neural processes involved in imagery and perception overlap and therefore imagined stimuli may be responded to as if it were real (Kosslyn, Ganis & Thompson, 2001; Ganis, Thompson & Kosslyn, 2004).

An early meta-analysis by Driskell, Cooper and Moran (1994) demonstrated moderate effect sizes for the effect of mental imagery on future performance of

goals. Imagining the process of undertaking a goal has been shown to improve the likelihood of future goal attainment (Pham & Taylor, 1999). Conway, Meares and Standart (2004) suggested that the ability to generate imagery about goals was a key process in the formation and attainment of goals.

Implementations intentions

Implementation intentions are another form of planning strategy that has been used to increase goal attainment (Gollwitzer, 1993). Implementation intentions have generally involved verbal statements about intentions related to goals. Specifically, they combine an intention to undertake a specific behaviour with information on when, where and how this will be implemented, otherwise known as 'IF-THEN' plans ('IF situation *X* arises THEN I will do behaviour *Y*'). Thus implementation intentions create a causal link between situational cues and goal-directed responses and it is this cue-response link which is thought to drive goal attainment (Gollwitzer, 1993; Gollwitzer, 1999). A meta-analysis by Gollwitzer and Sheeran (2006) revealed medium to large effect sizes of implementation intentions on goal attainment.

Libby, Shaeffer, Eibach and Slemmer (2007) demonstrated that prompting participants to mentally imagine their intentions elicited behaviour change, namely increasing voting. In a novel intervention Knäuper, Roseman, Johnson and Krantz (2009) demonstrated that implementation intentions combined with targeted mental imagery (imagining key elements of the implementation intentions) were related to higher rates of goal attainment than implementation intentions alone. In a follow up to this study Knäuper, McCollam, Rosen-Brown, Lacaille, Kelso and Roseman (2011) examined the effect of mental imagery when it was specifically targeted on key elements of implementation intentions on health behaviour (specifically fruit consumption). They demonstrated that, amongst low fruit consumers, consumption increased when mental imagery and implementation intentions were combined

compared to either strategy alone Knäuper et al (2011) proposed that combining mental imagery and implementation intentions capitalised on the mechanism through which each strategy has been shown to exert their efficacy, namely strengthening cognitive links between situational cues and goal directed behaviour (cue-response link). Therefore mental imagery and implementation intentions may facilitate goal attainment in a similar manner and their combined effect appears to be greater than their individual one. Furthermore it has been argued that, despite their traditionally verbal form, implementation intentions are mediated by an individual's ability to mentally imagine themselves behaving in a certain way in response to cues in the environment (Atance & O'Neill, 2001).

To date no research has investigated the extent to which people with the symptoms of depression are able to mentally imagine implementation intentions and how the proposed deficit in the generation of prospective imagery (Holmes et al., 2008) might interrupt this ability.

The effects of mild-to-moderate exercise on low mood

There is increasing evidence that exercise is helpful for people experiencing the symptoms of depression. Meta-analyses have reported medium to very large effect sizes of between .72 and 1.42 for exercise as a treatment for depression, relative to control conditions (Craft & landers, 1998; Stathopoulou, Powers, Berry, Smits, & Otto, 2006). The most recent Cochrane review of exercise for depression only included participants diagnosed with depression and reported a moderate effect (0.62) of exercise when compared to no treatment, with no significant differences between exercise and psychological therapy or pharmacological treatments (Cooney et al., 2013). The review recommended further research into the effects of exercise in people who do not meet the full diagnostic criteria for depression. The few meta-analyses that have investigated the effect of exercise using clinical versus non-clinical samples have reported that exercise is effective in reducing the symptoms of

depression in non-clinical samples. Although, as would be expected, the effect sizes are moderate (.50) and somewhat smaller than those found in the clinical population (North, McCullagh & Tran, 1990; Conn, 2010)

In line with these findings the Chief Medical Office (CMO) of the UK (2011) recommended that adults should get at least 150 minutes of exercise of moderate-intensity per week, noting the numerous benefits of regular physical activity including improving self esteem and reducing the symptoms of depression and anxiety. The CMO report included brisk walking as an example of an exercise with moderate-intensity. The NICE guidelines (2004) guidelines for depression have included exercise as a treatment for mild to moderate depression. A number of studies have demonstrated that brisk walking can be used as an efficacious intervention for improvements in physical health and mental health (Fisher, Li, Michael & Cleverland, 2004; Mier, Tanguma, Millard, Villarreal, Alen & Ory, 2011; Murphy, Nevill, Neville, Biddle & Hardman, 2002 & Tully et al., 2007). It has been suggested that the equivalent of 20 minutes of brisk walking a day is sufficient to improve public health and reduce mortality (Ekelund et al., 2015). A recent meta-analysis of walking as a specific type of physical activity intervention for depression and depressive symptoms reported and effect size of 0.86, concluding that walking has a large effect and is a promising treatment for depression (Robertson, Robertson, Jepson & Maxwell, 2012).

Present research

Research has demonstrated that practical behaviour change and goal attainment (e.g. voting, exercise, fruit consumption) can be increased through integrating implementation intentions and mental imagery. Implementation intentions involve planning the when, where and how to perform actions related to a specific goal or behaviour. This is similar to the process involved in prospective mental imagery, where the individual mentally simulates the steps they need to take to

complete certain behaviour or attain a goal. Since the generation of prospective mental imagery may be reduced in people with the symptoms of depression it may also reduce their access to implementation intentions in relation to goal-related behaviour. No research to date has investigated the effect of integrating implementation intentions and mental imagery in people with the symptoms of depression to increase goal attainment. In addition there is a general consensus that more research is needed to investigate exercise, in this case brisk walking, as an intervention for improving low mood. The aim of this study was to investigate the extent to which people with the symptoms of depression can generate prospective mental imagery and form implementation intentions in order to increase goal attainment and behaviour change. As the difficulty seems to be in the generation rather than the maintenance of imagery, aiding people with the symptoms of depression to generate prospective mental imagery targeted to the key elements of their implementation intentions may increase goal attainment.

This study predicted that targeting mental imagery to implementation intentions would increase goal attainment (brisk walking) above implementation intentions alone and a control condition (goal rehearsal), in people with the symptoms of depression.

The study also predicted that targeting mental imagery to implementation intentions would increase the generation of goal-related prospective mental imagery above implementation intentions alone and a control condition.

Finally, the study predicted that the targeting mental imagery to implementation intentions would lead to greater reductions in the symptoms of depression compared to implementation intentions alone and a control condition.

METHOD

Participants

Participants were UK University students recruited to a web-based study from two universities using online participant pools and by other means such as through targeted emails, adverts and posters.

Ethical approval

The study was recommended for Chair's action as it met the criteria for minimal risk (e.g. did not involve intrusive interventions, sensitive topics, deception of participants or working with vulnerable groups). Ethical approval was granted by the chairmen of the ethics committee's of University College London and the University of Bath, respectively (see Appendix 2 for ethics approval letter).

Measures

Participants in all conditions completed the same measures, in the same order.

***Patient Health Questionnaire - 2* (*PHQ 2; Löwe, Kroenke & Gräfe, 2005*).** The PHQ-2 is two item scale that measures the symptoms of depression over the past two weeks. It is a validated brief measure used to screen for the symptoms of depression. It contains two items scored from 0 to 3 (total range 0-6). Participants who scored ≥3 were considered eligible as this is the optimal cut-off score for detecting depression suggested by the authors. The authors reported good internal consistency of the measure (α = .83) and substantial correlations with other measures of depression, ranging from .67 to .87 (Löwe et al., 2005)

Mental imagery*:* Four items were designed to assess the extent, quality, clarity and vividness of the mental imagery generated by participants at baseline and were based on the measures used by Knäuper et al (2011). Participants were asked '*when setting the goal to increase your brisk walking did you imagine yourself doing*

this' (yes/no). They were then asked which one from five statements best described the quality of their image (from '*no image*' to '*perfectly clear and vivid image*'), with scores ranging from 0 to 5. Finally they were asked to rate how clear and how vivid their image was on two sliding scales (1-100). Internal consistency was measured using Cronbach's alpha (α = .59). These questions are presented in Appendix 3.

Intentions to brisk walk: Participants were given three statements about their intentions ('*I want to increase my brisk walking over the next two weeks'*, *'I intend to increase my brisk walking over the next two weeks'* and *'I plan to increase my brisk walking in the next two weeks')* and asked to rate them on a seven point likert scale (from '*I definitely do'* to '*I definitely don't'*). These questions were presented at baseline, one week follow-up and two week follow-up. The total score possible was 15 (range 0-15). Internal consistency was measured using Cronbach's alpha (α = .95). The questions are based on the measure of intentions used by Armitage (2007). These questions are presented in Appendix 4.

Godin Leisure-Time Exercise Questionnaire (LTQE; Godin & Shephard, 1997)*:* A modified version of the LTEQ was used to measure self-reported walking at baseline, one week follow-up and two week follow-up (the measure is presented in Appendix 5). Participants were asked on average, how many times per week they walked for more than 15 minutes at three different intensity levels: strenuous walking, moderate (brisk) walking and mild (casual) walking. Each intensity level had a drop down menu so that participants could indicate the number of episodes they had completed, ranging from 0 to 20. The authors reported two week test-retest coefficients of .94, .46 and .48 for the strenuous, moderate and mild categories respectively (Godin & Shepard, 1997). Scores from the LTEQ can be computed for weekly exercise activity in terms of METs (metabolic equivalents), which indicates an individual's resting metabolic rate. The number of episodes was multiplied by a constant given to each level of intensity (Strenuous = 9, Moderate = 5, Mild = 3) and

then summed to give each participant a METs per week score. In addition, participants were also asked '*how often, during the last week, have you engaged in any walking long enough to work up a sweat and increase your heart rate? (Often, Sometimes, Rarely/ Never)*. Only results in the units of METs are reported for the LTEQ.

