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ORIGINAL PAPER

The Impact of Understanding and Openness on State Mindfulness Following a Brief Meditation: A Sham Controlled Study

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Abstract

Objectives There is growing concern among researchers and practitioners that misunderstanding of the central acceptance-based foundations of mindfulness, and/or a lack of openness to mindfulness, may prevent recipients from fully benefiting from an intervention. The current study was the first to experimentally investigate the impact of mindfulness understanding and openness on the efficacy of brief mindfulness meditation. Specifically, it investigated how both variables influence state mindfulness change following meditation.

Method Participants ($n = 155$) were randomly assigned to a sham or active mindfulness meditation condition. Pre-intervention measures included participants' understanding of mindfulness (control vs. acceptance-based) and openness to mindfulness. State mindfulness levels were assessed before and after the intervention.

Results Participants in the active mindfulness condition reported significantly larger increases in state mindfulness than the sham, allowing further exploration of the primary research question. Higher openness was found to significantly predict increases in state mindfulness, while understanding was not.

Conclusions The current study provides preliminary evidence that higher openness to mindfulness practice leads to greater increases in state mindfulness following meditation. It also provides preliminary evidence that mindfulness understanding does not impact state mindfulness change following meditation. These findings emphasise the benefits of fostering open attitudes to mindfulness-based interventions (MBIs) to maximise treatment outcomes in clinical practice and suggest that the effectiveness of brief mindfulness meditation at eliciting mindful states is not compromised by misconceptions regarding its acceptance-based foundations. Major limitations discussed include placebo effects, suitability of the active and sham meditations, use of single item measures, and generalisability.

Preregistration This study was not preregistered.

Keywords Mindfulness · Brief meditation · Understanding · Openness · Sham

Mindfulness is a Westernised concept derived from ancient Buddhist philosophy (Carey, 2017). The broad practices and applications of mindfulness make defining the construct challenging, but most definitions draw upon three key components: attention and awareness, present-centredness, and non-judgement (Shapiro & Weisbaum, 2020). A widely accepted definition encapsulating these components was proposed by Kabat-Zinn (2003a), who described mindfulness as "the awareness that emerges through paying attention on purpose, in the present moment, and non-judgementally, to the unfolding of experience moment to moment" (p. 145). Mindfulness can be conceptualised as both a temporary mental state and a dispositional trait, the former referring to the immediate experience of being mindful (typically resultant from mindfulness meditation), while the latter referring to an individual's tendency to be mindful in everyday life (Black, 2011).

In recent years, mindfulness practice has been widely disseminated into Western medicine and culture to alleviate physical and mental suffering. The therapeutic benefits of the practice have led to the development of several mindfulness-based interventions (MBIs) and third wave cognitive and behavioural therapies, the most widespread including

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Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 2003b) and Mindfulness-Based Cognitive Therapy (MBCT; Segal et al., 2002). MBIs have been evidenced as effective treatments for several mental and physical health conditions (e.g. psychosis, addiction, pain, stress, insomnia, cancer management, and weight loss; Zhang et al., 2021). However, the largest effect sizes are typically reported for the treatment of anxiety and mood disorders (e.g. Hofmann et al., 2010; Vøllestad et al., 2012). While the literature would benefit from further research into mindfulness mechanisms, it is generally established that mindfulness practice improves psychological well-being by encouraging individuals to observe internal and external experiences as temporary mental events (also known as "decentring" or "meta-awareness"), thereby reducing maladaptive coping strategies (e.g. rumination, reactivity; Maloney et al., 2024). Other mechanisms include increasing body and situational awareness, attentional and emotional regulation, acceptance, and reducing bodily arousal (Burzler et al., 2019).

Identifying and addressing barriers and facilitators to treatment is crucial for the continuation and improvement of psychological therapies (Manuel, 2021). Despite the documented effectiveness of MBIs, there is a growing concern in the mindfulness community that patients are misunderstanding the fundamental foundations of mindfulness, thereby minimising its efficacy and potentially giving rise to adverse symptoms, which have been occasionally documented in research (i.e. Baer et al., 2019).

