UNIVERSITY OF
EXETER

**Major Research Project for the
Doctorate in Clinical and Community Psychology**

Using Mindfulness and the Dive Reflex as Techniques from Polyvagal Theory
to Regulate Approach Motivation

Victoria Barnes

Supervisor:
Kim Wright, Clinical Psychologist and Senior Lecturer

This work has been submitted in partial fulfilment of requirements for
the Doctorate in Clinical and Community Psychology

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Abstract

Two techniques, which have been hypothesised to decrease sympathetic activation via their effects on the vagal system, were investigated. Polyvagal theory has not yet been explicitly linked with approach motivation, though there is good reason to do so when considering implications for Bipolar Disorder. Existing literature suggests that mindfulness and the cold pressor test increase parasympathetic nervous system activation. The experimenter postulated that they would promote recovery from heightened approach motivation, to baseline states following an exciting trigger, due to their effect on the parasympathetic nervous system. This study aims to test the feasibility of a laboratory paradigm in which approach motivation is induced and then techniques are deployed whilst approach motivation is simultaneously measured via self-report and physiological response. Feasibility will be assessed in terms of: a) the extent to which the approach motivation induction task evokes a state of approach to reward; b) the validity of using a cross-over design (A-B; B-A) in which each participant undergoes the approach motivation induction task twice, each time followed by a different technique; c) the extent to which the mindfulness technique can be considered to have construct validity. A second aim is to determine the likely size of the deactivating effect that "dive reflex" and "mindfulness" techniques have upon elevated approach motivation. Students completed self-report measures that monitored changes in their mood (approach to reward) and cardiac functioning in response to the mood induction task was recorded. Participants repeated the task followed by a different technique.

Findings show that the mood induction task increased approach motivation and participants reported to be focussing on their breathing during the mindfulness condition, thus ascertaining the feasibility of the laboratory paradigm. Self-report showed mindfulness and mind wander conditions at administration 1 to have the desired calming effect. These elicited large effect sizes. Heart rate decreased during the cold compress condition at administration 1, with a large effect size.

Investigating the mood induction and techniques in a laboratory setting deemed them to be effective. With a larger sample the levels of significance may be greater. As physiological processes affected in the general population should also be affected in a clinical population, these findings are clinically relevant. This pilot study bridges some theoretical gaps by linking polyvagal theory (PVT) and the parasympathetic nervous system (PNS) to approach motivation. It could be the start of a line of research investigating the clinical utility of mindfulness and compress techniques as self help regulators of emotion for people with Bipolar Disorder (BD).

Introduction

Bipolar Disorder and the Behavioural Activation System

Bipolar Disorder (BD) is classified as at least one depressive plus at least one hypomanic or mixed episode, as characterised by intense euphoria, elevated self-esteem, flight of ideas, lack of sleep and risk taking behaviours (American Psychiatric Association, 1994). BD is a longitudinal, potentially debilitating disorder (McDonald, Schulze, Murray & Tohen, 2005), with a 1% prevalence rate (Ramana & Bebbington,

1995). During manic episodes, behavioural and emotional approach to reward

becomes prominent. Approach Motivation is the direction of behaviour, via emotion,

toward obtaining a reward. This process involves the Behavioural Activation System

(BAS, Gray, 1970, 1982, 1991) and the Sympathetic Nervous System (SNS). It is

suggested that people with BD have a dysregulated approach motivation system

(Depue & Iacono, 1989) due to a dysregulated BAS. Urosevic, Abramson, Harmon-

Jones and Alloy (2008) state that mania can result from a weak BAS regulation

system interacting with a maladaptive baseline BAS state, when a BAS relevant event

takes place. Experimentally, a BAS relevant event such as the "Go Task" can be used

to manipulate levels of approach motivation. Johnson, Ruggero and Carver (2005)

asked undergraduates to complete a "go" task in which they must press a button in

response to light as fast as possible. They were given positive feedback and a

monetary incentive. Current manic-type symptomatology predicted positive affect

post-reward, potentially linked to excessive behavioural activation compared to

healthy controls. This implies that people will report greater levels of approach

motivation following positive mood induction. However, pre-task mood was not

monitored, suggesting that results are less meaningful as individuals' relative changes

in levels of approach motivation can not be ascertained. Roiser, Farmer, Lam, Burke

et al (2008) adapted Johnson et al's (2005) task, finding individuals with BD to

perform worse than controls in emotional processing after positive mood induction. It

may be that people experiencing mania lack adaptive techniques to process and

regulate emotions.

Many studies investigating approach motivation use self-report measures (e.g.

BIS/BAS scales, Carver & White, 1994), which provide information about subjective

emotional experience. Johnson (2005) and Harmon-Jones, Abramson, Nusslock, Sigelman et al (2008) suggest that biological and psychological processes need to be simultaneously assessed in order to be applied clinically, especially as physiological and self report data is often dissociated. The consideration of biological correlates of goal pursuit and reward will assist validity and the development of interventions including self-regulation and self-monitoring. Indeed, techniques that activate the PNS may be implicated in the regulation of approach motivation. Although this link is yet to be made, Polyvagal theory assists this development by describing how the PNS reduces SNS activity and perhaps calms behavioural activation.

Polyvagal Theory

In a separate line of research, Polyvagal Theory (Porges 1995, 2007) offers a theoretical framework for examining the psychophysiological aspects of emotion regulation and approach to reward.

The Parasympathetic Nervous System (PNS) is a branch of the autonomic nervous system that has a de-activation role (negatively correlated with the Sympathetic Nervous System, SNS) of calm and rest, in non-threatening environments. Within the PNS are two vagal pathways. The old vagus is activated by life threatening stimuli. It immobilises bodily systems to conserve energy, by slowing breathing and heart rate. The new vagus has evolved in mammals, activated by safety signals from the environment, in order to remain calm in the absence of threatening social stimuli (Porges, 2007).

Vagal circuits are activated hierarchically in response to the environment. If newer structures are not functioning, older structures dominate, forming potentially maladaptive responses to the environment. Beauchaine, Gatzke-Kopp and Mead (2007) note how functional deficiencies of the new vagus lead to decreased vagal tone, emotional lability and psychopathology. However, samples were not generalisable, only using children with conduct difficulties.

Polyvagal theory can be used to develop techniques to regulate SNS activity, such as in anxiety (Barnsley, Lynch and Hempel, paper in preparation). From the literature it appears that SNS activity is linked with approach motivation, yet no studies have investigated the regulation of approach motivation via techniques that reduce SNS activity through activating the PNS.

There is a need for the development of techniques that moderate vagal activity to an optimum, enabling individuals to respond appropriately to their environment (Beauchaine, 2001). Research to date draws upon social engagement and safety in response to perceived threat, however, little has been investigated regarding positive emotions. No research has been conducted to link polyvagal theory to excitement and approach motivation.

Measuring Sympathetic and Parasympathetic Activity

Measures of Cardiac Functioning that are relevant to this study include Cardiac Pre-Ejection Period (PEP), Respiratory Sinus Arrhythmia (RSA) and Heart Rate (HR).

PEP is a validated index of the SNS influence upon the heart (Hayano, Sakakibara, Yamada, Yamada et al, 1991). It is defined as the time interval between the onset of the left ventricular depolarisation and ejection of blood into the aorta (Sherwood, Allen, Obrist & Langer, 1986). Crowell, Beauchaine, Kopp, Sylvers and Mead (2006) successfully used PEP as an index of SNS-linked cardiac activity during reward tasks, designed to elicit behavioural approach. Based on suggestions from previous research, PEP is a valid measure of reactivity to reward (Brenner, Beauchaine & Sylvers, 2005). During times of approach to reward, PEP should be shorter (Beauchaine, 2001).

RSA relates to the periodic fluctuations in heart rate during the respiratory cycle (Bernston, Bigger, Eckberg, Grossman, Kauffman et al, 1997). It is a "widely used indicator of PNS activity directed at the heart, that is, vagal tone" (Ditto, Eclache and Goldman, 2006, pp. 228) and is an index of cardiac vagal function (Brenner, Beauchaine & Sylvers, 2005). It is heart rate variability in relation to respiration, by which the interval on an ECG is shorter during inhalation (Yasuma & Hayano, 2004). Katona and Jih (1975) found that the degree of parasympathetic heart rate control relates to the decrease in average heart rate caused by decreasing parasympathetic activity while keeping sympathetic activity constant. They found parasympathetic heart rate control to be directly proportional to the peak-to-peak variations in heart rate during respiration. Their results suggest that the degree of RSA may be used as a non-invasive indicator of parasympathetic cardiac control. Eckberg (2003) also associated RSA with breathing, implying that mindful breathing could help regulate heart rate and emotional state.

Heart Rate is determined by the number of heartbeats per unit of time, typically expressed as beats per minute (bpm) and can be measured using ECG. Heart rate is used as an index of both SNS and PNS activity, such that it increases with SNS arousal and decreases with PNS arousal (Cacioppo, Tassinary & Berntson, 2000). Eubanks, Wright and Williams (2002) revealed an interaction between task difficulty and incentive value, when participants were offered monetary gain for good performance, such that heart rate was proportional to task difficulty. Emotions have been found to play a role in heart rate response. Anger, fear, and anxiety are known to cause increased heart rate while depression usually results in lowering of heart rate (Appelhans & Luecken, 2006). Fowles, Fisher and Tranel (1982) demonstrated monetary incentive effects relative to elevated heart rate on a computer task aiming for a reward. They imply that heart rate is influenced by positive motivational states, not only negative states as previously assumed. To further research their paradigm, it would be interesting to investigate positive motivational states such as impulsivity and excitement.

In the current study, measurements of PEP, RSA and Heart Rate were taken but only those findings pertaining to Heart Rate are reported.

Emotion Regulation Techniques Suggested by Polyvagal Theory

The Dive Reflex

The Dive Reflex is elicited when the body is submerged into water and oxygen is directed away from inactive muscles, toward the heart and brain as a survival

mechanism (Elsner, Franklin, van Citters & Kennedy, 1966). It is associated with

decreased heart rate due to PNS activation (Andersen, 1966). Khurana, Watabiki,

Hebel, Toro and Nelson (1980) have shown that applying a cold compress to the face

is a non-invasive method that produces comparable physiological effects to full facial

immersion (Elsner, Franklin, van Citters and Kennedy, 1966). Hurwitz and Furedy

(1986) propose 40 seconds to be sufficient for desired physiological effects, finding

greater heart rate changes in an experimental condition and a sustainable rise in PNS

activity. Hughes and Stoney (2000) used a cold compress for 3 minutes at 4 degrees

centigrade, instructing participants to rest quietly without moving. This task generally

elicits an increase in heart rate variability (Durel, Kas, Anderson, McNeilly et al,

1993) and imitates the dive reflex in terms of decreased heart rate mediated by the

PNS (Khurana et al, 1980). Haddad, Laursen, Ahmaidi and Buchheit (2010) found

cold-water face immersion to be an effective trigger of the PNS post-exercise, looking

at heart rate recovery and variability. Clinically, cold water face immersion could be

used to lower the risk of autonomic problems, but more research is needed to look

into the effects of heart rate recovery and variability in order to help in the treatment

of disorders of affect. Cooling the face is used in dialectical behaviour therapy to

calm physiological arousal that occurs with intense negative emotions (Linehan,

1993), which could also be useful for a range of disorders.

