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Does mindfulness facilitate critical thinking?

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Registration date 07/01/2016	**Overall study status** Completed	[_] Statistical analysis plan [X] Results
Last Edited 09/04/2018	**Condition category** Other	[_] Individual participant data

Plain English summary of protocol

Background and study aims
Mindfulness is a type of attention that people can engage in which is purported to have many benefits. This type of attention was first written about in traditional Buddhist texts where it was said to lead to clarity of thought and the reduction of suffering. This type of attention is usually engaged in through meditation. Mindfulness means paying attention only to what is happening right now without getting caught up in it or reacting to it emotionally. Despite its origins as a way of cultivating clarity of thought, few studies have been concerned with the link between mindfulness and thinking skills in typically developing individuals. Critical thinking is the ability to analyse and evaluate evidence and arguments without bias from experience and prior knowledge. The application of critical thinking requires a non-automatic response to a problem situation in order to avoid heuristic and biased thinking - another way of saying taking shortcuts in your thinking. Such non-automatic, critical and reflective responses are generally associated with thinking in a slow, deliberate manner rather than a fast, intuitive way. We call the ability to exert control over how we are thinking self-regulation. This study aims to investigate the relationship between regular mindfulness practice using the Headspace app, self-regulation, and critical thinking.

Who can participate?
Healthy volunteers between the ages of 18 and 65 who are students at the National University of Ireland, Galway.

What does the study involve?
Participation involves completing some tasks which include: telling us some demographic information, completing some thinking exercises (these involve considering a problem situation and telling us what you think the solution is), completing some questionnaires on how you generally pay attention, think and feel, and completing a memory task. Then participants use the Headspace app for 6 weeks to access 30 meditation sessions. Participants are randomly allocated to one of two meditation conditions: either mindfulness meditation or 'sham' meditation (these sessions discuss meditation and introduce breathing exercises under the guise of mindfulness practice). This allows participants to learn meditation in their own time and wherever they feel comfortable. This takes just 10 minutes per day and can be done anywhere at any time using the internet with either smartphone, tablet or personal computer.

What are the possible benefits and risks of participating?
Taking part in the Headspace Foundation's programme has been demonstrated to have beneficial effects on wellbeing which you might experience. Students recruited from the cohort of first and second year psychology students will receive course credit for participating in the study. Those that complete all measures at all time-points will receive a complimentary 6-month subscription to Headspace (worth about €60). In addition, you will have the opportunity to contribute to the understanding of the role of mindfulness in higher-order cognition. Participants will be informed of the results of the study when they are available. There is little risk to taking part. However, the questionnaires may highlight a small amount of emotional distress for some people, but previous studies suggest that only a small number of participants experience this. Completing the questionnaires and the intervention is voluntary and if it does bring up difficulties we can recommend relevant professionals who can be contacted.

Where is the study run from?
National University of Ireland, Galway

When is the study starting and how long is it expected to run for?
October 2015 to March 2016

Who is funding the study?
National University of Ireland, Galway

Who is the main contact?
Chris Noone
noonec@gmail.com

Contact information

Type(s)
Public

Contact name
Mr Chris Noone

ORCID ID
http://orcid.org/0000-0003-4974-9066

Contact details
School of Psychology
NUI Galway
Galway
Ireland
H91 EV56
+353 (0)860 630 498
noonec@gmail.com

Additional identifiers

EudraCT/CTIS number

IRAS number

ClinicalTrials.gov number

Secondary identifying numbers
AEARCTR-0000756

Study information

Scientific Title
A randomised controlled trial to evaluate the effects of an online mindfulness intervention on executive function, critical thinking performance and thinking dispositions