Hospital Anxiety Depression Scale - depression sub scale (HADS; Zigmond and Snaith, 1983): This is a robust measure of depression that has been validated within the general population and has been shown to be sensitive to changes in response to psychotherapeutic and psychopharmacological intervention (Zigmond & Snaith, 1983; Snaith, 2003). There is also evidence that the depression and anxiety sub-scales are independent of each other and can be used separately. The depression sub scale contains 7 items, each scored 0 to 3 (total range 0-21). At present there is generally no single cut-off score for the HADS, however, it has been demonstrated that a cut-off score of ≥8 has sensitivity and specificity of approximately 0.80 respectively (Bjellhand, Dahl, Haug & Neckelmann, 2002; Herrmann, 1997). Therefore a cut off score of ≥8 was used to identify participants in the sample that met 'caseness' for depression. A review of the HADS reported Cronbach's alpha for the depression sub-scale varied from .67 to .90 (mean .82) and a correlation of .60 with other depression measures in common use (Bjellhand et al., 2002). This measure was presented at baseline, one week follow-up and two week follow-up.

Spontaneous use of imagery scale (SUIS; Reisberg, Pearson & Kosslyn, 2003): The *SUIS* was presented at baseline to measure individual differences in the tendency to use imagery in everyday life. This questionnaire consists of 12 items with each item rated on a 5-point scale, 1 to 5 (total range 12-60). A review of the psychometric properties of the *SUIS* reported that the measure had good internal consistency (Cronbach's alpha in the range of .72 to .76) and

correlated with other commonly used measures of imagery (correlations in the range of .35 to .38) (Nelis, Holmes, Griffith & Raes, 2014).

Behavioural Regulation in Exercise Questionnaire - second edition (BREQ; Mullan, Markland and Ingledew (1997)*:* This scale was presented at baseline to measure levels of autonomous motivation and controlled motivation. It contains 18 items each scored from 0 to 4 (total range 0-72). It has been suggested that autonomous motivation is a stronger predictor of behaviour than controlled motivation (Biondolillo & Pillemer, 2014) and therefore only the intrinsic sub-scale was used in the analysis (total range 0-16). The authors reported good internal consistency for this sub-scale (α = .86). It was included to investigate whether there were pre-intervention differences in motivation to exercise between conditions.

Design and Conditions

The study employed a mixed design with condition (control, implementation intention and implementation intention plus mental imagery) as the between-subject factor and time (baseline, one week follow up and two week follow up) as the within-subject factor. Brisk walking and depressive symptoms were the main outcomes measured at each time point.

Participants in all conditions were given the same goal intention; '*your goal is to increase your amount of brisk walking over the next two weeks (fourteen days)*'. According to randomisation the goal was then simply rehearsed, framed within implementation intentions or framed within implementation intentions and combined with mental imagery.

Goal rehearsal condition (control)*:* Participants were asked to rehearse the goal (to increase brisk walking) by typing it three times into a free-text space provided in the questionnaire. Other than the rehearsal of their goal, participants were not provided with an explicit plan making strategy. They were then asked to

watch a brief video of someone brisk walking and were given with some verbal instructions by the narrator to aid them in goal rehearsal, e.g. '*Think about going for a brisk walk during a typical day*'.

Implementation intention condition (II): As with the goal rehearsal condition, participants were asked to type the goal into free-text space provided three times. In addition, participants were given information on making implementation intentions in relation to their goal, by forming '*IF-THEN*' plans (Knäuper et al., 2011). Participants were given an example ("*IF I need to go to the store, THEN I will brisk walk there and back*") and were then asked to make three '*IF-THEN'* plans in relation to the goal and type them into the free-text space provided. They were then asked to watch a brief video of someone brisk walking and were then given verbal instructions by the narrator to aid their implementation intentions, e.g. '*think about the situation where you are most likely to go for a walk'.*

Implementation intention plus mental imagery condition (II + MI)*:* Participants were given the same instructions as in the implementation intentions condition. They were then asked to watch a brief video of someone brisk walking and were then given verbal instructions by the narrator to aid them in the generation of 'multi-sensory' mental imagery targeted to their implementation intentions, e.g. '*please use all of your senses to imagine your walk…imagine where you are going on your walk*'

Brisk walking video: All participants were asked to watch a video of someone brisk walking (briefly described above), whilst a narrator presented brief information (with subtitles) about brisk walking. After this the footage faded to black and the narrator gave verbal instructions that were specific to randomisation. The verbal instructions were subtitled in large white lettering, presented over a black background. The instructions were given to aid participants in their goal rehearsal, formation of implementation intentions or generation of mental imagery targeted to

the implementation intentions. The verbal instructions in each condition were matched as closely as possible (ranging from 200 to 230 seconds in duration and from 240 to 255 words in length). Transcripts of the instructions, for all conditions, are presented in Appendix 6.

Procedure

Inclusion criteria: Participants were asked to take part in the study if:

- They were aged 18 or over and were current students at a UK university.
- They currently exercised less than twice a week (below national guidelines from CMO).
- Did not have any physical health conditions that prevented them from exercising.
- They agreed to take a short eligibility screening questionnaire.

Participants who signed up through the online participant pools were automatically provided with a web-link to the online experiment. Participants who were recruited through posters were invited to contact the researcher who then emailed them a web-link to the experiment (recruitment aides are presented in Appendix 7). They were asked to read a participant information sheet and to undertake a short eligibility screen (participant information and consent form are presented in Appendix 8 and 9). It was explained that by agreeing to undertake the eligibility screening they were consenting to participate in the research. This eligibility screening involved administering the Patient Health Questionnaire 2 (PHQ2).

Eligible participants were invited to take part in the study and asked to complete a battery of demographic questions (age, gender, ethnicity, level of study). They were also asked to provide a university email address (ending in *ac.uk*) which

was used as correspondence for follow up questionnaires and to verify that they were a current student at a UK university.

Participants were then asked to read some brief standardised information about brisk walking. The information read: '*Brisk walking is defined as walking at a faster pace than is normal, as if you were late for a lecture, but not running. You should notice that your heart rate is increasing and you are breathing more heavily, perhaps breaking into a light sweat. However, you should not feel completely breathless and should still be able to hold a conversation with someone you might be walking with'*.

All participants were provided with the goal intention to increase their amount of brisk walking over the following two weeks. Subsequently they were randomly assigned, using a computerised block randomiser, to one of three conditions.

After all participants had watched the brisk walking video and followed instructions that were specific to randomisation they were asked to complete a number of measures (in the same order that they are presented in the *measures* section).

Finally, participants in all conditions were asked to complete a questionnaire, after 7 and 14 days that was emailed to them and completed online. Both follow-up questionnaires contained the same battery of measures. Participants were asked to answer questions about their mood (HADS), the amount of brisk walking they had done over the last week (LTQE) and their intentions to increase their brisk walking. Upon completion of the second follow-up questionnaire (14 days) participants were fully debriefed as to the purpose of the research and invited to contact the researcher with any questions. Participants who provided data at all three times points were entered into a prize draw to win one of six prizes in the form of vouchers as a reward for their participation.

Statistical Analysis

Using a repeated measures mixed (within – between factors) design a G*Power calculation (Faul, Erdfelder, Lang & Buchner, 2007) with α level set at .05 and β level set at .80 estimated that a sample of 102 participants would be required to detect a small effect size (d= .02). However, this sample size estimate was increased by 50% to 152 participants in order to take into account the high drop-out usually found in internet based studies (Murray, et al., 2009).

The following steps were taken to analyse the data according to the study's hypothesis:

1) ***Manipulation check***: A series of Kruskal-Wallace tests were carried out investigate whether there were any differences between conditions in the quality, clarity and vividness of mental imagery generated.

2) ***Brisk walking***: A repeated measures ANOVA with METs at time one, time two and time three as the within subject factor and condition as the between subject factor was carried out to investigate whether changes in brisk walking were related to condition.

3) ***Symptoms of depression***: A repeated measures ANOVA with HADS score at time one, time two and time three as the within subject factor and condition as the between subject factor was carried out to investigate whether changes in the symptoms of depression were related to condition.

4) ***Relationship between dependent variables and changes in brisk walking and symptoms of depression***: A correlational analysis was undertaken to compare dependant variables measured at baseline (level of brisk walking, symptoms of depression, spontaneous use of imagery and motivation to exercise) with changes in brisk walking and depressive

symptoms. A Pearson's correlation was computed between MET change scores (time 3 – baseline), HADS change scores (time 3 – baseline), baseline MET score, baseline HADS score, SUIS and BREQ II.

RESULTS

271 participants took the eligibility screening; 67 (24.72%) participants scoring ≥ 3 on the PHQ2 were eligible to take part in the study.

Two participants from the II + MI condition were excluded from the study as they reported that they were unable imagine themselves walking briskly.

Therefore 65 participants provided their data at time one, 45 provided data at time two (retention rate = 69.23%) and 43 provided data at time three (retention rate = 66.15%).

Participants were randomly allocated to one of three conditions; goal rehearsal (control: *n* = 23), implementation intentions (II: *n* = 21) or implementation intentions plus mental imagery (II + MI: *n* = 21).

Where data was lost to follow-up, an intention-to-treat model was used and the last recorded value was carried forward for missing outcome variables. Therefore data from 65 participants were used in the analysis.