Mindfulness

Mindfulness is believed to enhance well-being (Brown and Ryan, 2003) and is

associated with positive psychological and physiological states (Walach, Buchheld,

Buttenmuller, Kleinknecht and Schmidt, 2006). Kabat-Zinn (1990) notes that

mindfulness assists recovery after a stressor. An interesting development is to investigate its usefulness for BD and mania.

Morrison, Peyton & Northard (2003) propose that preventing manic escalation could be effective in balancing affect and behaviour. Mindfulness is a therapeutic skill in altering emotional appraisal and experience (Lynch, Chapman, Rosenthal, Kuo & Linehan, 2006). Being in a mindful state even momentarily increases well-being and lowers psychological distress (Lau, Bishop, Segal, Buis, et al, 2006; Greeson & Brantley, 2008). Indeed, Winbush, Gross & Kreitzer (2007) suggest that mindfulness can help reduce racing thoughts and assist in calming affect. Its link to the PNS (via the new vagus) has been postulated (Ditto, Eclache and Goldman, 2006). Increased RSA and decreased PEP have been observed while participants meditate (Jevning, Wallace & Beidebach, 1992), in line with previous research suggesting that meditation sustainably activates the PNS. The effects of both long and short term mindful practices could help to inform its clinical usefulness.

Gaps in the evidence base

Links between Polyvagal theory and approach motivation, or the PNS and approach motivation, have yet to be made explicit. As approach motivation is used in this study as an analogue of mania, the implications of Polyvagal theory for the understanding and treatment of Bipolar disorder begin to emerge (Figure 1).
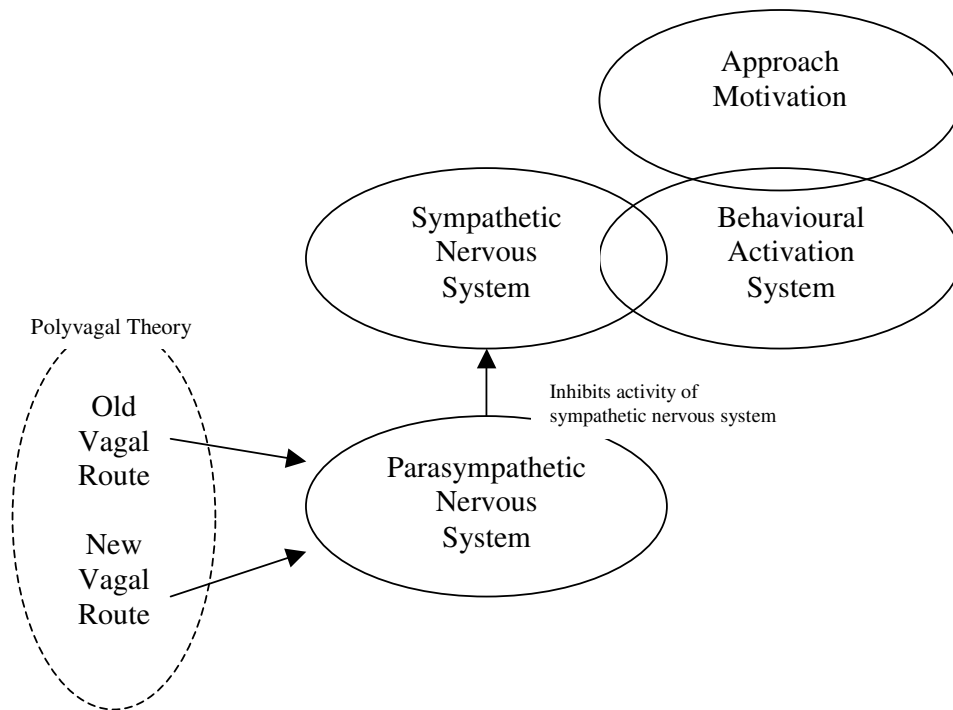
Figure 1. Ven diagram to illustrate physiological concepts that overlap or are related.

Arrows represent the directional relationship between concepts. Polyvagal theory

suggests that there are two routes to activating the PNS, which acts as a brake on the

SNS. SNS activity underpins increased approach motivation and heightened BAS

activity. Therefore, it is expected that activating the PNS affects approach motivation

and BAS activity via its effect on the SNS.

Implications of polyvagal theory for the regulation of approach motivation in the

general population have not been investigated. Moreover, mindfulness and cold

compress techniques for activating the PNS have not been explored in relation to

approach motivation.

There is virtually no research using mindfulness or dive reflex techniques in relation to mania (Segal, Williams, & Teasdale, 2002; Hughes & Stoney, 2000). Beauchaine (2001) states that there are no experimental studies examining these techniques in regulating approach motivation following positive mood.

Due to a lack of research to date, it is unclear whether the techniques proposed can be successfully applied in a laboratory setting, whilst inducing approach motivation. It is also unclear what sample sizes would be required to detect the effects of these techniques. On these grounds, a pilot study is required to bridge these gaps.

The Primary Objectives of this study are:

1) test the feasibility of a laboratory paradigm in which approach motivation is induced and then techniques are deployed whilst approach motivation is simultaneously measured via self-report and physiological response. Feasibility will be assessed in terms of: a) the extent to which the approach motivation induction task evokes a state of approach to reward; b) the validity of using a cross-over design (A-B; B-A) in which each participant undergoes the approach motivation induction task twice, each time followed by a different technique c) the extent to which the mindfulness technique can be considered to have construct validity.

2) determine the likely size of the deactivating effect that "dive reflex" and "mindfulness" techniques have upon elevated approach motivation.

The Secondary Objective is to test the hypothesis that, in the general population, mindfulness and cold compress techniques will promote recovery from an increase in approach motivation following an exciting trigger.

Method

Design

An experimental, between subjects design with unpaired data was employed as each participant completed two randomised, counterbalanced conditions. Figure 2 presents possible conditions to which participants were randomly allocated. Each condition was compared to assess its effects, thus condition is the independent variable. The dependent variable is level of approach motivation.

Measures and Materials

Questionnaires

Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988). Participants were asked to complete the PANAS (Appendix 1) in order to assess their mood before commencing the experiment. Trait scores on the PANAS are shown to be stable over time, show significant convergent and discriminant validity when correlated with peer-judgments, are highly correlated with corresponding measures of aggregated state affect, and are strongly and systematically related to measures of personality and emotionality (Watson, Clark & Tellegen, 1988).

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). Current depression was screened for as an exclusion criterion using the HADS (Appendix 2). This has advantages over other measures because of its sensitivity and consistent threshold score. A cut-off score of 8 on the depression subscale was used to identify individuals for exclusion.

Behavioural Engagement Scales (BES; Krauss, Depue, Arbisi & Spoont, 1992). The dependant variable (level of approach motivation after an exciting trigger) was assessed by self-report of mood change using the BES (Appendix 3). The BES can be sensitive to small changes in affect in people with no history of affective disorder (Wright, Lam & Newsom-Davis, 2005) and has been shown to have high internal consistency (Wright, Lam & Brown, 2008).

Hypomanic Personality Scale (HPS; Kwapil et al, 2000; Eckblad & Chapman, 1986) (Appendix 4) This was used to describe the sample in terms of their vulnerability to BD. The HPS has been validated longitudinally by Kwapil, Miller, Zinser, Chapman, Chapman and Eckblad (2000), who found that young adults with elevated HPS scores of 36 and above were more likely to develop bipolar disorder.

Physiological Measures

The following equipment was used to assess physiological changes throughout the testing period.

Cardiac activity was measured using an Electrocardiogram amplifier and Impedence

Cardiograph (BIOPAC Systems, Inc.). To collect impedance cardiography data, four

band electrodes were attached to the neck and back (Lozano, Norman, Knox, Wood,

Miller et al, 2007). Two spot electrodes were placed on the upper and lower torso to

collect electrocardiography data. Respiration rate was measured by means of a

respiration belt around the chest.

Mood Induction Task

The purpose of this task was to evoke approach motivation. It was delivered using E-

Prime software, and was based upon the Go Task devised by Johnson, Ruggero &

Carver (2005) (See Appendix 5 for task instructions). Four black squares appeared on

a computer screen. In each trial, one square turned red. Participants were instructed

to indicate the position of the red square by pressing a corresponding key as quickly

as possible. Participants were given identical feedback that they were amongst the

highest performers, which could win them a prize.

Experimental Manipulations

Table 1 presents the details of each condition.

Table 1: Explanations of mindfulness and compress conditions.

Manipulation 1: Mindfulness	*Experimental Condition:* Turning a dummy dial left upon inhalation and right upon exhalation, so as to induce a focus on breathing, whilst not altering breathing.
	Active Control Condition: Sitting quietly and letting the mind wander (Ditto et al, 2006), whilst turning a dummy dial left and right at will.
	Passive Control Condition: Participant asked to sit and wait, with no explicit instruction and no dummy dial.
Manipulation 2: Cold Compress	*Experimental Condition:* Maintaining a temperature of 5-10 degrees centigrade over the face for up to 15 minutes, using a chilled eye mask.
	Active Control Condition: An identical eye mask, heated in a microwave to a temperature of 40 +/- 2 degrees, applied to the face for up to 15 minutes.
	Passive Control Condition: The participant was asked to sit and wait with no explicit instruction and no eye mask.

See Appendix 6 for condition instructions.

Manipulation Checks

Manipulation checks 1 and 2 involved asking participants to rate how much they were thinking about their breathing during conditions 1 and 2, respectively. On a scale of 1-10, 1 corresponded to not thinking about their breathing at all, where 10 corresponded to thinking about their breathing all the time. The assumption is made that people would focus on their breathing more when they were asked to, during the experimental mindfulness condition.

Participants

Main Study

A total of 66 participants were tested (See Appendix 12 for sample size calculation. This gave 22 in each condition (active technique, active control, passive control), for both conditions (each participant completing 2 techniques).

Exclusion Criteria

Participants were required to be University of Exeter students aged between 18 and 38, to score less than 8 on the depression subscale of the HADS (Zigmond & Snaith, 1983), and not to be currently taking psychoactive medication. Participants were recruited by email (Appendix 9 and 10) and via a participant database.

Procedure

Pre-Pilot Phase

A pre-pilot was run to test feasibility and validity of the mood induction tasks and logistics of the experimental design. Nine students of the University of Exeter were recruited by poster and email, as an opportunistic sample (Appendices 10 and 11). Participants (7 female, 2 male, with a median age of 21 years, range of 18-38 years) completed the BES, followed by the mood induction task, then immediately afterwards, the BES was completed every 2 minutes for 15 minutes. Following the first mood induction task, 66.6% of participants returned to baseline levels of approach motivation in the 15-minute recovery period. The mean time to return to baseline was 6.94 minutes (range of 2.5-15 minutes). Following the second mood induction task, 66.6% of participants returned to baseline within 15 minutes. The mean time to return to baseline was 5.83 minutes (range of 0-15 minutes). Qualitative feedback showed that participants felt that the task engaged them and that they felt motivated to succeed. They felt that the task was appropriate in length at 4 minutes. Participants stated that they disbelieved the feedback about their performance, therefore this was modified in accordance with participant suggestions for the main study.