Kabat-Zinn (2015) identified several mindfulness misconceptions observed in clinical practice, including the common misconception that mindfulness is a mechanism that involves altering, controlling, or eliminating unwanted thoughts, feelings, and sensations (henceforth "the control misconception"). A key danger of this misconception is that it directly contradicts a central tenet of mindfulness: acceptance. Genuine mindfulness practice requires acceptance and non-judgement towards unpleasant present-moment experiences, without attempts to alter, control, or eliminate them (Shapiro et al., 2006). Attempts to control such experiences challenge this philosophy, thereby potentially acting as a barrier to achieving a mindful state (Kabat-Zinn, 2015). The Monitoring and Acceptance Theory (MAT; Lindsay & Creswell, 2017) proposes that the monitoring and acceptance of present-moment experience are essential to promote mindful states and improvements to psychological well-being as it enhances emotional regulation and reduces negative affective reactivity. While the theory is preliminary, review studies have reliably evidenced a positive correlation between acceptance and mindfulness efficacy (e.g. Simione et al., 2021; Toh et al., 2024). The control misconception also has the potential to minimise the therapeutic benefits of mindfulness because thought-control strategies have been consistently demonstrated to paradoxically enhance the prominence and influence of negative thoughts and sensations (Hayes et al., 2013; Hooper et al., 2010), as well as producing "side effects" such as frustration and disengagement (Westrup, 2014). While several other non-empirical sources have identified the prevalence and dangers of the control misconception (e.g. Burnett, 2020; Hayes & Strosahl, 2005; Rosenbaum & Magid, 2016; Sauer et al., 2011), only one study by Tifft et al. (2022) has quantitatively investigated its prevalence and potential consequences. Using a cross-sectional design, 103 US undergraduate students' approaches to mindfulness practice (either experiential control or acceptance-based) were assessed in relation to trait mindfulness and indices of psychological well-being. The study found that 58.2% of participants who reported using mindfulness with control intentions reported significantly lower trait mindfulness and greater worry, anxiety, depression, and negative affect than students with acceptance-based intentions. This study was the first to evidence the association between the control misconception and reduced trait mindfulness and therapeutic benefit.

The current study aimed to extend this work by experimentally investigating the impact of the control misconception on state mindfulness directly following mindful meditation. Specifically, it investigated whether participants with an incorrect understanding of mindfulness (i.e. believe its purpose is to *control* present moment experiences) become less mindful following a brief meditation than those who have a correct understanding (i.e. believe its purpose is to develop better *non-judgemental awareness* of present moment experiences). Since the control misconception violates the central acceptance philosophy of the practice, the misconception may act as a barrier from fully experiencing the effects of mindfulness meditation. As regular state mindfulness practice has been shown to cumulatively elevate trait mindfulness levels (e.g. Kiken et al., 2015), this line of enquiry may provide further support for the association between control intention and lower trait mindfulness reported by Tifft et al. (2022).

A further barrier to benefit from mindfulness interventions identified in the literature is a lack of openness towards mindfulness (i.e. low receptiveness and willingness to engage in mindfulness practice). Several systematic reviews of qualitative studies (e.g. Bamber & Schneider, 2022; Marks et al., 2023; Tate et al., 2018) have highlighted the prevalence of negative attitudes to mindfulness, which may contribute to low openness to engage with the practice. Examples of frequently cited barriers include low perceived credibility of MBIs, ambivalence towards meditation, difficulty finding time for meditation, and anxiety/fear associated with confronting uncomfortable emotions. Prior research has demonstrated the importance of openness on improving the efficacy of psychotherapy. For example, Ernst et al. (2015) identified low openness to Cognitive Behavioural Therapy

(CBT) among patients and families as a key barrier to its implementation for paediatric migraine treatment. A study by Picariello et al. (2017) with chronic fatigue patients revealed that high openness to CBT prior to the intervention significantly aided engagement. Furthermore, a randomised controlled trial by Wenzel et al. (2006) on the effectiveness of a modified version of CBT for participants with borderline-personality disorder (BPD) found that participants who reported greater openness and positivity towards the treatment were significantly less likely to meet the criteria for BPD at a 12-month follow-up than participants with a less open/positive attitude.