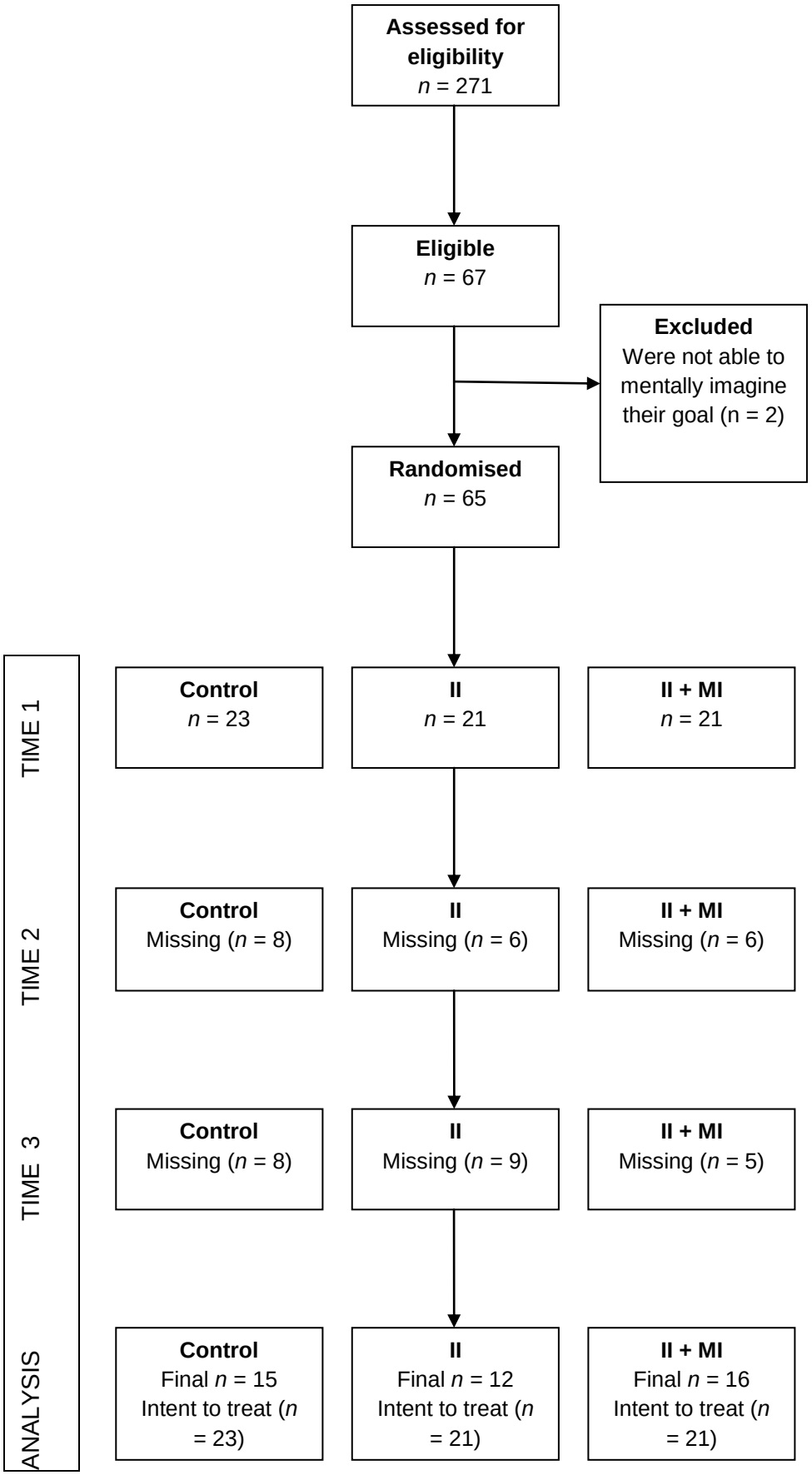

Figure 1:*TREND diagram of the randomised recruitment process.*

Data Preparation

All variables were evaluated against the assumptions of parametric testing and variables were examined separately for the three conditions and for all time points.

Visual examinations of boxplots for MET values (measuring brisk walking) indentified two high scoring outliers in the control condition and one in the II + MI condition at baseline, one high scoring outlier for each of the three conditions at time two and one high scoring outlier in the II and two in the MI + II condition at time three. These scores were changed to the mean plus two standard deviations. All of the MET variables were non-normal (MET at baseline: $D(65) = 0.15$, $p = .001$, MET at time 2: $D(65) = 0.13$, $p = .008$, MET at time 3: $D(65)$, $= .15$, $p = .001$) as assessed by a series of Kolmogorov-Smirnov (K-S) tests. They were therefore log transformed which corrected skewness and kurtosis (K-S tests = $p > 0.05$). The analyses were conducted on transformed values but the untransformed values are reported in the results, where relevant, for clarity.

Age and Intention to exercise values (at all 3 time points) were also not normally distributed. The values were log transformed but this did not improve distribution as assessed by K-S tests; age of participants, $D(65)$, $= 0.22$, $p = .000$, and intentions at baseline, $D(65)$, $= .26$, $p = .000$, intentions at time 2, $D(65) = .29$, $p = .000$, and intentions at time 3, $D(65)$, $= .20$, $p = .000$. Therefore non-parametric tests were used with these variables.

All other variables were normally distributed, without high scoring outliers (K-S tests = $p > 0.05$).

All variables were assessed for homogeneity of variance using the Levene's tests, which indicated equal variances ($p > 0.05$).

Demographic Information

Demographic information for participants in all three conditions is presented in Table 1. There were no significant differences between conditions on any of the demographic variables (examined using a series of Kruskal-Wallace tests). All results were rounded to two decimal places.

Table 1: *Participant demographics*

	Control (*n*=23)	**II (*n*=21)**	**II + MI (*n*=21)**	**Statistic**	**p value**
Age: M (SD)	21.22 (3.46) Range: 18 – 31	21.90 (4.13) Range: 18 – 36	21.33 (5.02) Range 18 - 41	*H* = .76	= .68
Gender: *n* (%)				*H* = .27	= .88
Male	8 (35%)	6 (28%)	6 (28%)		
Female	15 (65%)	15 (72%)	15 (72%)		
Ethnicity: *n* (%)				*H* = 1.34	= .51
White European	13 (57%)	7 (33%)	7 (33%)		
White Other	1 (4%)	3 (14%)	2 (10%)		
Asian British/ Other	5 (22%)	6 (29%)	11 (52%)		
Black British / Other	-	1 (4%)	-		
Mixed	3 (13%)	2 (10%)	-		
Other	1 (4%)	2 (10%)	-		
Prefer Not to Say	-	-	1 (5%)		
Level of study: *n* (%)	-	-	-		
Undergraduate	18 (78%)	15 (71%)	14 (67%)	*H* = .87	= .65
Post graduate (Masters)	5 (22%)	5 (24%)	6 (28%)		
Postgraduate (Doctorate)	-	1 (5%)	1 (5%)		

Note: *H* = Kruskul-Wallace test statistic.

Baseline differences

One-way ANOVA or Kruskul-Wallace tests were used to investigate differences between conditions on variables of interest measured at baseline. There were no significant differences between measures of brisk walking (MET), symptoms of depression (HADS), intentions to brisk walk (Intentions), spontaneous use of imagery (SUIS) or motivation to exercise(BREQ II) between the conditions at baseline (see Table 2).

Table 2: Baseline comparisons

	GR (n=23) M (SD)	**II (n=21) M (SD)**	**II + MI (n=21) M (SD)**	**Statistic**	***p* value**
MET	1.71 (0.38)	1.68 (0.35)	1.66 (0.36)	*F* = .12	*P* = .88
HADS	8.30 (4.00)	9.05 (3.15)	8.76 (2.21)	*F* = .30	*P* = .74
Intentions	11.91 (3.48)	13.19 (2.11)	13.24 (3.20)	*H* = 3.77	*P* = .15
SUIS	41.00 (7.39)	38.50 (7.15)	38.57 (8.45)	*H* = 1.31	*P* = .52
BREQ II	6.48 (3.85)	5.95 (3.98)	7.57 (2.87)	*F* = 1.09	*P* = .34

Note. MET = Metabolic Equivalence (log values), HADS = Hospital Anxiety and Depression Scale (Depression sub-scale only), Intentions = Intentions to brisk walk over the next two weeks, SUIS = Spontaneous Use of Imagery Scale, BREQ II = Behavioural Regulation in Exercise Questionnaire (Intrinsic sub-scales).

Manipulation check: Goal rehearsal

Twenty one participants appeared not to have followed the instructions given to all participants, to type the goal intention three times into the free-text boxes. The primary analysis was repeated with these participants excluded (see *sub-group analysis*).

Manipulation check: Implementation intentions

All participants in the II and II + MI conditions followed instructions to form implementation intentions, i.e. made three '*IF-THEN'* plans and typed them into the free-text box, (*n* = 42).

Manipulation check: Mental imagery

There were no significant differences between conditions on the quality of mental imagery participants generated, *H*(2), = 1.21, *p* = .55, the clarity of mental imagery participants generated, *H*(2), = .48, *p* = .79, or the vividness of mental imagery participants generated, *H*(2), = 1.10, *p* = .58. This indicated that condition did not affect the quality, clarity or vividness of mentally imagery generated by participants.

Group comparisons: Brisk walking (METs)

The primary hypothesis was that the difference between measures of brisk walking (MET) at time one, time two and time three would be greater in participants in the II + MI condition compared to participants in the other conditions (control and II). Means and standard deviations for measures of brisk walking across condition and over time are presented in Table 3.

Table 3: *Means (and standard deviations) for measures of brisk walking (MET) across condition and over time*

	Time 1	**Time 2**	**Time 3**
	M (SD)	**M (SD)**	**M (SD)**
Goal rehearsal (Control)	70.66 (56.05)	82.57 (56.02)	81.13 (58.08)
Implementation intentions	61.43 (37.71)	82.24 (54.78)	89.48 (65.23)
Implementation intentions plus mental imagery	63.00 (57.68)	80.71 (54.01)	89.67 (62.72)

Note: MET = Metabolic Equivalence, data is presented in original (untransformed) format.