Main Study

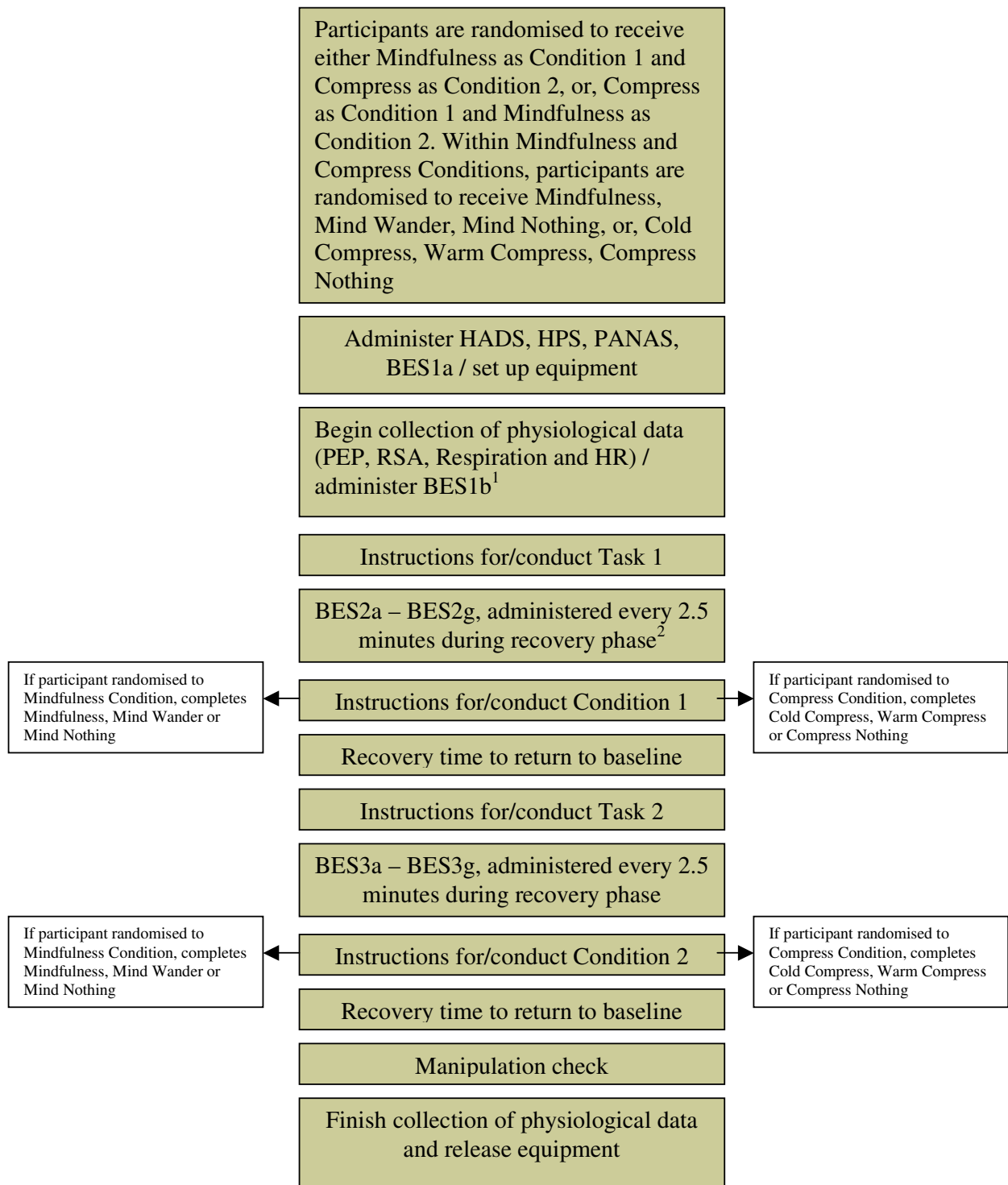Figure 2 depicts the experimental procedure (Also see Appendices 11, 13 and 15).

Participants are randomised to receive either Mindfulness as Condition 1 and Compress as Condition 2, or, Compress as Condition 1 and Mindfulness as Condition 2. Within Mindfulness and Compress Conditions, participants are randomised to receive Mindfulness, Mind Wander, Mind Nothing, or, Cold Compress, Warm Compress, Compress Nothing

Administer HADS, HPS, PANAS, BES1a / set up equipment

Begin collection of physiological data (PEP, RSA, Respiration and HR) / administer BES1b[1]

Instructions for/conduct Task 1

BES2a – BES2g, administered every 2.5 minutes during recovery phase[2]

If participant randomised to Mindfulness Condition, completes Mindfulness, Mind Wander or Mind Nothing

Instructions for/conduct Condition 1

If participant randomised to Compress Condition, completes Cold Compress, Warm Compress or Compress Nothing

Recovery time to return to baseline

Instructions for/conduct Task 2

BES3a – BES3g, administered every 2.5 minutes during recovery phase

If participant randomised to Mindfulness Condition, completes Mindfulness, Mind Wander or Mind Nothing

Instructions for/conduct Condition 2

If participant randomised to Compress Condition, completes Cold Compress, Warm Compress or Compress Nothing

Recovery time to return to baseline

Manipulation check

Finish collection of physiological data and release equipment

Figure 2. Flow diagram detailing components of the experimental procedure. The Mood Induction Task lasted for approximately 4 minutes each time. It involved feedback, which was identical for each participant, informing them of their increasingly competitive performance, intended to increase approach motivation.

During recovery phases, participants completed the BES every 2.5 minutes for a minimum of 5 minutes and a maximum of 15 minutes, depending on when their levels of approach motivation returned to baseline. Time taken to return to baseline was recorded. Manipulation checks were used to ensure that participants were not experiencing the effects of the first condition during the second condition. Participants were, therefore, asked to rate how much they were focussing on their breathing on a scale of 1-10.

Data Analysis

Self-Report Data

Data were analysed using SPSS Version 18. Prior to performing statistical tests, the distributions of variables were inspected to determine normality (Appendix 17). Any variables found to be non-normally distributed were analysed using non-parametric tests in preliminary comparisons. If variables were non-normally distributed, the median and range were reported (Appendix 16). For later analyses, assumptions of multi-variate analyses were checked. The Greenhouse-Geisser statistic was used where sphericity could not be assumed.

Physiological Data

Physiological data were processed using Acqknowledge version 4.1 software and ECG data were treated to remove artefacts (a band pass filter was applied from 0.5 to 35Hz), then signals were correlated against a prototypical ECG cycle for each

participant and peak amplitudes were detected automatically and manually checked.

Peak timings were exported to SPSS and were used to calculate mean HR over the

following seven 30 second periods: 90 seconds before BES1b; 30 seconds before BES

2a; 2.5 minutes after BES2a; 5 minutes after BES 2a; 30 seconds before BES 3a; 2.5

minutes after BES 3a; 5 minutes after BES 3a.

Effect sizes were calculated (Primary Objective 2) using G Power software version

3.0.10.

Results

Demographic and preliminary questionnaire data

The median age of the sample was 21 years (range 18-38 years); 39 (59.09%) were

female and 27 (40.91%) were male. Participants scored a mean of 5.59 *(SD* 2.37) on

the depression subscale of the HADS and median of 2 (range 0-7) on the anxiety

subscale of the HADS; no participants scored 8 or greater on the depression subscale,

thus no participants met this exclusion criterion. The median for HPS total scores was

10.5 (range 0-32). No participants scored 36 or greater on this scale, the score range

found to predict clinical levels of hypomanic personality traits. The mean score for

PANAS positive subscale was 28.89 *(SD* 6.40) and the mean score for PANAS

negative subscale was 12.86 *(SD* 4.19). The mean of BES1a and BES1b was taken to

calculate an overall mean BES baseline score, which was 21.45 *(SD* 3.64).

Mean HR at baseline was 76.48 *(SD* 10.92). A trend towards a significant positive

correlation was found between HR at baseline and baseline BES score (*r*=.24, *n*=60,

p=.069).

The experimental conditions were compared in terms of demographic data and scores

on preliminary questionnaires. Conditions were compared on the following variables:

age, HADS depression, HADS anxiety, hypomanic personality scale total, PANAS

positive total, PANAS negative total, behavioural engagement scale baselines and

heart rate at baseline. One-way ANOVAs were conducted on the continuous

dependent variables that were normally distributed. For non-normally distributed,

continuous variables, the Kruskal-Wallis test was used. For categorical variables,

Chi-Square was used.

The following six comparisons were tested: First, the three mindfulness conditions at

administration 1 were compared; next the 3 compress conditions at administration 1

were compared; then the 3 mindfulness conditions at administration 2 were compared;

the 3 compress conditions at administration 2 were compared; the 3 mindfulness

conditions across both administrations were compared; and the 3 compress conditions

across both administrations were compared. Table 2 displays all variables that were

significantly different at baseline for each of the 6 comparisons. There were no

significant differences for participants in the mindfulness or compress conditions

when times 1 and 2 were analysed independently. There were no significant

differences for the mindfulness conditions when combining times 1 and 2. For

participants in the compress conditions, when analysing administrations 1 and 2

together, there was a significant difference in HADS depression score, such that

participants in the warm compress (active control) condition reported higher levels of

depression (M 3.00, SD 2.25) than did participants in the cold compress

(experimental) condition (M 1.41, SD 1.94)

Table 2. Details of any significantly different variables at baseline for each of the 6

comparisons, pre-mood induction.

	Mindfulness	**Compress**
Administration 1	No significant differences	No significant differences
Administration 2	No significant differences	No significant differences
Administrations 1 and 2 combined	No significant differences	HADS depression score (F(2)=3.979, p=.024)

Note. HADS = Hospital Anxiety and Depression Scale.

Effectiveness of mood induction

Post mood induction 1, the mean BES score was 36.06 *(SD* 3.93), from a BES

baseline mean of 33.54 *(SD* 3.64), an increase of 1.74 *(SD* 2.86). A paired t-test

revealed this increase to be significant (*t*=-6.59, df=65, *p*<.001). Post mood induction

2, the mean BES score was 34.39 *(SD* 4.51), from a BES baseline 2 mean of 31.61

(SD 4.24), a mean increase of 2.79 *(SD* 2.69). A paired t-test revealed this change to

be significant (*t*(65)=8.41, *p*<.001).

Paired t-tests were used to compare changes in HR following the two mood

inductions. Post mood induction 1, the mean HR score was 76.40 *(SD* 10.29) a mean

decrease of .23 *(SD* 5.34). This change was found to be non-significant. Post mood

induction 2, the mean HR score was 75.93 *(SD* 9.33), a mean decrease of .61 *(SD*

6.45). This change was found to be non-significant.

In terms of the proportion of participants who responded to each mood induction, post

mood induction 1, 53 participants (80.3%) showed an increase in BES score. Ten

(15.15%) participants showed a decrease in BES score and three participants (4.55%)

did not change in BES score. Post mood induction 2, 57 participants (86.36%)

showed the expected increase in BES score, 2 participants (3.03%) showed a decrease

in BES score, and 7 participants (10.61%) did not change in BES score.

The proportion of participants that returned to baseline BES score within the 15-

minute recovery period was 90.91% at administration 1 and 89.39% at administration

2. The mean time taken to return to baseline was 5.04 minutes at administration 1 and

4.81 minutes at administration 2.