Despite the importance of openness as a facilitator to psychotherapy and the necessity of an open attitude to achieve mindfulness states (Kabat-Zinn, 2015), little research to date has investigated the link between openness and the success of mindfulness interventions. Barkan et al. (2016) found a correlational relationship between dispositional openness (as measured by a Big 5 personality questionnaire) and the use of mindfulness techniques during and after a course of MBSR. Yet, to the best of our awareness, no study has specifically investigated the impact of openness on the outcome of a brief mindfulness intervention exists in the literature, constituting a gap in knowledge which the current study will address.

In summary, this study investigated the impact of openness to and understanding of mindfulness on the effectiveness of a brief mindfulness intervention. Specifically, the study investigated whether (a) a correct (acceptance-based) vs. incorrect (control-based) understanding of mindfulness and (b) an open attitude to mindfulness impacted how mindful one became following meditation, as measured by a state mindfulness questionnaire. Since the research question required a pre-post design, there was potential for demand characteristics and/or placebo effects to confound results. Consequently, a sham mindfulness control condition based on Zeidan et al. (2010) was included to allow us to determine whether increases in state mindfulness were attributable to active mindfulness components of the intervention, as opposed to placebo effects or non-specific aspects of participation (e.g. relaxation or expectancy effects; Salomons & Kucyi, 2011). Importantly, previous sham-controlled studies have demonstrated the effectiveness of the active components of brief mindfulness meditations at increasing state mindfulness (e.g. Ruscio et al., 2016; Zeidan et al., 2015), whereby only participants in a mindfulness meditation group reported significant increases in mindfulness following the intervention. Based on the reviewed literature, we proposed three hypotheses:

Our first hypothesis (H_1) was that participants in the active mindfulness group will show a significant increase in state mindfulness following the intervention, relative to those in the sham condition. Our second hypothesis (H_2) was that participants with a correct understanding of mindfulness will show significantly larger increases in state mindfulness following the mindfulness meditation than participants with an incorrect understanding. Our third hypothesis (H_3) was that participants higher in openness will show significantly larger increases in state mindfulness following the mindfulness meditation than participants low in openness.

Method

Participants

A volunteer sampling technique was used to recruit 165 psychology students from Cardiff University. Participants volunteered via the School of Psychology's subject pool scheme in exchange for course credit. Two responses were excluded from the analysis due to incompleteness, with a further eight removed due to insufficient intervention engagement (i.e., <7.7 min of engagement with the intervention). This resulted in a final sample of 155 participants, consisting of 119 females, 31 males, and 5 non-binary/alternate gender participants, with an age range of 18–30 years ($M=20$ years). Participants' race/ethnicities were 80% White, 15% Asian or Asian British, 4% Mixed Ethnic groups, and 1% Arab. Students were required to be proficient in English to participate.

Power Analysis

Two a priori power analyses were conducted using G*Power Version 3.1.9.7. To test the preliminary research question (sham vs active), the minimum sample size required to detect a small effect size of 0.2 (based on Zeidan et al., 2015), using Cohen's (1988) criteria (power = 80%, $\alpha=0.05$) was $n=148$. Using a default medium effect size based on Gignac and Szodorai's (2016) recommendations, the minimum sample size required to test the primary research question (openness and understanding) using Cohen's criteria was $n=68$. A total sample size of $n=165$ was recruited to account for attrition and data-cleaning.

Design and Measures

Participants were randomly assigned to either an active ($n=73$) or sham ($n=82$) mindfulness meditation group, with outcome measures of state mindfulness taken before and after (pre/post) intervention. Participants' understanding of mindfulness (correct/incorrect) constituted an additional independent variable, while openness to mindfulness was measured as a covariate.

State Mindfulness Scale (SMS)

The outcome variable of state mindfulness was measured using the State Mindfulness Scale (SMS; Tanay & Bernstein, 2013). The SMS is a 21-item self-report measure in which respondents indicate, using a 5-point Likert Scale, their perceived level of attention to and awareness of present experiences during a specific time-period (e.g. past 10 min) in a given context (e.g. following mindfulness meditation). This scale was chosen because it has been previously used in research utilising brief mindfulness meditations (e.g. Luberto & McLeish, 2018) and has demonstrated good internal consistency, test–retest reliability, convergent, and discriminant validity in its initial testing and subsequent research (Ruimi et al., 2022; Tanay & Bernstein, 2013).