The assumption of sphericity was not met ($X^2(2) = 15.10$, $p = .001$) and therefore the Greenhouse-geisser correction was used to interpret the results. There was a significant main effect of time indicating that when all three conditions were combined brisk walking increased from time 1 to time 3, $F(1.64, 101.71) = 13.39$, $p < .000$. Planned comparisons indicated that there was a significant difference between time one and time two ($p = .000$), a significant difference between time one and time three ($p = .000$) but not between time two and time three ($p = .62$). There was no significant main effect of condition (control, II, II + MI) indicating that participants in the three conditions did not differ in measures of brisk walking averaged across the 3 time points, $F(2, 62) = .021$, $p = .98$. There was no interaction between time and condition, $F(3.28, 101.71) = .677$, $p = .58$. This indicated that the difference on measures of brisk walking between time one, time two and time three was not greater in the II + MI condition as hypothesised.

Group comparisons: Symptoms of depression (HADS)

The secondary hypothesis was that the difference on measures of the symptoms of depression (HADS) between time one, time two and time three would be greater in participants in the II + MI condition compared to participants in the other conditions (control and II). Means and standard deviations for measures of depression across condition and over time are presented in Table 4.

Table 4: *Means (and standard deviations) for measure of depression (HADS) across conditions and over time.*

	Time 1	**Time 2**	**Time 3**
	M (SD)	**M (SD)**	**M (SD)**
Goal rehearsal (Control)	8.30 (4.00)	6.57 (4.04)	6.30 (3.97)
Implementation intentions	9.05 (3.15)	6.81 (3.70)	6.48 (3.91)
Implementation intentions plus mental imagery	8.76 (2.21)	5.76 (3.22)	5.71 (3.62)

Note: HADS = Hospital Anxiety and Depression (Depression sub-scale).

The assumption of sphericity was not met ($X^2(2) = 25.18$, $p = .000$) and therefore the Greenhouse-geisser correction was used to interpret the results. There was a significant main effect of time indicating that, when all three conditions were combined, the symptoms of depression decreased from time one to time three, $F(1.50, 92.66), = 30.38$, $p = .000$. Planned comparisons indicated that there was a significant difference between time one and time two ($p = .000$), a significant difference between time one and time three ($p = .000$) but not between time two and

time three (p = .38). There was no significant main effect of condition, $F(1, 62) = .254$, $p = .77$, and no significant interaction between time and condition on measures of the symptoms of depression, $F(3, 92.66) = .603$, $p = .61$. This indicated that the difference on measures of the symptoms of depression between time one, time two and time three was not greater in the II + MI condition as hypothesised.

Sub group analysis

A sub-group analysis was undertaken with data removed from participants who did not appear to follow instruction in to rehearse the goal intention ($n = 21$), leaving a sample size of 44 (Control: $n = 17$, II: $n = 13$, II + MI: $n = 14$). The results remained the same i.e. there was no effect of condition over time on brisk walking or depressive symptoms.

Relationship between dependent variables and changes in brisk walking and symptoms of depression

The correlations are presented in Table 5. Overall change in brisk walking was negatively correlated with the overall change in depressive symptoms, $r = -.384$, $p = .001$. Baseline brisk walking was negatively correlated with overall change in brisk walking, $r = -.534$, $p = .000$ and baseline depressive symptoms were also negatively correlated with overall change in depressive symptoms, $r = -.350$, $p = .002$. Intrinsic motivation was positively correlated with brisk walking at baseline, $r = .256$, $p = .020$ but negatively correlated with overall change in brisk walking, $r = -.269$, $p = .016$. Intrinsic motivation was negatively correlated with depressive symptoms at baseline, $r = -.303$, $p = .007$ but positively correlated overall change in depressive symptoms, $r = .263$, $p = .018$.

Table 5: *Correlations between baseline measures and changes in brisk walking and depressive symptoms.*

	1	2	3	4	5	6
1. MET change	-					
2. HADS change	-.384**	-				
3. MET baseline	-.534**	.135	-			
4. HADS baseline	.022	-.350**	-.125	-		
5. SUIS	.220	.079	-.174	-.198	-	
6. BREQ II	-.269*	.263*	.256*	-.303*	.036	-

Note: * denotes significance at $p < .05$ (one-tailed), ** denotes significance at $p < .01$ (one-tailed).

DISCUSSION

This study investigated the extent to which combining targeted mental imagery with implementation intentions improved goal attainment in people currently experiencing the symptoms of depression. It was predicted that participants who mentally imagined their implementation intentions (II + MI condition) would perform more brisk walking compared to participants only forming implementation intentions (II condition) or mentally rehearsing the goal (Control condition). The results indicated that brisk walking increased over a two week period, with a significant increase between baseline, time two and time three and a non significant increase between time two and time three, across all conditions. Therefore neither forming implementation intentions (II condition) nor combining them with mental imagery (II + MI) appeared to increase brisk walking beyond simple goal rehearsal (control).

Previous research has suggested that individuals with depression may have a reduced ability to generate prospective mental imagery. Therefore it was predicted that, in this sample of individuals experiencing the symptoms of depression, generation of mental imagery would be highest in the II +MI condition. The vast majority of participants (94%) reported that they generated mentally imagery about their goal intention (to brisk walk), regardless of condition. A series of manipulation checks indicated that participants in the three conditions did not differ in terms of the quality, clarity or vividness of the mental imagery they generated. Therefore it appeared that mental imagery was not highest in the II + MI condition as expected, and that simply mentally rehearsing the goal (with no explicit instruction to use imagery) was sufficient for participants to generate mental imagery about their goal intention. Targeting mental imagery to implementation intentions did not appear to increase the quality, clarity or vividness of the mental imagery generated.

The study also measured participant's self-reported symptoms of depression, using the Hospital Depression and Anxiety Scale (HADS). At baseline 44 (67.68%) participants met 'caseness' for depression using the HADS, compared to 25 (38.46%) at time two and 23 (33.38%) at time three. Participants in all conditions reported a significant reduction in the symptoms of depression from baseline to time two and time three, but not from time two to time three. This mirrored the pattern of findings for brisk walking. Previous research has suggested that exercise, including walking, can improve mood (Cooney et al., 2013; Robertson et al., 2012). This study found an association between brisk walking and the symptoms of depression and it appeared that as brisk walking increased the symptoms of depression reduced. It also appeared that higher motivation to exercise was associated with higher baseline levels of brisk walking but smaller changes (pre-post) in brisk walking, perhaps due to a ceiling effect. In addition, higher motivation to exercise was also associated with lower symptoms of depression at baseline and greater changes

(pre-post) in depressive symptoms. Taken together the findings appear to confirm that there is a relationship between brisk walking and symptoms of depression and this relationship may be influenced by an individual's motivation to exercise.

Previous research has suggested that the formation of implementation intentions is an effective method for increasing goal attainment and changing behaviour (Gollwitzer, 1999). Targeting mental imagery to implementation intentions has been shown to increase its effectiveness (Knäuper et al., 2009, Knäuper et al., 2011). However, findings from this study suggest that neither implementation intentions nor targeting mental imagery to implementation intentions increased goal attainment above control. It is possible that goal attainment may have been improved by factors that were not specific to the experimental conditions (e.g. being given a goal intention and watching a video demonstration of the target-goal). It is feasible that these factors were sufficient to increase the salience of the goal intention which has been shown improve goal attainment, independent of implementation intentions (Gollwitzer, 1999). Furthermore, participants in all conditions reported generating mental imagery about the goal. Previous research has suggested that imagining oneself carrying out behaviour involves the same underlying processes as actual performance (Kosslyn et al., 2001; Ganis et al., 2004). Therefore it is possible that mentally imagining the goal was equivalent to undertaking the actual behaviour which may have acted as a plan making strategy that improved later goal attainment, independent of implementation intentions.

Previous research (Cocude et al., 1997; Holmes et al., 2008) has suggested that people with depression may have a reduced ability to generate prospective mental imagery (PMI). All participants completed a trait-measure of the use of imagery in everyday life (SUIS) with a combined mean of 39.4. This was in line with SUIS means calculated from other studies using non-clinical samples ranging from 36.4 to 40.8 (Nelis et al., 2014). In addition, the majority of participants appeared

able to generate PMI about the goal (to increase brisk walking) with no differences in the quality, vividness or clarity of PMI between conditions. Much of the previous research into the relationship between depression and mental imagery has involved participants with clinical depression whereas this study included participants who were experiencing some of the symptoms of depression but not necessarily meet the clinical criteria for depression. This may suggest that the reduction in the ability to generate PMI, as observed in previous studies, is associated with more severe depressive symptoms. The current study is the first to investigate the relationship between the symptoms of depression and goal-related PMI rather than general PMI. The findings from this study appear to suggest that people experiencing the symptoms of depression mood can generate PMI related to their goals. There appeared to be no extra benefit of targeting mental imagery to implementation intentions, perhaps suggesting that participants naturally generated goal-related PMI in all conditions.

Sixty five participants started the study and 45 participants provided their data at time two and 43 at time three, giving retention rates of 69.23% and 64.15%, respectively. High drop-out rates are common in online studies (Murray et al., 2009) and the appearance, order, relevance and length of online questionnaires all seem to be important in increasing response (Murray, White, Varagunam, Godfrey, Khadjesari & McCambridge, 2013). There may be several reasons for the higher than expected retention rate in this study. First, participants were offered an incentive to complete the study and this has been associated with higher retention rates (Booker, Harding & Benzeval, 2011). Second, all instructions and questions were kept as brief as possible, avoiding unnecessary detail, in order to reduce attrition. Third, research has suggested that the salience of an issue to an individual is associated with higher responses (Cook, Heath & Thompson, 2000). This study explicitly targeted individuals who were sedentary but wanted to increase their levels

of exercise and therefore this research may have been highly salient to participants, increasing response and retention. Overall, the retention rates observed in this study appear to support the efficacy of the internet as a method of delivering interventions aimed at behaviour change.