Comparing means of the changes in BES scores

To investigate whether the 2 inductions were equally effective, a paired t-test was

conducted to compare changes in BES scores post mood induction 1 and post mood

induction 2. The difference was found to be significant ($t(65)$=-2.21, *p*=.030), such

that the second mood induction appeared to have a greater impact on approach

motivation.

Investigation of the main hypotheses

Administrations 1 and 2 were analysed separately to begin with, due to the possibility

of order effects. Afterwards, the administrations were combined and analysed

together (See Appendices 18 and 19). Repeated Measures ANOVAs were used to test

the main hypotheses. To interpret the results, planned comparisons were used to test

predicted comparisons and post hoc tests were applied to test non-predicted

comparisons. For both planned and unplanned comparisons, repeated measures

ANOVAs were used, this time only with the two conditions of interest. To determine

the direction of significant effects, graphs of the interaction were inspected. For post-

hoc tests, a Bonferoni correction was applied to correct for the family wise error rate.

The alpha level was taken to be $p<.017$.

Administration 1

Considering mindfulness conditions at administration 1, BES2a total score, BES 2b

total score, and BES2c total score were set as dependent variables, with condition

(mindfulness, mind wander and passive control) as the between groups factor. There

was a main effect of time ($F(2, 66)=41.22$, $p<.001$), such that BES score decreased

over time. There was no main effect of condition. When investigating the interaction

between time and condition, a significant interaction was found ($F(4, 66)=4.01$,

$p=.006$, ES(f)=0.49).

Two planned comparisons were conducted between the experimental condition and

each of the two control conditions. When comparing mindfulness with the active

control (mind wander) condition, no significant interaction was found between time and condition ($F_{(2, 44)}$=1.15, p=.327, ES(f)=0.23). A trend was found when comparing mindfulness and the passive control condition ($F_{(2, 44)}$=2.64, p=.082, ES(f)=0.35), such that participants in the mindfulness condition showed a sharper decrease in BES scores.

A post-hoc comparison was conducted to compare the two control conditions. The interaction between time and condition was significant ($F_{(2, 42)}$=9.70, p<.001), such that participants in the mind wander condition showed a sharper decrease in BES scores post mood induction.

Figure 3 illustrates BES scores during the mindfulness condition at administration 1.
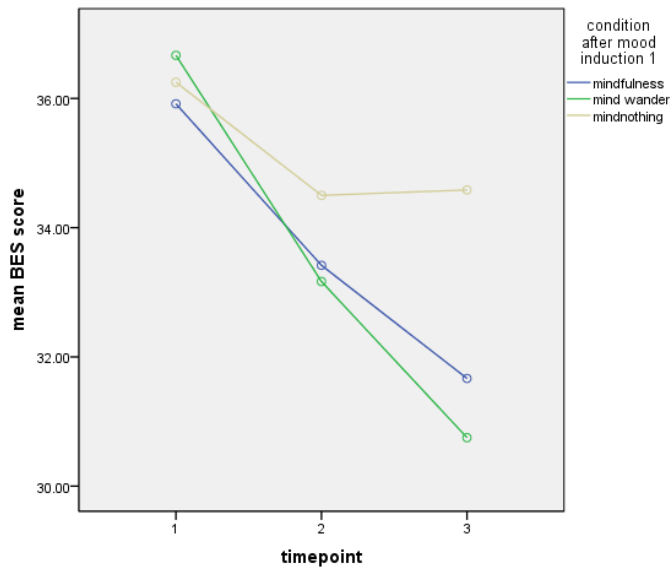
Figure 3. Graph to illustrate the mean BES scores across time for mindfulness conditions at administration 1, post mood induction task 1.

Considering compress conditions next, BES2a total score reversed, BES 2b total score reversed, and BES2c total score reversed were set as dependent variables, with condition (cold compress, warm compress and passive control) as the between groups factor. A main effect of time was found (Greenhouse-Geiser $F(2, 54)=30.34$, $p<.001$). A main effect of condition was also found ($F(2, 54)=3.86$, $p=.034$). The interaction between time and condition was not significant ($F(2.76, 37.25)=1.06$, $p=.374$, ES(f)=0.28). In order to determine the effect sizes of the comparisons between the experimental condition (cold compress) and the passive control (nothing), a planned comparison was conducted ($F(1.26, 3.55)=.41$, $p=.578$, ES(f)=0.16).

Considering heart rate during mindfulness conditions at administration 1, HR2a total score, HR2b total score, and HR2c total score were set as dependent variables, with condition (mindfulness, mind wander and passive control) as the between groups factor. There was no main effect of condition or time. When investigating the interaction between time and condition, no significant interaction was found ($F(4, 60)=.41$, $p=.800$, ES(f)=0.16). Considering heart rate during compress conditions next, HR2a total score reversed, HR2b total score reversed, and HR2c total score reversed were set as dependent variables, with condition (cold compress, warm compress and passive control) as the between groups factor. The Greenhouse-Geisser statistic showed a main effect of time ($F(1.60, 38.42)=4.51$, $p=.024$). The interaction between time and condition was also significant ($F(3.20, 38.42)=3.89$, $p=.014$, ES(f)=0.57). This is illustrated in Figure 4.
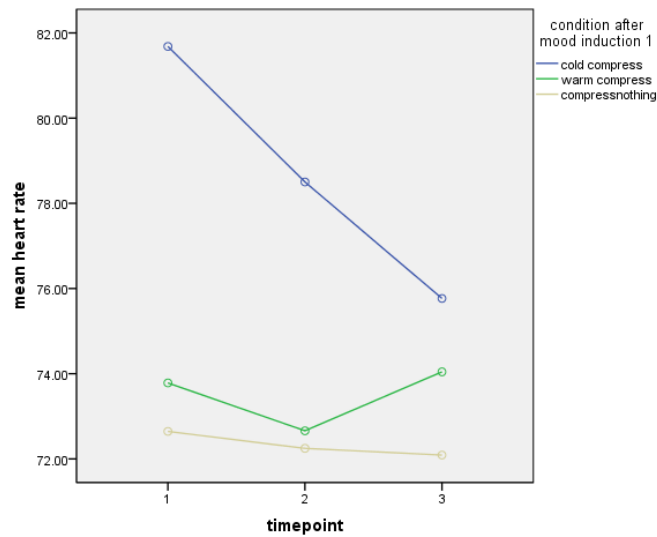
Figure 4. Graph to depict the mean heart rate data across time for compress conditions at administration 1, post mood induction task 1.

Planned comparisons conducted comparing compress with the active and passive control conditions. When comparing the cold compress with warm compress condition, Greenhouse-Geisser statistic was used and the interaction between time and condition was found to be significant ($F(1.36, 3.45)=6.58$, $p=.011$, ES(f)=0.62). When comparing cold compress with the passive control condition, a trend was found ($F(2, 44)=3.12$, $p=.059$, ES(f)=0.46).

A post hoc test was conducted to compare the active and passive control conditions. No significant differences were found.

Administration 2

To compare the mindfulness conditions at administration 2, BES2a total score reversed, BES2b total score reversed, and BES2c total score reversed were set as dependent variables, with condition (mindfulness, mind wander and passive control) as the between groups factor. A main effect of time was found (Greenhouse-Geisser $F_{(2, 54)}=31.11$, $p<.001$). No interaction between time and condition was found ($F_{(1.51, 54)}=.19$, $p=.764$, ES(f)=0.19). In order to determine the effect size of the comparison between the experimental condition and the passive control, a planned comparison was conducted ($F_{(2, 36)}=.81$, $p=.455$, ES(f)=0.11).

For the compress conditions at administration 2, a main effect of time was found ($F_{(2, 66)}=32.64$, $p<.001$). The interaction between time and condition was not significant ($F_{(3.19, 66)}=1.72$, $p=.171$, ES(f)=0.32). In order to determine the effect size of the comparison between the experimental condition and the passive control, a planned comparison was conducted ($F_{(1.62, 42.52)}=.45$, $p=.602$, ES(f)=0.14).

When investigating heart rate data during the mindfulness condition at administration 2, there was a main effect of time ($F_{(2, 48)}=4.62$, $p=.015$) but no significant interaction between time and condition ($F_{(df=4, 48)}=.73$, $p=.574$, ES(f)=0.19). When investigating heart rate data during the compress condition at administration 2, no significant effects were found ($F_{(4, 66)}=.26$, $p=.903$, ES(f)=0.15).

Combining administrations 1 and 2

To calculate combined scores, BES scores from mood induction 1 were used for participants who did mindfulness at time 1, whereas BES scores from mood induction 2 were used for participants who did mindfulness at time 2. The same was calculated for compress.

Considering mindfulness conditions first, BES combined score a, BES combined score b, BES combined score c were set as dependent variables, mindfulness condition as the between groups factor and order of administration as a covariate. A significant main effect of time (Greenhouse-Geisser $F(1.825, 111.34)=9.79$, $p<.001$) was found and the interaction between time and condition was found to be significant ($F(3.65, 122)=4.00$, $p=.006$, ES (f)$=0.32$).

Figure 5 illustrates BES scores during the mindfulness condition when administrations 1 and 2 were combined.
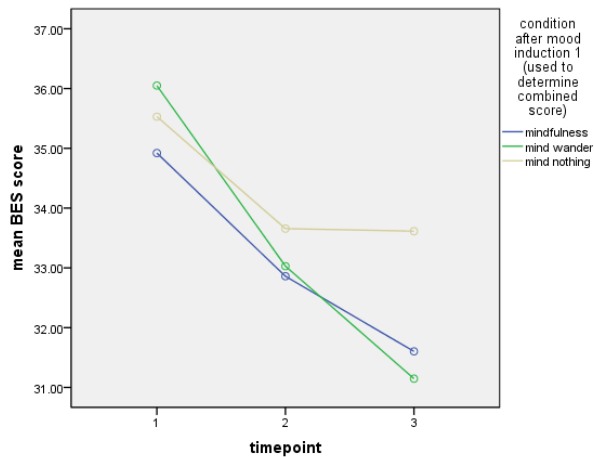
Figure 5. Graph to illustrate the mean BES scores over time for mindfulness

conditions when administrations 1 and 2 were combined. The combined score was

determined by using the condition after mood induction task 1.

Planned comparisons were conducted for significant results when administration 1

and administration 2 were combined. When comparing mindfulness with the mind

wander condition, the interaction between condition and time was not significant

($F(2, 80)=1.36$, $p=.264$, ES(f)=0.18). When comparing mindfulness with the passive

control condition, no significant differences were found and the effect size was small-

medium ($F(2, 80)=1.84$), $p=.166$, ES(f)=0.21).

A post hoc test was conducted to compare the active and passive control conditions.

The interaction between time and condition was found to be significant (Greenhouse-

Geisser $F(13.13, 122)=4.00$, $p=.006$).

Next, considering compress conditions, BES combined score a, BES combined score

b, BES combined score c were set as dependent variables, compress condition as the

between groups factor and HADS depression and order of administration as covariates. The interaction between time and condition was not significant ($F(3.06, 93,43)=1.32$, $p=.272$, ES(f)=0.10).