Study objectives
In a world where we have more information than ever before available to us, it is vital to be able to analyse this information, evaluate its quality, relevance, credibility, and logical soundness and apply it in appropriate circumstances (Butler, 2012). This ability is often described as critical thinking. In psychological literature, critical thinking is considered a metacognitive process involving skills such as analysis, evaluation and inference that, when used appropriately, increases the chances of producing a logical conclusion to an argument or solution to a problem (Halpern, 1998). Developing these thinking skills is important in order to make the most of the information available to us rather than just passively assimilating it (Dwyer, Hogan, & Stewart, 2014). Critical thinking is recognised as an important higher-order cognitive process which requires a non-automatic response to a problem situation in order to avoid the inappropriate application of heuristics and biases (West, Toplak, & Stanovich, 2008). The demand for skill in critical thinking has made the question of what determines effective critical thinking an essential one to investigate. Mindfulness originated in the Buddhist tradition as a way of cultivating clarity of thought. While most modern research focuses on the clinical benefits of mindfulness, an emerging body of work suggests that mindfulness can facilitate self-regulation of everyday thinking in typically developing individuals. This behaviour is best captured using critical thinking assessments. The aim of this study is to investigate the effect of an online mindfulness intervention on executive function, critical thinking skills and associated thinking dispositions.

1. Mindfulness will increase more for the mindfulness meditation (MM) group than for the sham meditation (SM) group from t1 to t4
2. Critical thinking will increase more for the MM group than for the SM group from t1 to t4 and this effect will be moderated by baseline endorsement of thinking dispositions
3. Endorsement of critical thinking dispositions will increase more for the MM group than for the SM group from t1 to t4
4. Executive control dispositions will increase more for the MM group than for the SM group from t1 to t4 and this increase will mediate the relationship between levels of mindfulness and critical thinking performance following the intervention
5. Wellbeing will increase and negative affect will decrease more for the MM group than for the SM group from t1 to t4
6. Positive affect will increase more for the MM group than for the SM group from t1 to t4
7. Negative real-world outcomes will decrease more for the MM group than for SM group from t1 to t4
8. Meditation quality will be positively associated with increases in mindfulness, executive control and critical thinking and meditation quantity, task enjoyment and task difficulty and it will be higher in the MM group and across time.
9. Meditation quantity will be positively associated with increases in mindfulness, executive

control and critical thinking and meditation quality, task enjoyment and task difficulty and will not differ across time or groups.
10. Task enjoyment will be positively associated with increases in mindfulness, executive control and critical thinking and meditation quality, meditation quantity and task difficulty and will not differ across time or groups.
11. Task difficulty will be positively associated with increases in mindfulness, executive control and critical thinking and meditation quality, meditation quantity and task difficulty and will not differ across time or groups.
12. Intervention acceptability will be positively associated with increases in mindfulness, executive control and critical thinking and meditation quantity, task enjoyment and task difficulty and it will be higher in the MM group but will not differ across time.
13. Attrition will be negatively associated with meditation quality, meditation quantity , task enjoyment and task difficulty and will not differ across time or groups.

Ethics approval required
Old ethics approval format

Ethics approval(s)
NUI Galway Research Ethics Committee, 11/09/2015, IRB Approval Number: 15/ Sept/03

Study design
Randomised controlled trial

Primary study design
Interventional

Secondary study design
Randomised controlled trial

Study setting(s)
Home

Study type(s)
Other

Participant information sheet
https://www.dropbox.com/s/i74amt89jr1bhgt/Info%20Leaflet%2C%20Consent%20Form.pdf?dl=0

Health condition(s) or problem(s) studied
Critical thinking

Interventions
Recruitment and Randomisation
Students from the School of Psychology undergraduate population will be invited to participate by email and through advertisements on social media. Announcements regarding the study will also be made by the researchers in lectures attended by 1st year and 2nd year undergraduate psychology students. On acceptance of this invitation potential participants will fill out the screening questionnaire online. Those that satisfy the inclusion criteria will be selected to take part in the intervention and will be randomised to either the mindfulness meditation group or the sham meditation group with a 1:1 ratio. Block randomisation will be employed using a fixed

block of 6 (Sealed Envelope Ltd., 2015). Unique Headspace access codes corresponding to the two conditions will be provided to the researcher. These will be labelled Condition A and Condition B and only after analysis will the nature of these conditions be revealed to the researchers by Headspace. Therefore both participants and researchers will be blinded. However, blinding can be readily undone on a participant-by-participant basis if necessary.