It is worth noting that the wording of the SMS was modified by asking participants to reflect on their experiences "right now" rather than over the past 10 min. This adjustment was made to minimize variability in pre-mindfulness scores. By prompting participants to report their state mindfulness in real-time, the pre-SMS scores more accurately reflected mindfulness under the same experimental conditions, rather than being influenced by the period preceding the experiment. This modification also improved the validity of the post-SMS scores, as asking participants to reflect on their experiences from "the past 10 min" would have captured their state mindfulness just before the meditation, rather than during the practice itself. For continuity, items were also altered to the present tense (e.g. "I am noticing thoughts come and go"). To ensure these changes did not alter the psychometrics of the scale, internal consistency was analysed using Cronbach's alpha. Values for the pre- and post-SMS questionnaires were high ($\alpha = 0.922$ and $\alpha = 0.946$ respectively), indicating strong consistency despite these alterations.

Mindfulness Meditation

Participants in the active mindfulness group completed the "Mindfulness of Body and Breath" 8-min guided meditation by Williams and Penman (2011). A body-and-breath meditation was used as its effects are often observed for extended periods of time and does not require advanced mindfulness skills, making it suitable for beginners (Sujiva, 2000). "Mindfulness of Body and Breath" was selected as it has been shown to reliably increase state mindfulness in multiple studies (e.g. Bravo et al., 2018; Kramer et al., 2013; Yusainy & Lawrence, 2015) and is used in clinical practice.

Participants in the sham meditation group listened to an 8-min pre-recorded sham meditation audio from Hope-Bell (2022). The meditation simply asks participants to "take some deep breaths as we sit in meditation". The prompt is repeated three times, with periods of silence between repetitions. This audio was a suitable control as it follows the same instructions used in a previous sham mindfulness study (Zeidan et al., 2010) although shorter in duration (8 min). This matched the length of the active mindfulness meditation.

Mindfulness Understanding

Mindfulness understanding comprised two levels (correct vs incorrect understanding) and participants self-selected into either group based on their response to a single-item question: "Which statement best fits your understanding of mindfulness? A key component of mindfulness is…" The answer options were as follows: (a) "to develop better mental control of thoughts, feelings or physical sensations in the moment" (incorrect understanding) or (b) "to develop better non-judgemental awareness of thoughts, feelings or physical sensations in the present moment" (correct understanding). The question and response options were based on Tifft et al. (2022), which used a similar single-item question to measure participants' acceptance vs control-based mindfulness intentions. However, the wording was altered to measure mindfulness understanding rather than intention. In the active mindfulness group, 43 participants (59%) had a correct understanding, and 30 participants (41%) had an incorrect understanding.

Openness to Mindfulness

Openness to mindfulness was included as a covariate based on participants' response to a single 5-point Likert-scale question on the survey. The question asked, "how open are you to mindfulness?" and response options were as follows: "not at all open(1)", "not very open(2)", "neutral(3)", "somewhat open(4)", "very open(5)". In the active mindfulness group, 1 participant (1%) selected *not at all open*, 3 participants (4%) selected *not very open*, 8 participants (11%) selected *neutral*, 28 participants (38%) selected *somewhat open*, and 45 participants (45%) selected *very open*.

Distractor Questions

Four "distractor" questions measuring attitudes towards mindfulness were constructed to divert participants' attention from the significance of the understanding and openness questions. The questions were carefully composed to prevent priming by including content unrelated to the principles underlying mindfulness (e.g. "which of the following mindfulness formats appeals to you the most?").

Procedure

Participants completed the study in person under controlled conditions to encourage maximum engagement and experimental control. The study was run entirely through Qualtrics using desktop computers and headphones provided. No time constraints were given, but participants were advised the study took approximately 25 min to complete. Participants were told the study was investigating people's attitudes towards mindfulness practice. After providing informed consent, participants completed the assessment battery in the following order: demographic information, pre-SMS, distractor questions, understanding and openness to mindfulness questions, meditation (either sham or mindfulness), and post-SMS. They were then debriefed on the full aim and design of the study.

Results

Preliminary analyses confirmed that none of the demographic variables recorded had any significant effect; hence, these variables were not included in any subsequent analyses. The next step in the analytic strategy was to determine the success of the intervention in terms of increasing state mindfulness. A 2×2 repeated measures ANOVA was thus performed with time (pre/post) as the repeated measure and intervention group (mindfulness/sham) as the between-subjects factor. Understanding of and openness to mindfulness were not included at this stage of the analysis, since they were pertinent only to the meditation condition involving an active mindfulness component.