In order to determine the effect size for the comparison between the experimental and passive control conditions, a further test was conducted including only those in these two conditions. No significant interaction between time and condition was found ($F(2, 80)=.44$, $p=.643$, ES(f)=0.10).

Considering heart rate during mindfulness conditions, HR combined score a, HR combined score b, HR combined score c were set as dependent variables, mindfulness condition as the between groups factor and order of administration as a covariate. No significant interaction was found between time and condition ($F(4, 114)=.85$, $p=.495$, ES(f)=0.17). Next, considering compress conditions, HR combined score a, HR combined score b, HR combined score c were set333333 as dependent variables, compress condition as the between groups factor and HADS depression and order of administration as covariates. No significant interaction was found between time and condition ($F(3.453, 93.22)=.51$, $p=.701$, ES(f)=0.15).

Manipulation Checks

An assumption was made that people in the mindfulness condition would focus more on their breathing because they have been asked to. As the data are normally distributed, a t-test was used. For administration 1, the three mindfulness conditions were significantly different in the amount that participants focused on their breathing

($F(2)=38.69$, $p<.001$). The three mindfulness conditions were also found to be significantly different at administration 2 ($F(2)41.14$, $p<.001$). T-tests were carried out to investigate where these differences lie. Those in the mindfulness group reported more focus on their breath than the other two groups, for both administrations. The assumption was made that participants in the three compress conditions would not differ in the amount that they focused on their breathing. The three compress conditions were not significantly different in terms of the amount that participants focused on their breath at either time point.

Discussion

One of the main objectives of this study was to test the feasibility of the laboratory paradigm. This was investigated in three ways. Firstly, via the extent to which the approach motivation induction task evoked a state of approach to reward. Approach to reward increased in 80.3% of participants post mood induction 1, and in 86.3% of participants post mood induction 2. This suggests that the task was successful.

Next, a crossover design was tested. Examining the results, different patterns emerged between administrations 1 and 2, for self-report and for heart rate. At administration 1, there was a trend for mindfulness to be different to the passive control condition, but not different to the active control condition. Given the large effect size, with a larger sample, the mindfulness condition might have been found to be effective relative to the passive control. However, the active control (mind wander) was shown to be significantly different to the passive control. At administration 2, however, no significance differences were found. When administrations 1 and 2 were combined, the active control was again found to be

different from the passive control. This finding does not support existing literature that being in a mindful state is the key to reducing arousal. Reasons for the effectiveness of the active control condition (letting the mind wander) could include distraction away from the task, or rhythmic concentration on the dummy dial, which was constant through both the experimental and active control conditions. Heart rate results for the cold compress condition show a similar pattern, in that a significant difference was found at administration 1 only. This suggests that something occurred at administration 2 that caused the condition to be less effective. This could be due to fatigue effects, or contamination effects of the first condition upon the second.

Finally, the manipulation checks found that validity of the mindfulness condition was high, in that participants reported that they were thinking about their breathing more so in this condition than in either of the control conditions.

Another main aim of this study was to determine the likely size of the deactivating effect that "dive reflex" and "mindfulness" techniques have upon elevated approach motivation. The secondary objective was to investigate whether mindfulness and cold compress conditions promoted recovery from an increase in approach motivation following an exciting trigger. Due to the different patterns of results found between administrations 1 and 2, it cannot be ascertained which findings are most reliable, or whether these time points can be reliably combined. It seems reasonable to assume that results at administration 1 are reliable due to this being participants' initial exposure to a condition. Also, significant results were found regardless of a small sample size, when only considering administration 1. Indeed, self report data for the mindfulness techniques showed an interaction between time and condition, as did

heart rate data with respect to the compress techniques. Taking the findings from administration 1, relative to the passive control condition the mindfulness technique appears to have a large effect size on self-report of approach motivation, whilst the cold compress technique appears to have a large effect size on heart rate.

It is interesting that the mental condition (mindfulness) was found to be significant through self-report, whereas the physical condition (cold compress) was found to be significant through physiological response.

Kabat-Zinn (1990) notes that mindfulness assists recovery after a stressor and Greeson & Brantley (2008) believe this to be effective in calming mood even after a few minutes. Indeed, the instructions used in the current study reflect a standard, short mindfulness exercise. It was novel to investigate the use of mindfulness after a positive emotion and it is postulated that mindfulness could be a useful self-help technique for people experiencing heightened approach to reward, in order to calm their mood. However, as participants in the mind wander condition recovered at least as quickly from heightened states of arousal, as reported in the BES, the effective components of these techniques should be investigated further. However, the trend towards a faster recovery in the mindfulness condition compared to passive control implies that mindfulness may have enhanced PNS activity, as proposed by polyvagal theory. Polyvagal theory suggests certain techniques that evoke PNS activity and should help reduce approach motivation, which involves high levels of SNS activity (Porges, 2007). It is known that the cold compress activates the PNS via the old vagal pathway, immobilising the body's resources in response to perceived threat (Khurana et al, 1980; Haddad et al, 2010). This was supported by current findings, whereby

heart rate in participants in the cold compress condition decreased more than

participants in the control conditions.

Physiological and psychological processes were assessed simultaneously in this study,

which fits with the implication that considering biological correlates along side

psychological, assists the development of self-regulation and self-monitoring

(Harmon-Jones, 2008). In addition to testing mood pre and post-manipulation, the

current study monitored mood throughout the recovery phase, which previous

research has not. Even though reaction time tasks highlight individual differences in

motivation, previous studies have not accounted for returning to baseline after

heightened arousal (Robinson , Meier, Tamir, Wilkowski, and Ode, 2009). Active

and passive controls were compared with experimental conditions. This has added to

the literature in looking at the cold compress alongside a comparable physical

condition. This study is valuable in the current trend of research that looks at cardiac

functioning as a measure of SNS-linked cardiac activity during reward tasks (Crowell

et al, 2006). The focus on excitement rather than a negative emotion, is particularly

novel. No existing literature linked polyvagal theory to excitement and approach

motivation. There is also limited research around deactivating physiological arousal

following experimental manipulation, which the current study explores. There was

virtually no previous research using mindfulness or dive reflex conditions in relation

to approach motivation. Nor were there any experimental studies examining these

conditions in regulating approach motivation following positive mood induction.

There are a number of limitations to the current study. Self-report revealed the task to

have increased approach motivation for most participants, however, heart rate data did

not reflect this so the task should be adapted further. Heart rate decreased post-task but may not have been related to approach motivation, therefore Cardiac PEP may have been a better measure. Where significant results were found, they were not the same for both self-report and heart rate.

Even though significant results were found for some comparisons, a larger sample would help generalisability of findings. Due to the cross over design and different pattern of findings at each administration, reliability cannot be ascertained. Perhaps with a larger sample, different results would emerge. The sample comprised mostly of female psychology students aged 18-20. Ideally the findings would be applied to people with BD, however, inducing approach motivation in a laboratory is limited and may not be a good analogue of mania.

Even though the manipulation checks suggest the mindfulness condition to be valid, it might not have reflected a full definition of mindfulness as staying in the moment (Linehan, 1993). The temperatures of the compresses when applied at the start of the technique were based on past research, however it is not known how long the compresses remained at their required temperatures during the recovery phase. Other variables may have affected recovery to baseline.

It should be noted that extraneous variables, which were not controlled for, could have affected vagal control and therefore RSA, PEP and heart rate data. The experimenter could have asked for details of current or recent drug use, general physical and mental health status, and levels of tiredness, stress or arousal.

Future replications could use similar manipulations in larger samples in order to adequately test the secondary hypotheses, which could not be investigated fully during this study. Each participant completing the task once only might ensure more representative data. Using people with BD would provide more clinically relevant findings. The task could also be adapted in order to strengthen its physiological effect.

Further replications of mindfulness and mind wander conditions would be beneficial in deconstructing what the effective components are (e.g. distraction, rhythmic concentration). In addition, keeping the cold compress at a constant temperature throughout the recovery phase by having various compresses might strengthen its effect and produce comparable data from self-report as well as heart rate.

There is a need for the development of techniques that moderate vagal activity to an optimum, enabling individuals to respond appropriately to their environment (Beauchaine, 2001). It would be interesting to investigate the effects of heart rate recovery and variability, via the PNS, after different types of tasks, eliciting positive emotions, in order to develop treatment for a range of mood disorders, including BD. Cardiac PEP might have given better indications of approach motivation than heart rate.

Although the current results cannot be generalised to BD, there appears to be an active component in some mental activities that reduces approach to reward after an exciting task. As the new vagus works more quickly, this might be a more efficient

self-help technique. These findings could lead to further research into self-help

techniques that can assist in calming individuals' levels of arousal, potentially mania.

It is useful to consider cardiac functioning as a measure of SNS-linked cardiac

activity during reward tasks and links have now been made between polyvagal theory,

excitement and approach motivation, which might help build understanding and

educate clinicians. Excitement and positive emotions are beginning to come into

focus as clinical constructs worthy of attention. Learning how to deactivate

physiological arousal following experimental manipulation is functional in developing

self-help techniques such as regulation and monitoring. Some clients find it difficult

to engage in psychological therapy and therapists might help this process via emotion

regulation. If activation of the PNS generates calmness, the client can feel safer and

more open to engage.

The relative effectiveness of letting the mind wander compared to mindfulness could

be considered in treatment, where people struggle to focus on the moment. Perhaps

mind wander is an initial phase leading to mindfulness, which might work better for

some individuals and even enhance therapeutic engagement. It could be that building

distraction or rhythmic concentration techniques into therapy is more beneficial. The

possible contamination of the first condition upon the second could be reflected

therapeutically in terms of the structure of techniques during the treatment phase.

Again, this might help educate clinicians about the ways in which therapy might

develop.

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Appendix 1: Positive and Negative Affect Schedule (PANAS)

Directions:

This scale consists of a number of words that describe different feelings and emotions. Read each item and then circle the appropriate answer next to that word. Indicate to what extent you feel this way <u>right now, that is, at the present moment</u>.

Use the following scale to record your answers.

(1)   =   very slightly or not at all
(2)   =   A little
(3)   =   Moderately
(4)   =   Quite a bit
(5)   =   Extremely

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
1. Interested	1	2	3	4	5
2. Distressed	1	2	3	4	5
3. Excited	1	2	3	4	5
4. Upset	1	2	3	4	5
5. Strong	1	2	3	4	5
6. Guilty	1	2	3	4	5
7. Scared	1	2	3	4	5
8. Hostile	1	2	3	4	5
9. Enthusiastic	1	2	3	4	5
10. Proud	1	2	3	4	5
11. Irritable	1	2	3	4	5
12. Alert	1	2	3	4	5
13. Ashamed	1	2	3	4	5
14. Inspired	1	2	3	4	5
15. Nervous	1	2	3	4	5
16. Determined	1	2	3	4	5
17. Attentive	1	2	3	4	5
18. Jittery	1	2	3	4	5
19. Active	1	2	3	4	5
20. Afraid	1	2	3	4	5

Hospital Anxiety and
Depression Scale (HADS)

nferNelson
understanding potential

Name: _____ Date: _____

FOLD HERE

FOLD HERE

Clinicians are aware that emotions pay an important part in most illnesses. If your clinician knows about these feelings he or she will be able to help you more.

This questionnaire is designed to help your clinician to know how you feel. Read each item below and **underline the reply** which comes closest to how you have been feeling in the past week. Ignore the numbers printed at the edge of the questionnaire.