Limitations

The primary limitation of the current study was the small sample size. A power analysis estimated that a sample of size of 102 participants would be required to detect a small effect size. The observed power of the condition by time interactions for brisk walking (β = .20) and depressive symptoms (β = .20) were below .80 and therefore sufficient power may have not been achieved to detect interactions that may have existed. As such we cannot confidently conclude that there was no effect, particularly a small effect, of condition on measures of brisk walking and depressive symptoms between groups. This limitation could be overcome by replicating the study with a larger sample size and therefore increasing the statistical power.

Increases in brisk walking and reductions the symptoms of depression were observed in all conditions. Therefore, it is suggested that factors that were present in all conditions, as opposed to condition specific factors, may have been responsible for this. One explanation may be that participant's awareness that they were being studied impacted on their behaviour, known as the Hawthorne effect (Sedgwick, 2010). Although the underlying mechanism may not be fully understood there is evidence that participating in research can alter self-reported behaviour (McCambridge, Witton & Elbourne, 2014). For example, simply answering questions about a behaviour has been shown to subsequently alter self-reports of that behaviour (McCambridge & Kypri, 2011). This is known as the 'research participation effect' (RPE) and there is a growing consensus that impact of RPE may have been overlooked (McCambridge, Kypri & Elbourne, 2014). As this study did not

employ a ‘pure’ control condition, where participants did not receive an intervention and were not asked any questions about the target behaviour, it is difficult to rule out the impact of the RPE. Without a ‘pure’ control group the impact of natural fluctuations in brisk walking and mood, independent of the intervention, can also not be ruled out.

The use of self-reported measure of brisk walking was a potential limitation of this study. Previous research comparing self-reported measures of walking with objective measures (e.g. pedometer) and did not find a relationship suggesting participant’s self-report of walking was inaccurate (Scott, Eves, French & Hoppë, 2007). The researchers also suggested structured interviews were superior to self-reported measures of walking. As this study was conducted online it was not possible to provide participants with pedometers or to conduct structured interviews with participants. A modified version of LTEQ questionnaire was used because it is a short, four item scale with good psychometric properties that is freely available. In addition, the questions can be summed to produce a single exercise outcome, metabolic equivalents (METs). The LTEQ has been correlated with objective levels of activity, as monitored by a portable motion sensor (Miller, Freedson & Kline, 1994). In this study there appeared to be tendency for participants to report large values on the LTEQ, contributing to non normal distribution. Previous research using a student sample also found the LTQE to be prone to outliers (Biobdolillo & Pillemer, 2014). Future research may want to consider the accuracy of the LTQE, particularly the presence and impact of outliers, when using this measure as a proxy for behaviour change.

Twenty one participants did not follow the instructions to rehearse the goal intention, although this did not appear to have any impact of goal attainment or depressive symptoms. This raises questions about how researchers can try to reduce missing data and ensure participants adhere to the procedure in web-based

research. It is suggested that the data quality from web-based research could be improved by minimising the use of free-text, using drop down or forced-choice options and restricting the ability to proceed until mandatory questions have been answered (Murray et al., 2009). Where appropriate, this study attempted to incorporate these suggestions into its design. However, free-text space was needed for participants to retype, and therefore rehearse, the goal intention. Unfortunately, there was no way of ensuring that participants used the free-text space as instructed, resulting in low adherence to the instructions. Whilst steps were taken to improve adherence to instructions, the remoteness of web-based research may reduce fidelity (and increase sources of 'noise'), making it more difficult to detect differences that might have existed in the sample.

Implications

The vast majority of research into implementation intentions has been undertaken with non-clinical samples. In the first meta-analysis to investigate the effect of implementation intentions on goal attainment among people with mental health, the researchers observed a large effect and concluded that they are a useful strategy for improving goal attainment in people with mental health problems (Toli, Webb & Hardy, 2015). Findings from the current study of individuals experiencing the symptoms of depression suggested that forming implementation intentions did not appear to improve goal attainment beyond control. There is a consensus that most of the research into implementation intentions has been undertaken with a homogeneous sample of students without mental health problems and that more research is needed to investigate the effectiveness of implementation intentions as a method of improving goal attainment in individuals with depression and other mental health problems.

Interventions such as implementation intentions have been designed for '*paper-pencil'* completion and it is possible that a change in the mode of delivery,

such as online administration incorporating visual and auditory features, may change the underlying psychological mechanisms (Murray et al., 2009). This was one of the first studies to administer implementation intentions online and it appeared that they did not improve goal attainment, compared to control. More research is needed to investigate whether a change in the mode of delivery, specifically using the internet, affects the effectiveness of interventions such as implementation intentions.

Overall the study appears to support the internet as a method for improving goal attainment and changing behaviour. However, there is a debate concerning the accessibility of web-based interventions (Murray, 2012). One view is that they can reduce health inequalities by opening up access to health information that was previously only accessible by health care professionals. Conversely others have argued that web based interventions could increase health inequalities as they may not be accessible for the most vulnerable groups in society e.g. homeless people, older people and people experiencing poverty. This study used a student sample which may have differed from the general population in some important ways e.g. greater access to computers and the internet, higher level of computer literacy and more leisure time to participate in research. It is important to consider whether web-based interventions can be generalised to the wider population and how accessible they may be to the members of society who are most at risk of health problems and therefore have the most to gain from behaviour change.

There appeared to be no differences at baseline in motivation to exercise between individuals randomised to the three conditions. Qualitatively, the researcher noted that many of the emails received from individuals requesting to participate contained information about their current exercise behaviour and expressed a goal to change it in some way (e.g. ‘ I don’t currently exercise but I would like to start’). This may suggest that the participants recruited in this study were sufficiently

motivated to change their behaviour. In addition, it is important to note that all participants who completed the study were entered into a prize draw and some participants also received course credits in exchange for their participation. It is unknown whether the findings from this study could be generalised to a clinical sample, not taking part in a research trial, where there is no financial incentive to adhere to the intervention and motivation to change behaviour might be reduced.

Previous research has suggested that dysphoric individuals are able to identify goals but are less willing to pursue such goals and more pessimistic about the likelihood of successful goal attainment (Dickson, Moberley & Kinderman, 2011). This study appears to suggest that people who are experiencing some of the symptoms of depression can generate mental imagery about their goals which was associated with improved goal attainment. Research should further investigate the conditions under which individuals naturally generate goal-related mental imagery. Future research could also attempt to investigate the relationship between mental imagery and a greater range of behaviour with individuals experiencing more severe symptoms of depression.

Summary

This was the first known study to investigate the effect of combining implementation intentions and targeted mental imagery on goal attainment in people experiencing the symptoms of depression. Overall, there were significant increases in goal attainment (brisk walking) and significant reductions in the symptoms of depression, with no significant differences between any of the conditions. This does not seem to support previous findings that the combination of implementation intentions and mental imagery improves goal attainment beyond implementation intentions alone and goal rehearsal. A potential implication is that factors that were present in all conditions, such as being given a goal intention and watching a video demonstration of the goal, were sufficient to improve goal attainment and reduce

depressive symptoms. In addition, it was expected that the generation of goal-related prospective mental imagery (PMI) would be highest in the condition that instructed participants to generate PMI. However, the majority of participants reported that they generated PMI regardless of the condition they were assigned to and there were no differences between conditions in the quality, clarity or vividness of PMI. This may imply that individuals with the symptoms of depression can generate PMI and may do this naturally in relation to being given a goal intention. This study did not control for the research participation effect or natural fluctuations in brisk walking or mood. Therefore these conclusions are tentative and more research is needed to clarify whether the findings from this study are robust or due to the methodological limitations.

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Part 3: Critical Appraisal

Overview

In this appraisal I reflect upon the implications that the major research project has had on my own clinical work. I then evaluate web-based research, considering its advantages and drawbacks, using examples from my own research. Finally, I reflect upon the process of undertaking a meta-analysis as part of the literature review, specifically focusing upon what I considered to be the challenges of this method.

The impact of research upon my clinical work

Through undertaking the research project I developed a greater understanding of how mental imagery might be involved in the maintenance of many mental health problems such as anxiety and depression (Holmes, Lang, Mould & Steele, 2008; Holmes, Lang & Shah, 2009). I became awareness of how little I tended to enquire about imagery, let alone use it as an intervention, in my own clinical work. Therefore my research had implications for my clinical work as I started to ask questions about imagery during psychological assessments and, if appropriate, include it in my formulations of a client's difficulties. In addition I also started to introduce imagery as part of my clinical interventions. For example, I used prospective imagery exercises when clients had specific and concrete goals that they wanted to attain in their everyday life. As part of these exercises I would encourage clients to imagine themselves in the process of undertaking their goal and completing their goal. Subjectively these exercises appeared to have been generally acceptable and even helpful, to the clients who engaged in them.

The environment that I found the imagery exercises most useful in was clinical health settings working with individuals with long-term health conditions. I was able use my newly acquired understanding about the possible benefits of combining implementation intentions with mental imagery with clients seeking to

change their health behaviour. This gave me the opportunity to take the theory that was being investigated in my research and apply it in real-world clinical situations. It also gave me an impression of what this intervention might look like and how it could be applied if it were to be generalised to wider settings. From my own clinical judgement the combination of implementation intentions and mental imagery appeared to be helpful in facilitating goal attainment with clients. This is interesting given that findings from the research project suggested that the combination of implementation intentions and mental imagery did not appear to provide any extra benefit beyond a control condition. This highlights the disparity between what one believes to be helpful based on their own clinical judgment and what is observed to be effective in clinical research.