Table 1 shows mean pre- and post-SMS scores in the active and sham meditation groups. Overall, both groups showed increases in state mindfulness post-intervention; however, the increase was significantly greater in the active vs the sham group (10.63 vs 7.18), as confirmed by the relevant interaction term in the ANOVA, $F_{(1,147)} = 4.62$, $MSE = 242.03$, $p = 0.043$. Thus, the intervention can be regarded as successful in that it induced state mindfulness over and above that in the sham condition. This warrants further exploration of the impact of understanding and openness.

Accordingly, a linear regression was performed on the change in state mindfulness scores from pre- to post-intervention for the active mindfulness group alone, with openness and understanding as predictor variables. The overall regression model was significant, $F_{(2,70)} = 4.01$, $R^2 = 0.103$, $p = 0.023$, with higher openness predicting greater increases in state mindfulness, $\beta = 0.307$, $p = 0.008$. Understanding, meanwhile, was not a significant individual predictor of state mindfulness change, $\beta = -0.107$, $p = 0.347$. Table 2 shows the total number of participants in the active mindfulness group endorsing each point on the openness scale and the mean SMS change for participants in each case. The group means for understanding are shown in Table 3.

Discussion

This study set out to examine whether openness to, and understanding of, mindfulness affects the outcome of a brief mindfulness intervention. The preliminary aim of the present study was to determine whether the intervention itself was successful in elevating state mindfulness above and beyond a sham mindfulness intervention. Analysis confirmed this to be the case as participants in the active mindfulness group showed a significantly larger increase in state mindfulness scores, than participants in the sham group.

The primary aim was to investigate whether holding the control misconception minimises how mindful one becomes following mindfulness meditation. Analysis revealed that understanding was not a significant predictor

Table 1 Mean pre- and post-SMS scores in active and sham meditation groups

	Intervention	*M*	*SD*	*n*
Pre-test SMS	Active	71.62	14.34	73
	Sham	72.37	13.11	82
Post-test SMS	Active	82.25	12.9	73
	Sham	79.95	15.49	82

Table 2 Mean SMS score change in the active mindfulness group by participants' openness scores

Openness	1 — Not at all open	2 — Not very open	3 — Neutral	4 — Somewhat open	5 — Very open
n	1	3	8	28	33
Mean SMS change	1	10	2	10	14

Table 3 Mean pre- and post-SMS scores in the active mindfulness group by correct/incorrect understanding

	Understanding	*M*	*SD*	*n*
Pre-test SMS	Correct	72.93	15.77	30
	Incorrect	70.70	13.18	43
Post-test SMS	Correct	84.70	11.18	30
	Incorrect	80.53	13.72	43

of increases in state mindfulness. That is, participants showed a significant increase in state mindfulness following the mindfulness meditation irrespective of their prior level of understanding. While these results oppose H_2 and findings by Tifft et al. (2022), they present interesting clinical implications. Namely, they suggest that the effectiveness of mindfulness meditation is not compromised by misunderstanding the acceptance-based foundations of the practice. Not only do these findings highlight the power and accessibility of mindfulness, but they suggest that educating patients on its principles in MBIs may not be necessary to produce an effective intervention that elicits mindful states. Consequently, MBIs may benefit financially and practically by reducing the time and resources currently allocated to the psychoeducational component of early sessions. These findings also suggest that MBIs may be a suitable treatment option for patients who do not have the cognitive or emotional readiness to engage in therapy that requires complex theoretical understanding (e.g. children, older adults, patients with learning difficulties, ADHD, language barriers).

A further aim of the present study was to investigate whether those who were more open to mindfulness would report a larger increase in state mindfulness following the intervention than those who were less open. The regression analysis confirmed this to be the case, thereby supporting H_3. This finding is consistent with previous literature demonstrating the importance of openness on improving the efficacy of psychological therapies (e.g. Ernst et al., 2015; Picariello et al., 2017; Wenzel et al., 2006). However, the present study is the first to demonstrate high openness to mindfulness as a facilitator of mindfulness interventions.