Don't take too long over your replies, your immediate reaction to each item will probably be more accurate than a long, thought-out response.

A   D

I feel tense or 'wound up'
- [3] Most of the time
- [2] A lot of the time
- [1] From time to time, occasionally
- [0] Not at all

I still enjoy the things I used to enjoy
- [0] Definitely as much
- [1] Not quite so much
- [2] Only a little
- [3] Hardly at all

I get a sort of frightened feeling as if something awful is about to happen
- [3] Very definitely and quite badly
- [2] Yes, but not too badly
- [1] A little, but it doesn't worry me
- [0] Not at all

I can laugh and see the funny side of things
- [0] As much as I always could
- [1] Not quite so much now
- [2] Definitely not so much now
- [3] Not at all

Worrying thoughts go through my mind
- [3] A great deal of the time
- [2] A lot of the time
- [1] Not too often
- [0] Very little

I feel cheerful
- [3] Never
- [2] Not often
- [1] Sometimes
- [0] Most of the time

I can sit at ease and feel relaxed
- [0] Definitely
- [1] Usually
- [2] Not often
- [3] Not at all

A   D

I feel as if I am slowed down
- Nearly all the time [3]
- Very often [2]
- Sometimes [1]
- Not at all [0]

I get a sort of frightened feeling like 'butterflies' in the stomach
- Not at all [0]
- Occasionally [1]
- Quite often [2]
- Very often [3]

I have lost interest in my appearance
- Definitely [3]
- I don't take as much care as I should [2]
- I may not take quite as much care [1]
- I take just as much care as ever [0]

I feel restless as if I have to be on the move
- Very much indeed [3]
- Quite a lot [2]
- Not very much [1]
- Not at all [0]

I look forward with enjoyment to things
- As much as I ever did [0]
- Rather less than I used to [1]
- Definitely less than I used to [2]
- Hardly at all [3]

I get sudden feelings of panic
- Very often indeed [3]
- Quite often [2]
- Not very often [1]
- Not at all [0]

I can enjoy a good book or radio or television programme
- Often [0]
- Sometimes [1]
- Not often [2]
- Very seldom [3]

Now check that you have answered all the questions

A   D

TOTAL [ ][ ]

Appendix 3: Behavioural Engagement Scales (BES)

<u>Circle ONE statement in EACH section that best describes
how you feel at the PRESENT MOMENT</u>

A.
1. Exuberant vitality, surging with energy
2. Vigorous, extremely energetic
3. Active, lively, animated
4. Fresh, slightly energetic
5. Fairly fresh, adequate energy
6. Slightly tired, somewhat lacking in energy
7. Rather tired, lethargic, not much energy
8. Very fatigued, sluggish
9. Tremendously weary, hard to keep going
10. Utterly exhausted, entirely worn out, practically
    at a standstill

B.
1. Everything is possible for me
2. Extremely optimistic
3. Very confident about things
4. Feel self-assured, things seem good
5. Feel adequate about myself and prospects
6. Slightly discouraged about things
7. Little confidence in things, about my abilities
8. Feel inadequate, nothing seems to be going right
9. Extremely pessimistic about everything
10. Everything seems bleak and futile, feel totally inept

C.
1. Elated, euphoric, ecstatic
2. Tremendous delight and happiness
3. Cheerful, in high spirits
4. Pretty good
5. O.K.
6. A little bit low
7. In low spirits, somewhat sad and blue
8. Clearly depressed
9. Very depressed, feels painful
10. Utter depression and gloom

D.
1. Thoughts are literally racing through my head
2. I have rapid, penetrating ideas
3. Thoughts come quickly and effortlessly
4. Thoughts are fairly quick and clear
5. My mind is alert
6. Not particularly alert
7. Thoughts are slow, takes longer to pick up on   things
8. Thoughts are sluggish
9. My mind feels dull and monotonous
10. My mind is stagnant, dead, nothing moves

E.
1. Passionately absorbed in the world's excitement
2. Excited, stimulated, great zest for life
3. Enthusiastic about life
4. Motivated and interested in things
5. Somewhat interested in things
6. Not very enthusiastic about things
7. Generally unenthusiastic about life
8. Apathetic, unmotivated
9. No real interest or desire for anything
10. Nothing is interesting - not even family or friends.

Appendix 4: Hypomanic Personality Scale (HPS)

Instructions:
Please answer each item true or false. Please do not skip any items. It is important that you answer every item, even if you are not quite certain which is the best answer. An occasional item may refer to experiences that you have had only when taking drugs. Unless you have had the experience at other times (when not under the influence of drugs), mark it as if you have not had that experience.

Some items may sound like others, but all of them are slightly different. Answer each item individually, and don't worry about how you answered a somewhat similar previous item.

Circle either:

_____
___

True   False   1. I consider myself to be pretty much an average kind of person.

True   False   2. It would make me nervous to play the clown in front of other people.

True   False   3. I am frequently so "hyper" that my friends kiddingly ask me what drug I'm taking.

True   False   4. I think I would make a good nightclub comedian.

True   False   5. Sometimes ideas and insights come to me so fast that I cannot express them all.

True   False   6. When with groups of people, I usually prefer to let someone else be the center of attention.

True   False   7. In unfamiliar surroundings, I am often so assertive and sociable that I surprise myself.

True   False   8. There are often times when I am so restless that it is impossible for me to sit still.

True   False   9. Many people consider me to be amusing but kind of eccentric.

True   False   10. When I feel an emotion, I usually feel it with extreme intensity.

True   False   11. I am frequently in such high spirits that I can't concentrate on any one thing for too long.

True   False   12. I sometimes have felt that nothing can happen to me until I do what I am meant to do in life.

True   False   13. People often come to me when they need a clever idea.

True   False   14. I am no more self-aware than the majority of people.

True   False   15. I often feel excited and happy for no apparent reason.

True   False   16. I can't imagine that anyone would ever write a book about my life.

True   False   17. I am usually in an average sort of mood, not too high and not too low.

True   False   18. I often have moods where I feel so energetic and optimistic that I feel I could outperform almost anyone at anything.

True   False   19. I have such a wide range of interests that I often don't know what to do next.

True   False   20. There have often been times when I had such an excess of energy that I felt little need to sleep at night.

True   False   21. My moods do not seem to fluctuate any more than most people's do.

True   False   22. I very frequently get into moods where I wish I could be everywhere and do everything at once.

True   False   23. I expect that someday I will succeed in several different professions.

True   False   24. When I feel very excited and happy, I almost always know the reason why.

True   False   25. When I go to a gathering where I don't know anyone, it usually takes me a while to feel comfortable.

True   False   26. I think I would make a good actor, because I can play many roles convincingly.

True   False   27. I like to have others think of me as a normal kind of person.

True   False   28. I frequently write down the thoughts and insights that come to me when I am thinking especially creatively.

True   False   29. I have often persuaded groups of friends to do something really adventurous or crazy.

True   False   30. I would really enjoy being a politician and hitting the campaign trail.

True   False   31. I can usually slow myself down when I want to.

True   False   32. I am considered to be kind of a "hyper" person.

True   False   33. I often get so happy and energetic that I am almost giddy.

True   Fasle   34. There are so many fields I could succeed in that it seems a shame to have to pick one.

True   False   35. I often get into moods where I feel like many of the rules of life don't apply to me.

True   False   36. I find it easy to get others to become sexually interested in me.

True   False   37. I seem to be a person whose mood goes up and down easily.

True   False   38. I frequently find that my thoughts are racing.

True   False   39. I am so good at controlling others that it sometimes scares me.

True   False   40. At social gatherings, I am usually the "life of the party".

True   False   41. I do most of my best work during brief periods of intense inspiration.

True   False   42. I seem to have an uncommon ability to persuade and inspire others.

True   False   43. I have often been so excited about an involving project that I didn't care about eating or sleeping.

True   False   44. I frequently get into moods where I feel very speeded-up and irritable.

True   False   45. I have often felt happy and irritable at the same time.

True   False   46. I often get into excited moods where it's almost impossible for me to stop talking.

True   False   47. I would rather be an ordinary success in life than a spectacular failure.

True   False   48. A hundred years after I'm dead, my achievements will probably have been forgotten.

Appendix 5: Mood Induction Task Instructions

"You will now see some black squares appearing on the computer screen, of which there will be 4 at a time. For each set of 4 squares, one will turn red. What you need to do is press the key that corresponds to the red square as quickly and as accurately as possible. You could receive a reward at the end of the task depending on how fast and accurate your performance is".

Example of false feedback to maintain excitement, during task completion:

"Well done, your fast and accurate responses puts you in the top 7% of people who have completed this task, which means you could win a prize".

Appendix 6: Condition Instructions

1) Cold Compress: "I will now place this cold compress in your forehead, which I would like you to keep there, if you can, until I remove it".

2) Warm Compress: "I will now place this warm compress in your forehead, which I would like you to keep there, if you can, until I remove it".

3) Mindfulness: "Please turn this dial to the left each time you inhale, and to the right each time you exhale, for a few minutes, until I ask you to stop. Do not try to change your breathing, just notice it and turn the dial accordingly".

4) Mind Wander: "Please sit comfortably and quietly for a few minutes and let your mind wander, until I prompt you to come back to the experiment".

5) Do Nothing: "I am not going to ask you to do anything for a few minutes, so that we can get ready for the next part of the experiment".

Appendix 7: Email Invitation for Research Participation (Pre-Pilot Study)

Email Title: Invitation to take part in a research study (for research credit) – please delete if not interested

Title of Study: Challenge tasks, bodily reactions and emotional response: A pilot study

This is an invitation to participate in a pilot for an experiment: if you are not interested please delete this message.

 I am running a study to investigate a novel experiment, to check that it is feasible and the likely effects that it will produce. Taking part involves doing tasks in which you have to react quickly to coloured shapes on a computer screen. You will be asked to complete a questionnaire about your current mood on several occasions.

If you would like to find out more and/or you are interested in taking part, please contact the researcher directly at ████████████████, who will supply you with additional information including a full participant information sheet and consent form.

Thank you.

██████████

Trainee Clinical Psychologist

Appendix 8: Participant Information Sheet and Consent Form (Pre-Pilot Study)

Title of Study: Challenge tasks, bodily reactions and emotional response
Purpose of Study: A Pilot Study.

This is a pilot for an experimental study about task performance, reward and emotions and will look at things that can affect these.

Being a "pilot" study, this means that it is carried out to see if the experiment that we would like to run is feasible, and to give us an idea of the best way of running a larger, main study.

Procedure

You will be asked to attend a single testing session, which will last around 45 minutes.
During the experiment you will be asked to complete a computer-based task that involves reacting to coloured shapes on two occasions. If you do well at this you will have the opportunity to win a small prize. You will be asked to complete a short questionnaire about your current mood state at several points during the experiment.

Remuneration

You will receive a single payment for your involvement, or alternatively, first year Psychology students can choose to accept course credits.

Ethical Consideration

You will be asked a few questions about your current mood state when we begin the experiment, and again during the experiment.
In the unlikely event that the mood questionnaires show that you are experiencing significant emotional distress, you can be signposted to relevant services and support networks that may help you, if you wish.