The experience of using the intervention clinically was also helpful in demonstrating factors that could impact on the intervention. These factors included ambivalence to behaviour change, low motivation and long-term and chronic conditions that could act as a barrier to changing behaviour and attaining goals. It also made me aware that clients may be sufficiently motivated to change but could be obstructed by systemic factors that act as barriers to change. I speculate that these factors are probably not unique to clinical populations and are likely to be present in non-clinical populations, like the student sample used in this research, to some extent.

This research encouraged me to pay greater attention to the role of mental imagery in my clinical assessments and formulations. By using implementation intentions and mental imagery in my clinical work it gave me an impression of its potential usefulness as an intervention, an impression which was not supported by the findings from the project. It also gave me some insight into the factors that can possibly impact upon the efficacy of an intervention which are likely to be present in both clinical and non-clinical populations.

Evaluation of web based research

From the outset of the major research project there were several key objectives that were taken into consideration during its design. It was imperative that the project was presented in a format that was user friendly and as accessible as possible. It was important to counterbalance this with a use of a format that would be time and resource-efficient. The majority of research into implementation intentions had been conducted using conventional questionnaires and surveys (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006). However, I also wanted to incorporate multimedia elements into the research such as demonstration videos with spoken (and subtitled) instructions for participants. Therefore it was decided that project would be designed as a web-based experiment. The internet was used at all levels of the research, from the recruitment of participants to the delivery of the experimental interventions and the collection of data. This has given me some insight into some of the advantages and challenges of conducting web-based research.

One of the advantages of employing a web-based design was that it was viewed favourably by the UCL research ethics committee as it did not require any direct face-to-face contact with research participants. I also believe that this, along with other factors, meant that the study met criteria for minimal risk and therefore the project was referred for Chair's action rather than having to be reviewed by the full ethics committee. This understandably accelerated the research process and allowed me more time to design the experiment and recruit participants.

Another advantage is that web-based research can make better use of a researcher's and participant's time and resources. Employing a web-based design meant that participants could sign up to the study and take part at anytime. This avoided the process of arranging time slots with participants for testing which can increase pressure on researcher and the participants. Other than the space in which

participants used to take part in the research, this experiment did not require any additional physical space, e.g. lab space. Therefore, the use of web-based research could help to reduce demand for physical resources and space which may already be limited in universities, and particularly in clinical settings.

I believe that web-based research may have a number of benefits for participants. The use of the internet to recruit individuals, deliver interventions and collect data provides greater anonymity for participants. This may be particularly important in research involving stigmatising issues such as mood, health and risk behaviours. The internet can also increase the accessibility of research to individuals through the use of social media websites and apps to advertise research. This may help to increase the transparency of psychological research and reduce any stigma that may be involved in participation.

This is not to say that using a web-based design was without challenges. As discussed social media websites such as Facebook and Twitter can offer opportunities to advertise research to a vast number of potential participants. However, I found that advertising in this way was a fairly low-yield method with individuals expressing very little interest. More targeted advertisements such as online participant pools yielded much more interest from individuals. Conventional methods of recruitment such as posters and flyers were also very useful in recruiting participants, although they did require more effort and resources than recruiting using the internet. I found that using a combination of both web-based and conventional methods was helpful in the recruitment of participants.

There had been feedback from previous trainees and researchers that university-wide mailing lists such as *UCL announce* had yielded very high returns in terms of interest in participation. In fact the desired sample size for this project was in part, estimated on the number of participants that could be recruited from *UCL announce*. However, *UCL announce* was cancelled shortly before the project was

due recruit. The precise impact that its cancellation had on this project, and other projects, is unknown. However, it appears that the alternatives that were suggested such as advertising on social media and in the university e-newsletter yielded smaller returns than would have been expected from *UCL announce*. Perhaps as a consequence of this, the project did not meet the estimated sample size and therefore was not sufficiently powered to detect some effects that may have existed.

The feedback in regards to *UCL announce* was that it was cancelled in an attempt to try and reduce the number of emails received by students. This raises several questions about the practical and ethical issues of using email to advertise research. On the one hand it may increase access to potentially effective interventions to a wider range of people. However, these emails may be perceived by individuals as a being a nuisance and an inconvenience. Conversely, as more and more research is being advertised by email it may reduce its overall impact as individuals become increasingly less interested and fatigued by such emails. Also as it is a relatively new method there may be insufficient procedures in place to regulate the amount and content of emails advertising research. Researchers should be aware of the possibility of adverse reactions to such emails, particularly if they contain sensitive issues that may be problematic for email recipients.

In web-based research there is typically a greater degree of distance between the researcher and participant (British Psychological Society, 2013). Amongst other things, this is likely to have implications for controlling the procedures and environment of research. It may be harder to verify participant's data and there is greater opportunity for participants to misrepresent themselves. This study took steps to control this by asking participants to provide a valid university email address to verify that they were current students and therefore aged 18 or over. However, there are no ways of knowing whether participants met the other inclusion criteria

such as being sedentary and it is possible that individuals could have misrepresented themselves in order to participate.

In web-based research it can also be harder to control the environmental conditions in which participants are responding to the experimental stimuli. This raises important questions for the current research, such as did participants view the brisk walking demonstration video and if so under what environmental conditions was it viewed (e.g. were there any distractions). It was also noticed that a portion of participants did not accurately follow the instructions to repeat and rehearse the goal intention they were given. An attempt to control for this was made by excluding data from these participants, although it did not appear that failing to follow the instructions had any impact on the overall results. Due to the greater degree of distance in web-based research it can be more difficult to control environmental and procedural factors that may influence a participant's response therefore making it much harder to measure the impact this may have on the validity of the research.

The greater degree of distance can also make it more difficult for to monitor participant's feelings and responses to the research (British Psychological Society, 2013). Of course this is not only an issue for web-based research but also for other methodologies where there is minimal contact with participants. The lack of any direct face-to-face contact can make it harder to be aware of and respond to participant's concerns, particularly unexpected and/or adverse reactions to the research. This is important for psychological research that may involve reporting information about one's mood and symptoms or other information which could be considered sensitive. The project took steps to minimise this risk by providing participants with details for channels of support (e.g. the researcher, student psychological service). It is possible that, in web-based research, participants are less likely to contact the researcher (or other channels of support) with their concerns due to the greater degree of distance. Alternatively, the remoteness might

make it easier for the participant to raise their concerns due to the increased anonymity. Very little is known about this and future research could begin to investigate the potential impact of these factors.

A common feature in web-based research is poor response and retention rates (Murray et al., 2009). This was something that I was aware of and anxious about in the decision to use a web-based design. In order to take this into account the estimated sample size was increased by 50%. As expected, response to the research was low and it required frequent use of targeted advertisement to try and maintain a steady flow of participants into the research. However, to my surprise, the retention rate was much higher than expected, particularly between time 2 and time 3 where only one participant dropped out. It is interesting to consider what factors may have influenced the relatively low attrition. Efforts were made to try and keep the experiment as user-friendly as possible by being transparent about exactly what it would involve and the time commitment required. I also tried to keep the experiment as short as possible as higher responses have been associated with shorter questionnaire length (Deutskens, DeRuyter, Wetzels & Oosterveld, 2014). It appears that incentivising participation by entering individuals into a prize draw upon completion might have been an important factor in the retention of participants, although this was not investigated further. Meta-analyses have demonstrated that participants are more likely to complete a study if there is an incentive involved (Göritz, 2004). However, this does have implications for research where there may not be the resources to offer financial incentives or where financial incentives would be inappropriate.

To my knowledge, this was also one of the first studies to investigate effectiveness of implementation intentions using a web-based experiment. Implementation intentions have been validated as an effective method of improving goal attainment relative to other planning strategies using conventional designs e.g.

'*paper-pencil'* completion (Gollwitzer & Sheeran, 2006). This raises an important question of whether the effectiveness of a well validated intervention is transferable when it is delivered using a different method, e.g. online. Is it possible that the mode of delivery could change the underlying process of an intervention or a participant's response to that intervention? Whereas conventional research has demonstrated large effect sizes for implementation intention (Gollwitzer & Sheeran, 2006), this study did not demonstrate their effectiveness relative to a control condition. Clearly more research is needed to clarify this discrepancy and investigate whether implementation intentions are as effective when they are delivered electronically, using web-based designs.

Although web-based research is not possible, or appropriate, in all circumstances it certainly offers a number of advantages. These include increased anonymity for participants as well as increasing access to research for participants. From my experience it is also a very efficient method for researchers, particularly clinical psychology trainees, who are likely to have other demands on their time such as clinical work. However, the advantages must also be counterbalanced with the challenges. Typically web-based research has lower response and retention rates meaning that there is a need for larger sample sizes. In order to increase response and retention researchers may feel the need to incentivise participation which has ethical implications as well as having the effect of increasing demand for limited resources, such as departmental and graduate school funding. There is also a greater degree of distance between researcher and participant in web-based research. This can make it more difficult to control environmental and procedural factors which may influence the fidelity of the research and affect its validity. Overall, I think that using a web-based design was the best decision for this piece of research but I would advise researchers to weigh-up the pros and cons of this

method and consider whether it would be in fitting with their research question and aims.

Reflections on undertaking meta-analysis

It was decided that the literature review question could not be validly answered by a narrative review alone and that a meta-analysis would be the most appropriate method. The decision to undertake a meta-analysis came with its own challenges and it had implications for the literature review as a whole.

In deciding to conduct a meta-analysis I became aware of my own lack of knowledge about this method. I had often quoted findings from meta-analyses in reports and used them in my appraisal of interventions; however, I realised had relatively little understanding of the underlying method of this technique. Although the basic theory and assumptions of meta-analysis were covered in teaching, the course did not provide any specific teaching on meta-analysis. Fortunately I was able to make use of the knowledge and experience of my supervisors and other staff in the department who had more experience of this method.