These findings raise the question as to the underlying mechanisms by which higher openness facilitates mindful states following meditation. One possible explanation is that greater openness to mindfulness could produce more active engagement with the intervention than those who are less open. Barkan et al. (2016), for instance, previously found that participants who were higher in dispositional openness showed greater use of mindfulness techniques during and after a course of MBSR. An alternative explanation is that higher openness creates a stronger expectation or belief that a mindfulness intervention will work, in turn generating a stronger placebo effect; thus, not only do participants become more mindful due to the intervention, but also due to differences in outcome expectations (Boot et al., 2013).

Potential mechanisms notwithstanding, these findings highlight potential areas for alteration in the assessment and delivery of MBIs. Namely, they suggest that it may be beneficial for clinicians to routinely screen patient openness to mindfulness during assessments before recommending MBIs as a treatment. If identified as a barrier, treatment efficacy may be improved by implementing strategies to reduce resistance to mindfulness (e.g. myth busting, discussing efficacy data, psychoeducation). Lastly, if such findings are replicated in future studies, it may be beneficial for future research investigating the efficacy of mindfulness interventions to include openness to mindfulness as a control variable.

In sum, while this study only represents the start of what needs to be a wider exploration of the effect of understanding and openness within mindfulness research, the results tentatively offer some useful implications for the clinical practice of mindfulness.

Limitations and Future Directions

It is firstly worth noting that the sham mindfulness condition did yield significant increases in state mindfulness. This indicates that non-active components of the meditation (e.g. placebo/expectancy effects) accounted for a considerable proportion of the increase in state mindfulness following the intervention. That is, participants in the active meditation group may have shown a significant state mindfulness increase simply because they anticipated a positive outcome. Although these findings differ from those reported by Ruscio et al. (2016) and Zeidan et al. (2015), they are consistent with other studies that have documented significant increases in state mindfulness following similar sham meditations (e.g. Davies et al., 2023; Johnson et al., 2015; Walsh & Greaney, 2013). While such increases could indeed reflect the contribution of non-specific intervention effects on increasing state mindfulness, it is possible such increases could be attributable to active mindfulness components present in sham meditations. The creation of an effective sham condition is challenging, as the meditation should match the attentional and contextual features of mindfulness interventions, without engaging in the active therapeutic elements of mindfulness practice (Davies et al., 2021). Sham meditations based on Zeidan et al. (2010) have been criticised by their inclusion of breath work (i.e. "take some deep breaths") as attention to the breath is considered a foundational mindfulness technique and has been shown to exclusively increase present moment awareness, non-judgemental attitudes, and trait mindfulness (Frewen et al., 2011; Hanh, 2005). Therefore, participants in the sham group may have shown a significant increase in state mindfulness due to the mindful breathing components of the meditation, as opposed to non-specific intervention effects. This limitation was recognised and amended by Davies et al. (2023), who devised a sham meditation closely resembling the non-active components of the "Mindfulness of Body and Breath" meditation by Williams and Penman (2011) but replaced mindfulness components with the following instruction: "stay in the here and now as we sit in mindfulness practice". The procedure was not included in the present study as it was published after the

research had commenced. This sham procedure provides a unique advantage over previous versions, as it excludes the potential confound of mindful breathing and more closely resembles the structure and content of mindfulness meditations, thereby providing impetus for its use in future evaluative mindfulness research and in further exploration of the present study.

The significant state mindfulness increase in the sham meditation group could also be attributable to participants' previous mindfulness experience. Despite being allocated to the sham meditation group, participants with previous mindfulness training may have possessed mindfulness skills sufficient to engage in independent mindfulness meditation, thereby increasing their levels of state mindfulness following the intervention. This limitation has been recognised by other researchers (e.g. Priebe & Kurtz, 2022; Hope-Bell, 2022), and could be accounted for in future research by matching participants on mindfulness experience during recruitment or through measuring and controlling for previous experience using statistical procedures.

Another limitation worth discussing is the choice of active mindfulness meditation. Like many guided meditations, "Mindfulness of Body and Breath"(Williams & Penman, 2011) incorporates acceptance-based instructions (e.g. "seeing if it's possible to allow the sensations in the body to be just as they are, not trying to control anything or wanting things to be different from how you find them" 3:37); and therefore, it is possible that the guidance and training provided in the meditation may have overridden participants' control misconceptions. As such, incorrect understanding may have been no detriment in the current study because the guided meditation resolved the control misconception. Recognising this, it would be beneficial for future research to include a manipulation check following the meditation to ensure participants' intentions during the meditation were congruent with their prior understanding.