Intervention

Intervention materials will be delivered via Headspace, a commercially available application which runs on all major smartphones, tablets and web browsers. The Headspace meditation scripts are designed by an individual with Buddhist monastic training who guides users through mindfulness meditations and key concepts related to mindfulness meditation using both audio and visual materials. In order to participate, individuals are required to have access to a smartphone or desktop computer with Internet access. Headspace makes meditating accessible by combining technology and simple techniques that are designed for new meditators. Participants can practice at any time of day wherever they prefer. Headspace offers straightforward, guided, bite-sized mindfulness training that is non-religious. We have signed guarantees with Headspace that participant data collected through Headspace will never be sold, distributed, or publicised (except anonymously in scientific publications with Headspace having no involvement in the conduct, analysis, or reporting of the research in any way). Participants will be sent an email introducing Headspace and describing the sign-up process. To get started, participants are required to register on headspace.com using their name and email address. Each participant will be given a unique code providing free access to Headspace for the duration of the study. After registering, participants may begin meditating straight away.
The proposed intervention is 6 weeks in length. All participants will be encouraged to practice meditation/sham-meditation daily for the course of the 6 weeks using by listening to each of the 30 ten minute guided sessions which they will access through the Headspace app. The nature of the sessions they can access depends on the group they are assigned to.

Experimental Condition

Participants in the experimental condition will gain access to 30 sessions of guided mindfulness practice. These sessions introduce the concept and practice of mindfulness training and each session gradually builds on the previous one. The sessions are guided by Andy Puddicombe, a trained Buddhist monk who is also a registered meditation consultant with the UK Health Commission. Each session begins with the participant begin instructed to sit, close their eyes and take deep breaths. Following this, participants are guided through mental body scan exercises intended to cultivate a mindful state which involve practicing focusing attention on present-moment sensations in the body without emotionally elaborating on these sensations. Gradually participants learn to re-direct their attention when the mind wanders and to broaden their present-moment awareness to all current internal and external stimuli. Towards the end of the course of sessions, participants are encouraged to apply this type of awareness to everyday activities.

Active-control Condition

Participants in the active-control condition will gain access to 30 sessions of guided sham meditation practice. These sessions discuss meditation and introduce breathing exercises under the guise of mindfulness practice. However, specific instructions for how to pay attention to the breath or other stimuli are not given. Instead, participants are encouraged to sit quietly, with their eyes closed and every few minutes they are reminded to take deep breaths as they sit in meditation. These sessions are also guided by Andy Puddicombe and accessed in exactly the same way as content in the experimental condition. This approach was taken as it controls for both physiological relaxation and expectations regarding meditation. Other approaches used in previous have only controlled for one of these. For example progressive muscle relaxation only

controls for physiological relaxation, while mind wandering inductions only control for expectations regarding meditation. These approaches did improve on previous attention-only and audiobook controls and all of these are a significantly better approach than waitlist controls when possible.

Data collection will take place during the week preceding the start of the intervention in the PC Suites of the School of Psychology at NUI Galway. Three sessions will be scheduled in order to facilitate attendance at different times, each of which will be able to accommodate up to 30 participants comfortably. A break with food and refreshments will be given half way through the procedure. This data collection approach will be repeated during the week following the end of the intervention.

Data will be primarily be analysed through a series of 3 x 2 (time x group) mixed ANOVAs for each outcome measure with mediation analyses conducted using Structural Equation Modelling to test whether executive function, meditation quality and adherence are mediators of any potential relationship between mindfulness and critical thinking. Correlations between manipulation check measures will also be examined as will their correlations with FFMQ change scores.

Intervention Type
Behavioural

Primary outcome measure
Primary measures will be taken at baseline and following the end of the intervention. All of the measures except the Sternberg Working Memory Task will be presented using SurveyGizmo.

Halpern Critical Thinking Assessment (HCTA; Halpern, 2010)
The HCTA involves 25 real-world situations with closed and open questions based on these situations. These situations involve medical research, social policy analysis and other types of problems encountered in everyday life. Five domains of critical thinking are assessed using the HCTA: Verbal reasoning, argument analysis, thinking as hypothesis testing, likelihood and uncertainty, and decision-making and problem-solving. The test includes 5 sets of questions (one open and one closed) for each of these domains. The scoring guide provides answers for forced-choice questions while open-ended questions are graded according to specific grading prompts (for more detail see Dwyer, Hogan, & Stewart, 2012). Greater scores are awarded to more accurate and comprehensive answers and total scores can range from 0 to 194 (Halpern, 2010). The internal reliability of the HTCA tends to be adequate (Dwyer et al., 2012; Halpern, 2010).