Understanding meta-analysis in more detail also involved undertaking a lot of independent learning. I found it helpful to start by reading meta-analyses that had been published in high-quality journals. I avoided the tendency to only read the main findings in favour of studying the method and results sections in an effort to get to grips with the underlying method. Through reading published meta-analyses I was able to get an impression of how the process could be communicated in writing. It also drew my attention to how information and detail can be lost or omitted in the writing of the research. Through my independent learning I found that the Cochrane handbook was a valuable tool for understanding meta-analysis (Higgins & Green, 2011). It also provided me with helpful and accessible information about meta-analysis and was used as a framework of best practise. This was important in trying

to ensure my method was as clear and transparent as possible so that individuals could fully appraise my research and, if appropriate, replicate it and produce reliable findings.

Another challenge of undertaking a meta-analytic review was not just familiarising myself with software like EndNote but with other software such Review Manager which is more specific to meta-analyses. This was difficult as I had not used either before and I only had limited time to learn how to use these pieces of software. Again I found that resources such as the Cochrane handbook contained accessible guidance about using such software as part of a review (Higgins & Green, 2011). I also found it helpful to seek support from staff in the department that had experience of using these programmes.

An important issue in meta-analysis is whether we should synthesis results from diverse research or to what extent should we mix '*apples and oranges*' (Moayyedi, 2004). This was relevant to the review as it combined research from different populations (e.g. clinical and non-clinical samples, working age and older adults). The implication of this is that it may have introduced sources of heterogeneity which could have impacted upon the validity of the overall findings. After much deliberation it was decided that in this case, due to a lack of research in the area, mixing '*apples and oranges*' would be appropriate in order to further our understanding of the research topic. This has helped me to understand the issues that are associated with undertaking a meta-analysis. The suggestion that different types of studies should not be mixed is not a hard and fast rule. Whilst synthesising results from diverse and varied research may have serious implications it may also be the only way to further our knowledge of certain phenomena (McCambridge, Wiiton & Elborne, 2014).

Despite providing some challenges and initially being a source of some stress I think that undertaking a meta-analysis improved the review in a number of

ways. Firstly, it enabled me to investigate a research question that very few studies had addressed individually. Second, through the synthesis it allowed me to further investigate disparities between findings from individual studies. Finally, in addition to investigating whether an intervention was effective or not, using a meta-analysis also provided an estimate of the intervention effect. I think all of these factors helped to strengthen the scientific rigor of the review. I feel that undertaking a meta-analysis also helped me to develop professionally as a clinician and as a researcher. It improved my critical appraisal skills in being able to evaluate a piece of research, particularly meta-analyses, through paying more attention to methodological limitations and the impact these factors may have on the quality and validity of research. I think these skills may become increasingly important for psychologists as progressively more reviews include meta-analyses which may have clinical implications, for example reviewing the evidence base for interventions.

Conclusion

This critical appraisal has given me the opportunity to reflect on the process of carrying out the empirical study and meta-analytic review. Firstly, through conducting the research, I was made aware of how little I used features of it, such as mental imagery, in my everyday clinical practice. Therefore I attempted to make greater use my newly acquired understanding in my assessments and formulations and also in my clinical interventions. Secondly, I have developed some skills in the development of web-based research and experienced the advantages and challenges of this method. Finally, I have learnt new skills in the area of meta-analysis which I think has also impacted on my ability to critically evaluate research, paying particular attention to methodological issues and the impact this can have on the validity and reliability of research.

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Appendix 1: Electronic Search Terms

PSYCINFO:

1. exp Physical Activity/
2. exp Energy Expenditure/
3. exp Sports/
4. (exercise$ or exercising).ab,ti.
5. (physical adj5 activity).ab,ti.
6. (physical adj5 exercise).ab,ti.
7. running.ab,ti.
8. walking.ab,ti.
9. (cycling or bicycling).ab,ti.
10. (weight adj3 (lifting or training)).ab,ti.
11. yoga.ab,ti.
12. swimming.ab,ti.
13. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12
14. exp "Depression (Emotion)"/
15. exp Major Depression/
16. exp Atypical Depression/
17. exp anxiety/
18. exp anxiety disorders/
19. exp anxiety sensitivity/
20. depress$.ab,ti.
21. anxiet$.ab,ti.
22. dysthym$.ab,ti.
23. 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22
24. (dose adj5 response).ab,ti.
25. intensity.ab,ti.
26. 24 or 25
27. 13 and 23 and 26
28. human.po.
29. 27 and 28
30. dissertation.dt.
31. 29 not 30

COCHRANE

#1 MeSH descriptor: [Exercise] explode all trees
#2 exercise
#3 physical activity
#4 sports
#5 #1 or #2 or #3 or #4
#6 MeSH descriptor: [Depression] explode all trees
#7 MeSH descriptor: [Dysthymic Disorder] explode all trees
#8 MeSH descriptor: [Anxiety] explode all trees
#9 depression
#10 anxiety
#11 dysthymia
#12 #6 or #7 or #8 or #9 or #10 or #11
#13 dose response
#14 exercise intensity
#15 #13 or #14
#16 #5 and #12 and #15

MEDLINE

1. exp Exercise/
2. exp Exercise Therapy/
3. exp Sports/
4. exp Physical Fitness/
5. (exercise$ or exercising).tw.
6. (physical adj5 activity).tw.
7. (physical adj5 exercise).tw.
8. running.tw.
9. walking.tw.
10. swimming.tw.
11. yoga.tw.
12. (cycling or bicycling).tw.
13. (weight adj3 (lifting or training)).tw.
14. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13
15. exp Depression/
16. exp Depressive Disorder/
17. exp Dysthymic Disorder/
18. exp Anxiety/
19. exp Anxiety Disorders/
20. depress$.tw.
21. dysthym$.tw.
22. anxiet$.tw.
23. 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22
24. exp Dose-Response Relationship, Drug/
25. (dose adj5 response).tw.
26. intensity.tw.
27. 24 or 25 or 26
28. 14 and 23 and 27
29. randomized controlled trial.pt.
30. controlled clinical trial.pt.
31. randomized.ab.
32. placebo.ab.
33. drug therapy.fs.
34. randomly.ab.
35. trial.ab.
36. groups.ab.
37. 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36
38. exp animals/ not humans.mp
39. 37 not 38
40. 28 and 39

WEB OF SCIENCE:

TOPIC: ('exercise' OR physical activit* OR sport*) AND TOPIC: (depress* OR anxiet* OR dysthym*) AND TOPIC: (exercise NEAR/10 intensit*)

Refined by: RESEARCH AREAS: (PSYCHOLOGY) AND RESEARCH AREAS: (PSYCHOLOGY OR BEHAVIORAL SCIENCES OR PHYSIOLOGY OR SPORT SCIENCES OR PSYCHIATRY OR NURSING OR HEALTH CARE SCIENCES SERVICES OR BIOMEDICAL SOCIAL SCIENCES).

Appendix 2: Ethics Approval Letter

UCL RESEARCH ETHICS COMMITTEE GRADUATE SCHOOL OFFICE

Dr Neil Ralph

Department of Clinical, Educational and
Health Psychology 1-19 Gower Street

UCL

28th April 2014

Dear Dr Ralph

Notification of Ethical Approval

Project ID: 5290/001: Combining mental imagery and implementation intentions to increase brisk walking in people with dysphoria

In my capacity as Chair of the UCL Research Ethics Committee (REC) I am pleased to confirm that I have approved your study for the duration of the project i.e. until September 2015.

Approval is subject to the following conditions:

1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form'.

The form identified above can be accessed by logging on to the ethics website homepage: http://www.grad.ucl.ac.uk/ethics/ and clicking on the button marked 'Key Responsibilities of the Researcher Following Approval'.

2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported.

Reporting Non-Serious Adverse Events

For non-serious adverse events you will need to inform Helen Dougal, Ethics Committee Administrator (ethics@ucl.ac.uk), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

Reporting Serious Adverse Events

The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.

On completion of the research you must submit a brief report (a maximum of two sides of A4) of your findings/concluding comments to the Committee, which includes in particular issues relating to the ethical implications of the research.

With best wishes for your research.

Yours sincerely

Professor John Foreman

Chair of the UCL Research Ethics Committee

Cc: Daniel Wright, Applicant

Professor Peter Fonagy

Appendix 3: Mental Imagery Questions

Mental Imagery Questionnaire

When setting the goal to increase your amount of brisk walking did you actually imagine yourself doing this?

- ❍ Yes
- ❍ No

Which one of the statements below best described the image you had of yourself brisk walking?

- ❍ No image at all
- ❍ Vague and dim image
- ❍ Moderately clear and vivid image
- ❍ Very clear and vivid image
- ❍ Perfectly clear and vivid image

Please provide details on your mental image (between 1-100)

_____ My image was clear
_____ My image was vivid

Appendix 4: Intentions to brisk walk questions

Intentions to brisk walk questionnaire

How much do you agree with the following statements?

I want to increase my brisk walking over the next week

- ❍ I definitely do
- ❍
- ❍
- ❍ I'm not sure
- ❍
- ❍
- ❍ I definitely don't

I intend to increase my brisk walking over the next week

- ❍ I definitely do
- ❍
- ❍
- ❍ I'm not sure
- ❍
- ❍
- ❍ I definitely don't

I plan to increase my brisk walking over the next week

- ❍ I definitely do
- ❍
- ❍
- ❍ I'm not sure
- ❍
- ❍
- ❍ I definitely don't

Appendix 5: Godin Leisure-Time Exercise Questionnaire (LTQE) Modified

Godin Leisure-Time Exercise Questionnaire (Godin & Shepard, 1997) Modified Version

During the last week, how many times on the average have you done the following kinds of walking for more than 15 minutes (please choose how many times from the drop down box)?