It is important to note that the acceptance-based content in "Mindfulness of Body and Breath" is not unique. The guided meditations included in MBCT, MBSR, and DBT programmes are carefully constructed to cultivate the key qualities of mindfulness (Day, 2017; NHS, 2019; Santorelli et al., 2017). Furthermore, a recent review of 13 popular UK meditation apps by Roquet and Sas (2018) revealed that 54% incorporate acceptance-based instruction in their guided meditations. Consequently, the high prevalence of acceptance-based content in clinical and commercial guided meditations may suggest that the control misconception may not be problematic in such contexts. A more relevant line of enquiry could be to investigate the consequences of the control misconception during self-guided mindfulness practice, in which no guidance is provided to potentially buffer the effects of the control misconception. Daily self-guided mindfulness practice has been documented as a highly valued and encouraged form of meditation in MBIs (e.g. Taylor et al., 2021); therefore, investigation into the impact of the control misconception during self-guided practice would be worthwhile considering its popularity and significance, especially for individuals who intend to continue mindfulness practice independently following mindfulness training.

It is worth noting that a marked skew in participant openness in the current study may limit conclusions drawn from the results. The vast majority indicated that they were either *very open* ($n = 75$) or *somewhat open* ($n = 55$) to mindfulness (130/155 total participants). Future research may benefit from recruiting a larger proportion of participants who are less open to mindfulness in order to determine more conclusively whether this is indeed a barrier to the success of a mindfulness intervention.

A further limitation is that openness to mindfulness was measured using a single-item Likert scale. This method was used as a multi-item scale measuring openness to mindfulness is yet to be designed, and research shows that single-item measures are sufficiently effective for measuring attitudes towards a given attitude object (Wanous & Reichers, 1996). However, we recognise that multiple-item scales capture a more dimensional and valid representation of people's attitudes (Diamantopoulos et al., 2012). Therefore, further exploration into openness to mindfulness would benefit from the creation and subsequent testing of a multi-item measuring scale.

Similarly, the present study measured understanding of mindfulness using a single item question as opposed to a continuous measure (e.g. via a Likert scale). We felt a dichotomous measure was sufficient for the current study as it best aligned with the specificity of our research question. That is, the study was solely focused on investigating the impact of correct vs incorrect understanding of mindfulness. Furthermore, research has highlighted the utility and practical benefits of single item measured in early, exploratory research (e.g. Schmidt, 2018). However, we recognise that this method may have led to a loss of nuanced information (i.e. participants may not have agreed with either statement, or had an understanding that lay somewhere in the middle). Therefore, this, alongside investigating the impact of other forms of misunderstanding, would be a good focus for future research.

Lastly, it is worth recognizing that the sample consisted exclusively of undergraduate psychology students from Cardiff University. Since clinical psychology is a key area of psychological study and has been documented to be a preferred degree component by students (Friedrich, 1996), it is possible that participants in the present study had a better understanding of and higher openness to mindfulness than the general population. Additionally, self-selection bias may be at play, as students interested in mindfulness may have been more likely to participate. Such features may have

led to biased data that is less reflective of broader attitudes towards mindfulness. Therefore, future research should consider exploring understanding and openness to mindfulness in broader populations, or clinical populations where applications are more relevant.

Author Contribution Bronwen Davies: conceptualisation, data curation, formal analysis, investigation, methodology, resources, visualisation, writing —original draft, writing —review and editing.

Rachel Juden: conceptualisation, data curation, formal analysis, investigation, methodology, resources, writing — original draft.

James Greville: formal analysis, writing — review and editing.

Nic Hooper: conceptualisation, methodology, project administration, supervision, writing —review and editing.

Data Availability Data from this study is available in the supplementary information.

Ethical approval Ethical approval was gained from Cardiff University Research Ethics Committee.

Consent to participate All participants were required to read a detailed information sheet and complete a consent form before participating.

Conflict of interest The authors declare no competing interests.

Use of Artificial Intelligence No artificial intelligence was used in this study.

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