Benefits

There are no intended direct benefits to participants, other than receipt of either course credits or payment for your participation.

Confidentiality

The information you give will be kept strictly confidential and will be identified by an identification code, not your name. Any form that requires your name (e.g., this consent form) will be stored separately from the other material. Your name or other identifying information will never be associated with any research reports or publications that use the results of your questionnaires or experiment results.

Withdrawal/Premature Completion

Your participation in the evaluation is voluntary, and you may discontinue at any time, without prejudice. Whilst we would like you to complete questionnaires as fully as possible, you do not have to answer any question you do not wish to.

Invitation to ask further questions

You may ask any questions you have concerning this study before you sign this consent form and feel free to raise any queries you have throughout the testing period.

Consent

Should you be willing to take part, please sign the following declaration:
I give my informed consent to participate in this study of "Challenge tasks, bodily reactions and emotional response: A pilot study". *I have read and understood the participant information sheet and consent form.*

Participant Name: (Printed)
Date:
Signature:

Investigator Name: (Printed)
Date:
Signature:

Any questions can be directed to the researcher or supervisor on the details below:

███████ Trainee Clinical Psychologist Email: ████████████	███████ Clinical Psychologist Email: ████████████

Concerns about the study can be addressed to the Chair of the Ethics Committee, School of Psychology, University of Exeter.

Appendix 9: Email Invitation for Research Participation (Main Pilot Study)

Email Title: Invitation to take part in a research study (for research credits) – please delete if not interested

Title of Study: Challenge tasks, bodily reactions and emotional response.

This is an invitation to participate in an experiment: if you are not interested please delete this message.

I am running a study to investigate a novel experiment, to check that it is feasible and the likely effects that it will produce. Taking part involves doing tasks in which you have to react quickly to coloured shapes, and you may also be asked to do tasks that involve pressing a pack to your forehead, or thinking about certain things. You will be asked to complete questionnaires about your current mood, and to wear some electrodes so that certain aspects of your body state can be monitored during your participation.

If you would like to find out more and/or you are interested in taking part, please contact the researcher directly at ███████████████, who will supply you with additional information including a full participant information sheet and consent form.

Thank you.

██████████

Trainee Clinical Psychologist

Appendix 10: Participant Information Sheet and Consent Form (Main Pilot

Study)

Title of Study: Challenge tasks, bodily reactions and emotional response.

Purpose of Study

This is an experimental study about task performance, reward and emotions and will look at things that can affect these.

This study is a "pilot" study, which means that it is carried out to see if the experiment that we would like to run is feasible, and to give us an idea of how strong any effects would be.

Procedure

You will be asked to attend a single testing session, which will last around one hour. During the experiment you will be asked to complete a computer-based task that involves reacting to coloured shapes on two occasions. If you do well at this you will have the opportunity to win a small prize. You will also complete some other tasks that could involve pressing a pack to your forehead, or thinking about certain things. You will be asked to complete some short questionnaires about your current mood state at several points during the experiment. You will have electrodes attached to your torso, so that your physiological state can be monitored. We will also use a remote eye tracker to monitor your eye activity: this is wall-mounted so does not involve wearing any equipment.

Remuneration

You will receive a small single payment for your involvement, or alternatively, first year Psychology students can choose to accept course credits.

Ethical Consideration

You will need to wear loose fitting clothing on the day of testing, in order to have electrodes attached to your torso easily and unobtrusively. These electrodes will measure physiological changes during the experiment and should be comfortable for you to wear.
You will be asked a few questions about your current mood state and about your personality when we begin the experiment, and about your mood state again during the experiment.
In the unlikely event that the questionnaires show that you are experiencing significant levels of psychological distress, you can be signposted to relevant services and support networks that may help you, if you wish.

Benefits

There are no intended direct benefits to participants, other than receipt of either course credits or payment for your participation.

Confidentiality

The information you give will be kept strictly confidential and will be identified by an identification code, not your name. Any form that requires your name (e.g., this consent form) will be stored separately from the other material. Your name or other identifying information will never be associated with any research reports or publications that use the results of your questionnaires or experiment results.

Withdrawal/Premature Completion

Your participation in the evaluation is voluntary, and you may discontinue at any time, without prejudice. Whilst we would like you to complete questionnaires as fully as possible, you do not have to answer any question you do not wish to.

Invitation to ask further questions

You may ask any questions you have concerning this study before you sign this consent form and feel free to raise any queries you have throughout the testing period.

Consent

Should you be willing to take part, please sign the following declaration:
I give my informed consent to participate in this study of *"Challenge tasks, bodily reactions and emotional response"*. I have read and understood the participant information sheet and consent form.

Participant Name: (Printed)
Date:
Signature:

Investigator Name: (Printed)
Date:
Signature:

Any questions can be directed to the researcher or supervisor on the details below:

▮▮▮▮▮▮▮ Trainee Clinical Psychologist Email: ▮▮▮▮▮▮▮▮▮	▮▮▮▮▮▮▮ Clinical Psychologist Email: ▮▮▮▮▮▮▮

Concerns about the study can be addressed to the Chair of the Ethics Committee, School of Psychology, University of Exeter.

Appendix 11: Letter of Ethical Approval

UNIVERSITY OF EXETER

SCHOOL of PSYCHOLOGY
ETHICS COMMITTEE

Washington Singer Laboratories
Perry Road
Exeter
EX4 4QG

Telephone   +44 (0)1392 264626
Fax   +44 (0)1392 264623
Email   m.l.dexter@exeter.ac.uk

To:	**Victoria Barnes**
From:	**Louise Pendry**
CC:	**Kim Wright**
Re:	**Application 2009/150 Ethics Committee**
Date:	**April 18, 2011**

The School of Psychology Ethics Committee has now met and discussed the amendments to your proposal, **2009/150** - ***Utilising Mindfulness and the Dive Reflex as Techniques from Polyvagal Theory to Regulate Approach Motivation***. The project has been approved in principle for the duration of your study.

The agreement of the Committee is subject to your compliance with the British Psychological Society Code of Conduct and the University of Exeter procedures for data protection (http://www.ex.ac.uk/admin/academic/datapro/). In any correspondence with the Ethics Committee about this application, please quote the reference number above.

I wish you every success with your research.

L. Pendry

Louise Pendry
Chair of School Ethics Committee

Appendix 12: Sample Size Calculation

Given the absence of published research using the proposed experimental paradigm, a primary aim of this study was to inform sample size calculations for future studies. In order to determine sample size in the current study, the most relevant existing experimental design using a cold compress and physiological measures (Haddad, Laursen, Ahmaidi & Buchheit, 2010), was considered and was found to have a large effect size. This does not include the condition of mindfulness. Within the mindfulness literature, there is a wide range of effect sizes and no single study is directly comparable. On the basis of the information available, 22 participants in each of the 3 conditions (active technique, active control, passive control) were deemed sufficient to detect a large effect size ($f = 0.4$) with a power of 0.8.

Appendix 13: User Consultation

A non-service user population was used. The results will be relevant for individuals with Bipolar Disorder. The project was presented to the Torbay Bipolar Group to gather their ideas and comments before testing, in order to reflect upon clinical relevance and alter the design where necessary. Upon project completion, the research findings will be offered to this group in a feedback meeting (See Dissemination Statement, Appendix 15).

Appendix 14: Dissemination Statement

In order to benefit a wide audience of service users, mental health professionals, academics and the general public, the intended dissemination of the research includes:

- Submission for publication to the Journal of Abnormal Psychology, which has been selected as it publishes a range of research in this area and places a strong emphasis on clinical relevance. This journal has a target audience of psychologists, psychiatrists, and other mental health professionals.
- Submission to further journals will be made, as appropriate.
- Presentation at the BABCP conference.
- Feedback to the Torbay Bipolar Group, following an initial meeting pre-testing phase. This group comprises of individuals experiencing Bipolar Disorder themselves and therefore this feedback session will allow me to disseminate to service users directly, with a view to my research being passed on to others via the group. It will also allow service users to comment on my findings and discuss possible plans for future research.
- A summary of the findings will be offered to any participants who request to be informed. This summary will contain my contact details and a reference to any publications resulting from the study.
- A presentation to trainee clinical psychologists.
- My research supervisor will disseminate my research and any publications, as and when necessary, to future Doctorate or PhD students who undertake research in this area.

Appendix 15: Written Procedure

The Biobehavioural Lab of the University of Exeter Mood Disorders Centre was set up with the relevant equipment. Participants completed the four preliminary questionnaires upon arrival.

Participants were given a brief explanation of the Physiological Measures as follows:

1) Cardiac Functioning: "Electrodes will be attached to parts of your chest, neck and back, in order to continually monitor physiological changes that relate to the things I am investigating in this study. Should this become uncomfortable at any time please let me know."

2) Respiration: "The respiration band will fit around your waist in order to monitor your breathing, which is useful in looking at some of the variables I am investigating in this study."

3) GSCR: "Two electrodes will be attached to two fingers on your non-dominant hand, which you will keep relatively still and not use for the computer based task. This will give me useful data for my experiment."

Instructions for Mood Induction Task 1 were given (See Appendix 5). Participants completed Mood Induction Task 1, which lasted approximately 4 minutes and included feedback (See Appendix 5). This feedback was identical for all participants and was intended to increase levels of approach motivation. Immediately after the first Mood Induction Task, instructions for Condition 1 were given and participants completed Condition 1 (See Appendix 6). Participants completed the BES at 2.5 minute intervals throughout this period, for a minimum of 5 minutes and a maximum of 15 minutes, or as long as it took for their BES score to return to baseline. Time taken to return to baseline was recorded. Next, instructions for Mood Induction Task 2 were given and participants completed Mood Induction Task 2 (Identical to mood induction task 1). Immediately afterwards, instructions for Condition 2 were given and participants then completed Condition 2. Again, participants completed the BES at 2.5 minute intervals throughout this period, for a minimum of 5 minutes and a maximum of 15 minutes, or as long as it took for their BES score to return to baseline. Time taken to return to baseline was recorded. At this point, a manipulation check was administered to ensure that participants were not experiencing the effects of the first condition at this time. For this purpose, participants were asked to rate the amount which they were focussing on their breathing, on a scale of 1-10, along with qualitative details of what they were thinking about. At this point, the experiment was complete, physiological data ceased, and all equipment was released. Participants were debriefed and had the opportunity to ask any questions.

In terms of continual data collection, the self-report assessment of mood (BES) was completed pre-task, post-task, then again at 2.5-minute intervals during the recovery to baseline phases during each condition. In addition, throughout the experimentation period, Cardiac PEP, RSA, Respiration and GSCR were continuously monitored and recorded using BIOPAC equipment.