Heuristics and Biases items (West, Toplak, & Stanovich, 2008)
This series of standard items assessing cognitive biases is included as there is evidence that these assess an aspect of critical thinking not captured by traditional measures (West et al., 2008). These items assess participants' ability to deal with problems involving causal base rates, noncausal base rates, the law of large numbers, regression to the mean, the gambler's fallacy, conjunctions, covariation, Bayesian reasoning, framing and probabilistic reasoning (for full details of the items see West et al., 2008). Each of these items will be scored as either correct (1) or incorrect (0). Though these are not representative of a unidimensional construct, it has been shown to be useful to aggregate scores on these items (West et al., 2008).

Five Factor Mindfulness Questionnaire (FFMQ; Baer et al., 2006)
This questionnaire assesses levels of dispositional mindfulness. The FFMQ includes 39 items which tap five facts of mindfulness: describing (i.e. labelling experience with words), observing (i. e. paying attention to sensations, thoughts and feelings), non-reactivity (i.e. noticing thoughts

without emotionally responding to them), non-judgment (i.e. acceptance of thoughts and feelings) and acting with awareness (i.e. lack of distraction). It employs a 5-point Likert scale (e.g. 1 = never or very rarely true; 5 = very often or always true). This measure has demonstrated adequate internal consistency and construct validity (Baer et al., 2008).

Need for Cognition scale (Cacciopo, Petty, & Kao, 1984)
This unidimensional scale measures the extent to which individuals tend to engage in effortful cognitive activity (Cacciopo, Petty, & Kao, 1984). The scale includes 18 items which are rated on a 5-point Likert scale (e.g. 1 = extremely uncharacteristic of me; 5 = extremely characteristic of me). It has been extensively validated and has been found to have adequate reliability (Tolentino, Curry, & Leak, 1990).

Actively Open Minded thinking scale (Stanovich & West, 1997)
This scale assesses the extent to which individuals tend to approach information in an open and flexible manner as opposed to a rigid manner which leads to resistance to belief change. The scale includes 41 items and these are rated on a 6-point Likert scale (e.g. 1 = strongly agree; 6 = strongly disagree).

Objective measures of meditation adherence (no. of sessions initiated and completed and no. of minutes spent meditating) will be gathered through the Headspace app.

Secondary outcome measures

Secondary measures will assess effects on wellbeing in order to compare with previous studies employing Headspace and will be taken at baseline and follow-up. All of the measures except the Sternberg Working Memory Task will be presented using SurveyGizmo.

Sternberg working memory task (Sternberg, 1975)
This task is a measure of executive control of working memory. It involves memorising a series of letters and indicating, as quickly and accurately as possible, whether a probe was in this series or not.

Positive Affect and Negative Affect Schedule (PANAS; Watson & Clark, 1994)
This scale is the most widely-used instrument for assessing inter- and intra-individual differences in experiences of positive and negative emotion. The PANAS-X consists of 60 items. Each item describes a different feeling or emotion and the scale can be used to assess general levels of positive and negative affect by asking participants to indicate to what extent they felt each of these emotions over the past week using a 5-point Likert scale (e.g. 1 = very slightly or not at all; 5 = extremely). Psychometric evaluations tend to find good reliability for the positive and negative subscales (Simmons & Lehmann, 2012).

Warwick-Edinburgh Mental Wellbeing Scale (Tennant et al., 2007)
This is a 14-item scale of mental well-being covering subjective well-being and psychological functioning, in which all items are worded positively and address aspects of positive mental health. The scale is scored by summing responses to each item answered on a 5-point Likert scale. The minimum scale score is 14 and the maximum is 70. A high score reflects a high level of positive mental health and a low score reflects a low level of positive mental health (Stewart-Brown & Janmohamed, 2008).

Real World Outcomes Inventory (Butler et al., 2012)
This is a behavioural checklist focused on life outcomes from many domains ranging in severity from mildly negative (e.g., paying late fees for a movie rental) to severely negative (e.g., spending a night in jail). It was developed based in the Decision Outcomes Inventory (Bruine de

Bruin et al., 2007). The version employed here is slightly adapted to ensure cultural relevance. Any items which do not fit the Irish context will not be used (e.g. got blisters from sunburn).