Strenuous walk (Fast as you could walk, heavy sweating) _____ (min:0-max:20)

Moderate walk (Brisk paced walk, light sweating) _____ (min:0-max:20)

Moderate walk (Brisk paced walk, light sweating) _____ (min:0-max:20)

During the last week how often have you engaged in any walking long enough to work up a sweat (heart beats rapidly)?

- ❍ Often
- ❍ Sometimes
- ❍ Never/ Rarely

Appendix 6: Transcript of brisk walking videos

Control	Intentions	Imagery
You have set a goal of increasing the amount of brisk walking you do over the next two weeks You are more likely to achieve your goal if you plan it first This involves planning how you will undertake and achieve your goal as part of your everyday life Please recall the brisk walking goal you have made Think about how you will fit that goal into your everyday life Take a moment to think about achieving this goal You might want to repeat the goal to yourself in your mind Think about going for a brisk walk during a typical day Think about how you plan to fit brisk walking into your day, What will you actually do? What are the specific steps you will need to take to achieve this goal? How will you make time to achieve	You have set a goal of increasing the amount of brisk walking you do over the next two weeks You are more likely to achieve your goal if you identify a situation where you will carry out your goal... ...and then decide how you will carry out your goal in that situation Please recall the three 'if-then' intentions you previously made Please pick which one you think you are most likely to do in everyday life Really take a moment to think about doing this intention You might find it helpful to repeat your if – then intention, to yourself in your mind Think about the situation where you are most likely to go for a walk Then think about how you will ensure that you increase your brisk walking in this situation It is very important that you think about the if then intention you are most likely to achieve in your	You have set a goal of increasing the amount of brisk walking you do over the next two weeks You are more likely to achieve your goal if you mentally imagine your intentions We would like you to imagine yourself doing one of your intentions Please recall the three 'if-then' intentions you previously made Please pick which one you think you are most likely to do in everyday life Really take a moment to imagine what you will look like doing the intention Imagine, in your mind, the time of day you will start the walk Imagine the location that you will start your walk Imagine how you will get ready for your walk Please use all of your senses to imagine your walk What can you feel in your body as you begin your walk?

your goal? When will you do it? It is very important that you are able to achieve your goal as part of your everyday life Following these steps will help you to achieve your goal Really take a moment to think about achieving your goal as part of your everyday life. This is the end of the video, Thank you for watching **Words: 202**	everyday life Following these steps will help you to achieve your goal Really take a moment to think about your if-then intention, the one you are most likely to do in your everyday This is the end of the video Thank you for watching **Words: 196**	What can you see around you? What sounds do you notice on your walk? What different smells do you notice? Continue to imagine where you are going on your walk It is very important that you are imagining carrying out your goal as part of your everyday life Following these steps will help you to achieve your goal Really take a moment, using all your senses, to imagine your goal This is the end of the video Thank you for watching **Words: 217**

Appendix 7: Recruitment aides (poster and electronic newsletter)

UCL Ethics Project ID Number: 5290/001
University of Bath Ethics Approval Code: 14-220
Data Protection Registration Number: Z6364106/2014/02/22

Would you like to exercise more?

And win up to £250!

We are recruiting participants for an **on-line** study investigating how different strategies can be used to help people to increase the amount of walking they do and what impact this has on their mood.

We are asking you to take part if:

- ❑ You are aged 18 and over
- ❑ You are a current student at a UK university
- ❑ You do not already exercise regularly (more than twice a week)

If you are eligible we will ask you to complete a questionnaire and set you the goal of trying to increase the amount of walking you do over a two week period. Then we will email you two brief online questionnaires at one week, and two weeks after you completed the first one.

Participants who complete all three questionnaires will be entered into a prize draw to win one of six prizes (1x £250, 2x £75, 1x £50 and 4x £25).

Please contact Daniel.Wright@ucl.ac.uk
Please contact Daniel.Wright@ucl.ac.uk
Please contact Daniel.Wright@ucl.ac.uk
Please contact Daniel.Wright@ucl.ac.uk
Please contact Daniel.Wright@ucl.ac.uk
Please contact Daniel.Wright@ucl.ac.uk
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http://www.ucl.ac.uk/news/students/102014/30
Participants needed for a st...
Suggested Sites
Web Slice Gallery
UCL
UCL Home › UCL News › Participants needed for a study on mood and wal...
UCL News
UCL News home
All news
Student news
Staff news
UCL in the media
UCL Opinion
Services
Services for staff
Services for media
Get updates from UCL News
All channels
Participants needed for a study on mood and walking
30 October 2014
Six cash Prizes up to £250 to be won!
We are looking for people who normally exercise less than twice a week to help us in our online study of the effects of motivating strategies on mood and exercise (brisk walking).
If you exercise less than twice a week and are interested in helping us, we will ask you to complete an online questionnaire and set yourself a goal of increasing the amount of brisk walking you do over two weeks. Then we will email you two brief online questionnaires at the end of one and two weeks.
Foster court
The first 150 Participants who set a goal of increasing brisk walking and complete the two follow-up questionnaires will be entered into a prize draw to win one of six prizes (1x £250, 2x £75, 1x £50 and 2x £25).
After we have 150 participants we will close the study, so be brisk!
If you are interested in participating in this study please contact:
Daniel.Wright@ucl.ac.uk
This study has been approved by the UCL Research Ethics Committee as Project ID Number: 5290/001.
Daniel Wright, Trainee Clinical Psychologist, UCL Clinical Psychology
Share

Appendix 8: Participant information sheet.

Information Sheet for *Participants* in Research Studies

You will be given a copy of this information sheet.

Title of Project: **Combining mental imagery and implementation intentions to increase brisk walking in people with dysphoria**

This study has been approved by the UCL Research Ethics Committee (Project ID Number): 5290/001

This study has been approved by the Ethics Committee of the University of Bath (Approval Code): 14-220

Name	Daniel Wright
Work Address	Research Department of Clinical, Educational and Health Psychology, 1-19 Gower Street, UCL, London, WC1E 6BT.
Contact Details	Daniel.wright@ucl.ac.uk

Would you like to improve your health and physical fitness? Would you like to walk more? We are recruiting participants for a study exploring what strategies can be used to help people increase the amount of walking they do and what impact this has on their mood over a two week period.

Research shows that walking can improve mental and physical health, and it can be just as effective as running.

Requirements

In order to participate in our study you must meet the following requirements

- Be aged 18 or over.
- Be studying at a UK university (demonstrated by submitting a valid ac.uk email address).
- Have normally exercised less than twice a week in the past six months
- Consent to being asked two screening questions about your mood - you will only be invited to participate in the study if you meet the eligibility criteria for these two questions.

This is important because we are specifically recruiting students who do not normally exercise regularly and may be experiencing some everyday symptoms of low mood.

The Prize Draw

If you complete the questionnaires three times over the two weeks you will be entered into a prize draw to thank you for your participation and you could win one of six prizes worth up to

£250.

Details of the Study

If you decide to take part in the study we will set you the goal of increasing your amount of brisk walking over the next two weeks (fourteen days). We will ask you watch a video demonstrating brisk walking and we will ask you to follow some instructions which have been shown to increase goal attainment. After this we will ask you to complete a questionnaire; we will ask you some demographic questions, some questions about your mood, how much brisk walking you do, and some more questions related to the instructions you followed. We will ask you to complete this questionnaire three times over two weeks. The second and third time will be approximately one and two weeks after your first time. We do not think that this will take you more than 15 minutes on each occasion. The strategies will be presented over the Internet and all data will be collected over a secure website.

If you have any reason to believe that brisk walking might be dangerous for you, e.g. you have a health condition; we would ask that you do not participate further or that you participate at your own risk. Otherwise we do not anticipate that our research will cause you any harm. Our research will involve asking you about your mood over the last two weeks and we suggest that you contact your GP if you are concerned about your mental health. You are also advised to contact the UCL Student Psychological Services (http://www.ucl.ac.uk/student-psychological-services/index_home) if you have concerns.

We will not ask you to identify yourself by your name. All data will be kept confidentially in line with the Data Protection Act 1998. You are reminded that you have the right to withdraw from the research at any time without giving any reason by closing your browser. However, as your participation is anonymous we will not be able to withdraw data that you may have previously submitted to us. If you have any concerns about taking part in this research you are invited to contact the researcher.

Data from this research will be analyzed and presented as part of Doctoral Thesis in Clinical Psychology. It is expected that the data will also be prepared and submitted for publication in an academic journal.

Please discuss the information above with others if you wish or ask us if there is anything that is not clear or if you would like more information.

All data will be collected and stored in accordance with the Data Protection Act 1998.

Appendix 9: Participant consent sheet

Informed Consent Form for *Participants* in Research Studies

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Project: **Combining mental imagery and implementation intentions to increase brisk walking in people with dysphoria.**

This study has been approved by the UCL Research Ethics Committee (Project ID Number): 5290/001.

This study has been approved by the Ethics Committee of the University of Bath (Approval Code): 14-220

Thank you for your interest in taking part in this research. Before you agree to take part the person organising the research must explain the project to you.

If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you to decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

Participant's Statement

I

- have read the notes written above and the Information Sheet, and understand what the study involves.
- understand that if I decide at any time that I no longer wish to take part in this project, I can notify the researchers involved and withdraw immediately.
- consent to the processing of my personal information for the purposes of this research study.
- understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.
- agree that the research project named above has been explained to me to my satisfaction and I agree to take part in this study.
- understand that I must not take part if I think there is any reason that brisk walking might be dangerous to my health. If I know of any reason but continue to take part I accept the risks as my own.
- understand that the information I have submitted will be published as a report. Confidentiality and anonymity will be maintained and it will not be possible to identify me from any publications.
- understand that I will be entered into a prize draw for taking part in this research and that some of my personal details will be passed to UCL Finance for administration purposes.
- agree that my non-personal research data may be used by others for future research. I am assured that the confidentiality of my personal data will be upheld through the removal of identifiers.