Appendix 16: Means and Standard Deviations of Key Variables

Variable	Mean/Median	SD/Range
Gender	1.4091	.49543
Age*	21	18-38
HADS depression	5.5909	2.37278
HADS anxiety*	2	0-7
HPS total*	10.5	0-32
PANAS positive total	28.8939	6.40223
PANAS negative total	12.8636	4.18748
BES 1a total reversed	32.7879	4.26981
BES 1b total reversed	34.3182	3.65917
BES baseline 1 reversed	33.5455	3.64135
BES 2a total reversed	36.0606	3.93360
BES 2b total reversed	33.6667	3.85241
BES 2c total reversed	32.3939	3.89034
BES 2d total reversed	32.7222	5.17693
BES 2e total reversed	33.1818	5.47391
BES 2f total reversed	34.4286	5.12696
BES 2g total reversed	34.6000	5.94138
BES baseline 2 reversed	31.6061	4.23857
BES 3a total reversed	34.3939	4.50599
BES 3b total reversed	32.3333	4.12994
BES 3c total reversed	31.6667	4.06233
BES 3d total reversed	30.8889	5.13224
BES 3e total reversed	30.9000	8.11651
BES 3f total reversed	33.1429	3.89138
BES 3g total reversed	34.1429	4.14039
Manipulation check 1*	1	1-10
Manipulation check 2*	1	1-10

*non-normally distributed variables, where median and range is reported.

Appendix 17: Histograms for demographics, self-report and heart rate data

age of participant

Mean = 23.70
Std. Dev. = 6.122
N = 66

change in bes scores after task1

Mean = 1.74
Std. Dev. = 2.863
N = 66

change in bes scores after task2

Mean = 2.79
Std. Dev. = 2.692
N = 66

HADS depression score

Mean = 5.59
Std. Dev. = 2.373
N = 66

HADS anxiety score

Mean = 2.09
Std. Dev. = 2.013
N = 66

hpstot

Mean = 12.33
Std. Dev. = 8.238
N = 66

positive and negative affect scale positive total

Mean = 28.89
Std. Dev. = 6.402
N = 66

positive and negative affect scale negative total

Mean = 12.86
Std. Dev. = 4.187
N = 66

behavioural engagement scales 1a total reversed

Mean = 32.79
Std. Dev. = 4.27
N = 66

bes1btotrev

Mean = 34.32
Std. Dev. = 3.659
N = 66

behavioural engagement scales baseline 1 reversed

Mean = 33.55
Std. Dev. = 3.641
N = 66

bes2atotrev

Mean = 36.06
Std. Dev. = 3.934
N = 66

bes2btotrev

Mean = 33.67
Std. Dev. = 3.852
N = 66

bes2ctotrev

Mean = 32.39
Std. Dev. = 3.89
N = 66

bes2dtotrev

Mean = 32.72
Std. Dev. = 5.177
N = 18

bes2etotrev

Mean = 33.18
Std. Dev. = 5.474
N = 11

bes2ftotrev

Mean = 34.43
Std. Dev. = 5.127
N = 7

bes2gtotrev

Mean = 34.60
Std. Dev. = 5.941
N = 5

behavioural engagement scale baseline at time 2 reverse score

Mean = 31.61
Std. Dev. = 4.239
N = 66

bes3atotrev

Mean = 34.39
Std. Dev. = 4.506
N = 66

bes3btotrev

Mean = 32.33
Std. Dev. = 4.13
N = 66

bes3ctotrev

Mean = 31.67
Std. Dev. = 4.062
N = 66

bes3dtotrev

Mean = 30.89
Std. Dev. = 5.132
N = 18

bes3etotrev

Mean = 30.90
Std. Dev. = 8.117
N = 10

bes3ftotrev

Mean = 33.14
Std. Dev. = 3.891
N = 7

bes3gtotrev

Mean = 34.14
Std. Dev. = 4.14
N = 7

extent thinking about breathing during technique 1

Mean = 3.03
Std. Dev. = 2.919
N = 66

77

extent thinking about breathing during technique 2

Mean = 3.20
Std. Dev. = 2.889
N = 66

extent thinking about breathing during technique 2

Mean = 76.565
Std. Dev. = 10.84652
N = 61

hr01

Mean = 76.3127
Std. Dev. = 10.34819
N = 61

hr02

Mean = 75.045
Std. Dev. = 9.53
N = 61

hr03

Mean = 74.3929
Std. Dev. = 9.48202
N = 61

hr04

Mean = 75.6686
Std. Dev. = 9.20466
N = 60

hr05

79

Mean = 74.2617
Std. Dev. = 8.7758
N = 59

Mean = 74.8992
Std. Dev. = 9.0842
N = 59

Appendix 18: Graphs comparing BES scores for mindfulness and compress conditions at each administration

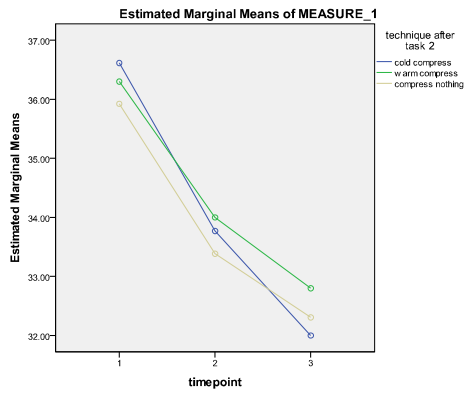Graph comparing the 3 mindfulness conditions at administration 1, illustrating a significant difference between mindfulness and mind nothing, and between mind wander and mind nothing conditions.

Graph comparing the 3 mindfulness conditions at administration 2.

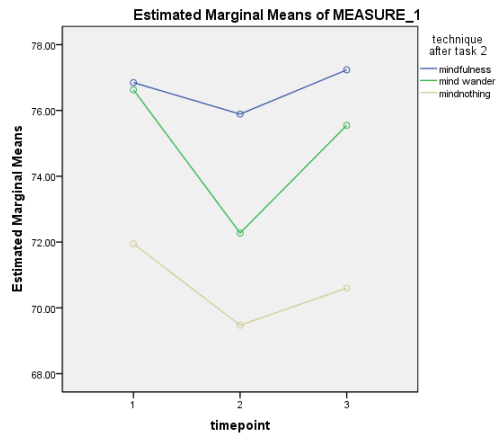Graph comparing the 3 mindfulness conditions at administrations 1 and 2 combined, illustrating a significant difference between mind wander and mind nothing conditions.

Graph comparing the 3 compress conditions at administration 1.

Estimated Marginal Means of MEASURE_1

technique after
task 1
— cold compress
— warm compress
— compress nothing

Estimated Marginal Means

timepoint

Graph comparing the 3 compress conditions at administration 2.

Estimated Marginal Means of MEASURE_1

technique after
task 2
— cold compress
— warm compress
— compress nothing

Estimated Marginal Means

timepoint

Graph comparing the 3 compress conditions at administrations 1 and 2 combined.

Estimated Marginal Means of MEASURE_1

cold compress
warm compress
and compress
nothing
conditions
— cold compress
— warm compress
— compress nothing

Estimated Marginal Means

timepoint

Covariates appearing in the model are evaluated at the following values: HADS anxiety score = 2.0909,
timecomp = 1.5455

Appendix 19: Graphs comparing heart rate data for mindfulness and compress conditions at each administration
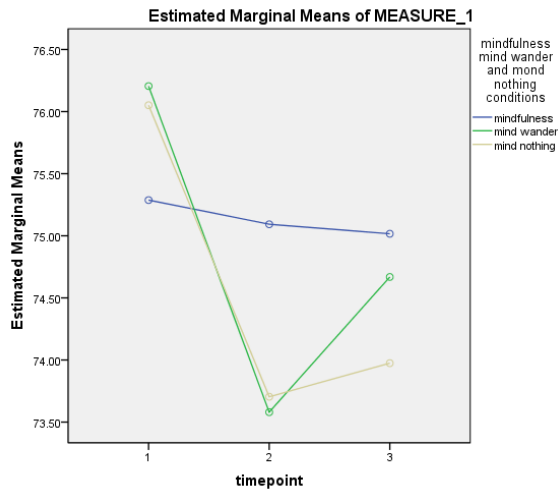
Graph comparing the 3 mindfulness conditions at administration 1.
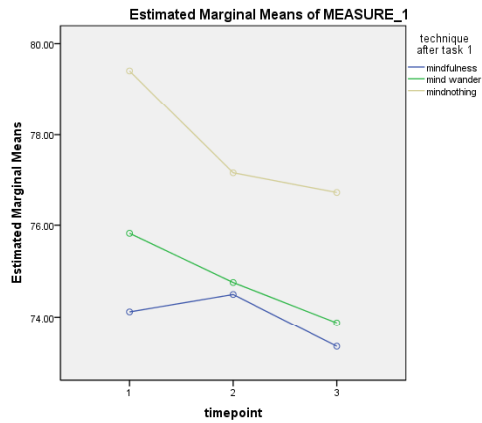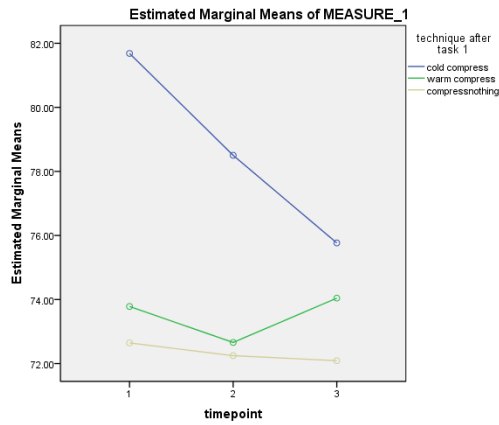

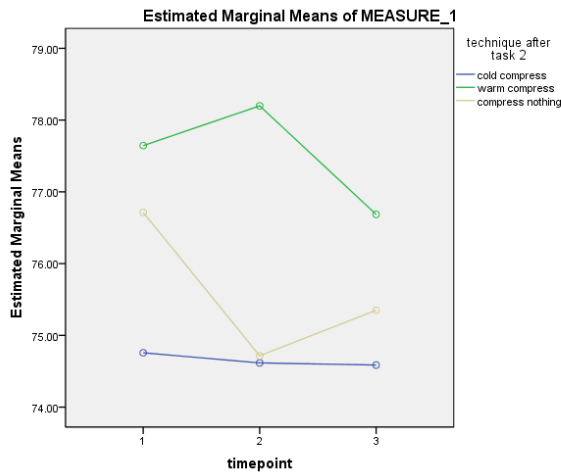Graph comparing the 3 mindfulness conditions at administration 2.

Graph comparing the 3 mindfulness conditions at administrations 1 and 2 combined.

Graph comparing the 3 compress conditions at administration 1, illustrating a significant difference between cold compress and warm compress conditions.

Graph comparing the 3 compress conditions at administration 2.

Graph comparing the 3 compress conditions at administrations 1 and 2 combined.
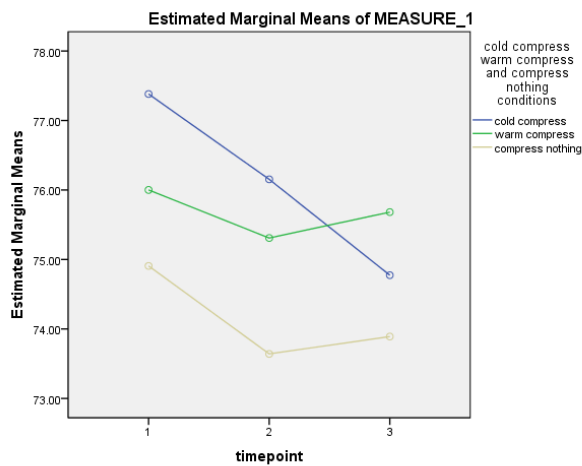
Covariates appearing in the model are evaluated at the following values: HADS depression score = 2.0517