Manipulation checks
In week 2 and week 4 participants will complete short questionnaires assessing mindfulness meditation quality and task expectations, enjoyment and difficulty. These will be completed online, allowing participants to complete them at their convenience. Participants will be asked to complete these measures directly following a meditation session.

Practice Quality- Mindfulness questionnaire (Del Re et al., 2013)
This 6-item questionnaire assesses perseverance and receptivity during meditation. Perseverance is defined as the ability to continually redirect attention back to the focus of the meditation. Receptivity refers to the willingness to fully experience what is arising during the course of a meditation session. The items are presented alongside a percentage scale and participants are asked to indicate the percentage of time during their meditation session during which their experience reflected each of the item statements. This scale has been shown to fit a 2-factor structure and has demonstrated a predictive relationship between practice quality and improvements in psychological symptoms (Del Re et al., 2013)

Technology Acceptance Model questionnaire (TAM; Davis, 1993)
Items from the TAM assessing expectations, enjoyment and difficulty using the Headspace app will be presented to participants. The TAM is a widely-used measure of user acceptance of technology. The items on this scale are phrased as statements and are measured on a 5-point Likert scale (e.g. 1= strongly disagree; 5 = strongly agree).

Intervention Acceptability (Kirkpatrick et al., 2013)
Four items assessing satisfaction with the intervention were administered. Two questions using a 5 point Likert scale (e.g. 1 = very dissatisfied; 5 = very satisfied) will assess general satisfaction with the programme and satisfaction with the content of the guided sessions in particular. The next two questions require yes/no answers and relate to whether participants would recommend the programme and whether they felt it was worth their time. Questions like these have been used in previous research examining the acceptability of low-intensity online treatments and across a range of different age groups and health conditions (Kirkpatrick et al., 2013).

Overall study start date
16/10/2015

Completion date
11/03/2016

Eligibility

Key inclusion criteria
1. University students at National University of Ireland, Galway
2. 18 to 65 years of age
3. Either English as first language or university-level English (i.e. equivalent to 80 on TOEFL or 6.5 on IELTS; both standardised and recognised tests of English as a foreign language)

Participant type(s)
Healthy volunteer

Age group
Adult

Lower age limit
18 Years

Sex
Both

Target number of participants
80

Key exclusion criteria
1. Alcohol or drug dependent
2. Currently on any form of sedating medication
3. Have suffered from any medical conditions associated with a head injury, spinal injury, epilepsy, or stroke (because these can interfere with cognitive performance) or do not possess normal or corrected-to-normal vision and hearing (required for computerised tasks)
4. Exhibiting clinical levels of depression, anxiety or psychotic symptoms (as assessed with the Modified Mini Screen)

Debriefing phone calls will be made to those excluded and they will be offered access to the intervention materials. An experienced clinician has agreed to provide advice on the management of any participant in whom a high level of emotional distress is identified. Any such participants will also be provided with a database of relevant professionals and professional organisations.

Date of first enrolment
20/11/2015

Date of final enrolment
25/01/2016

Locations

Countries of recruitment
Ireland

Study participating centre
National University of Ireland, Galway
Ireland
H91 EV56

Sponsor information

Organisation
National University of Ireland, Galway

Sponsor details
University Road
Galway
Ireland
H91 EV56

Sponsor type
University/education

ROR
https://ror.org/03bea9k73

Funder(s)

Funder type
University/education

Funder Name
National University of Ireland, Galway

Alternative Name(s)
Coláiste na hOllscoile, Gaillimh, Ollscoil na hÉireann Gaillimh, Queen's College, Galway, University College, Galway, NUI Galway, National University of Ireland, Galway, National University of Ireland Galway, Ollscoil na Gaillimhe, National University of Ireland, Galway/NUI Galway, NUI Galway, OÉ Gaillimh

Funding Body Type
Government organisation

Funding Body Subtype
Universities (academic only)

Location
Ireland

Results and Publications

Publication and dissemination plan
We submitted a protocol paper in December 2015. The results of this study will be reported in the form of a journal article which will be submitted upon its completion in May 2015. Blogs and social media will also be employed by the authors to share the results of this study.

Intention to publish date

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Available on request

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Protocol article	protocol	12/04/2016		Yes	No
Results article	results	05/04/2018		Yes	No