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Comparison of mindfulness training and acceptance and commitment therapy in a workplace setting: results from a randomized controlled trial

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ABSTRACT

Mindfulness interventions have become a common feature of worksite stress management provision. However, the evidence underpinning these interventions continues to attract scrutiny, with unresolved questions surrounding: the generalizability of mindfulness research findings to real-world workplace training applications, comparability of different mindfulness approaches offered in workplace settings, and effects on job performance. The current trial contributes to the literature by exploring effects of mindfulness training (MT) and acceptance and commitment therapy (ACT), which were delivered to staff in the same healthcare organization. Participants were randomly assigned to a 4-session MT program ($n = 63$), a 4-session ACT program ($n = 67$), or a waiting list control group ($n = 69$). Study measures were administered on five occasions spread across a 6-month period. Results indicated that both MT and ACT reduced perceived stress and improved mindfulness and sleep quality when compared to the control group. ACT showed slight superiority in helping employees align their behaviour with personal values. Neither MT nor ACT was effective in reducing work limitations. We consider explanations for equivocal effects on job performance outcomes, and highlight the importance of testing the effectiveness of worksite mindfulness interventions under ecologically valid conditions.

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Introduction

The past two decades have witnessed considerable interest in workplace applications of mindfulness interventions (Flaxman et al., 2013; Jamieson & Tuckey, 2017). These programs have traditionally been advocated for their potential to reduce stress and improve mental health among working populations. It is also common to see assertions that the same interventions could simultaneously enhance job performance (Coo & Salanova, 2018; Dane & Brummel, 2014; Glomb et al., 2011; Good et al., 2016; Huang et al., 2015). Most research in this area has evaluated workplace *mindfulness training* (MT) programs, which are derived from the well-established mindfulness-based stress reduction (MBSR) protocol, and thus focus primarily on the practice of mindfulness meditation (Janssen et al., 2018; Lomas et al., 2019). A smaller yet growing strand of research has evaluated worksite training adaptations of *acceptance and commitment therapy* (ACT), a distinct intervention approach that also seeks to cultivate mindful self-regulation processes (Hayes et al., 2011; Prudenzi et al., 2021).

Evidence generally supports the utility of workplace applications of these approaches, particularly for reducing perceived stress and psychological distress, and improving some aspects of positive well-being (Bartlett et al., 2019; Lomas et al., 2019; Prudenzi et al., 2021; Towey-Swift et al., 2023; Unruh et al., 2022; Vonderlin et al., 2020). However, despite the popularity of these programs, and demonstrated efficacy for influencing stress and mental health outcomes, the workplace mindfulness intervention literature continues to wrestle with conceptual and methodological challenges (Jamieson & Tuckey, 2017).

First, questions surround the generalizability of findings derived from different strands of mindfulness research to the mindfulness interventions delivered in workplace settings (Bartlett et al., 2019; Good et al., 2016). For example, the proposal that mindfulness programs enhance work performance remains unsubstantiated, and has been partly justified by survey research demonstrating associations between trait mindfulness and performance-related outcomes (Mesmer-Magnus et al., 2017), and results of laboratory experiments (often with student samples) testing the influence of one-off mindful meditation exercises on immediate cognitive (e.g., attentional) task performance (Chiesa et al., 2011). Similarly, mindfulness intervention trials can diverge from typical workplace training implementation, for instance by evaluating programs that are too lengthy for many organizational settings, and/or by applying stringent eligibility criteria for research purposes (e.g., selecting employees based on elevated level of stress, medication intake, or lifestyle factors; Bartlett et al., 2019). These evidence sources have proved valuable in their own right. Nonetheless, scholars caution against extrapolating such findings to workplace mindfulness interventions, which are in

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practice often abbreviated versions of originating training protocols and attended by heterogeneous staff groups (Bartlett et al., 2019; Good et al., 2016; Vonderlin et al., 2020). Given the contention that some promised benefits of workplace mindfulness have been overhyped, it is important that research continues to scrutinize theorized effects of these programs under ecologically valid conditions (Janssen et al., 2018; Van Dam et al., 2018; Waters et al., 2018).

A second issue concerns the increased prominence of ACT-based training in workplace settings, particularly (although not exclusively) for improving the well-being of healthcare staff (Prudenzi et al., 2021). ACT and MT emerged from different wings of psychology and deploy different techniques and terminologies. Nonetheless, in theory, ACT targets the same mindfulness processes as MT programs (Hayes et al., 2011). Because of the overlap, clinical and health psychology authors have discussed ACT alongside MT (e.g., Baer, 2003; Hayes et al., 2011) and these approaches have been synthesized together in treatment research reviews (Johannsen et al., 2022). By contrast, ACT studies have been omitted from most systematic reviews of the worksite mindfulness literature (e.g., Bartlett et al., 2019; Janssen et al., 2018; Lomas et al., 2019; Virgili, 2015; Vonderlin et al., 2020). Some reviews do not mention ACT. Others exclude ACT on the grounds that a) ACT does not utilize mindfulness meditation as its central component, or b) ACT is considered a more therapeutic approach than MT (Bartlett et al., 2019). In their recent review, Vonderlin et al. (2020) included some studies involving ACT, but only if ACT techniques were deployed as an adjunct to MT. The apparent uncertainty surrounding ACT's position as a workplace mindfulness intervention could be resolved through comparative research, aimed at revealing equivalence and difference among MT's and ACT's effects on employees' mindfulness, well-being, and work-related functioning (Chiesa & Malinowski, 2011). Comparative research is likely to have high practical utility, by establishing whether there are viable alternatives to MT when seeking to enhance mindfulness skills in workplace settings (Glomb et al.'s, 2011). We believe that explorations of alternative approaches are warranted, given that some employees may be less inclined to engage in the regular meditative practice that is a hallmark of MT protocols (Polk et al., 2016).

Third, there is insufficient evidence to support the widely communicated assertion that these interventions enhance job performance (Bartlett et al., 2019; Vonderlin et al., 2020). The field has become complicated by an array of performance and productivity outcomes used to assess the influence of mindfulness interventions on work-related effectiveness, including self-reports of work engagement and job-related efficacy through to company metrics and supervisory ratings of employees' performance (Lomas et al., 2019; Vonderlin et al., 2020). In most studies, performance measures are not explicitly linked to the theorized self-regulatory and stress-buffering processes that mindfulness interventions are designed to target (i.e., by modifying employees' relationship with difficult inner experience; Glomb et al., 2011; Shapiro et al., 2006). Hence, this research area may be advanced by adopting work-related measures that capture this link, for example by assessing whether mindfulness interventions reduce the extent to which employees' stress-related thoughts, feelings, and physical states interfere with the ability to be productive at work (Bartlett et al., 2017; Janssen et al., 2018; Wolever et al., 2012).

The final issue we consider reflects methodological challenges of conducting longitudinal intervention trials in workplace settings. Conclusive review evidence on workplace programs is often based on pre-to-post evaluations, with less data on effect sustainability (Bartlett et al., 2019; Janssen et al., 2018; Virgili, 2015; Vonderlin et al., 2020). Shorter assessment periods might also obscure potentially important effects of these programs. For example, mindfulness interventions may exert a "downstream" influence on some variables of interest (e.g., employees' sleep quality and work productivity), implying that change on such outcomes might emerge over a wider timeframe (Bartlett et al., 2019; Crain et al., 2017; Glomb et al., 2011). Accordingly, a common recommendation is for workplace trials to extend controlled evaluations over several months (Janssen et al., 2018; Vonderlin et al., 2020).

With these issues in mind, the current effectiveness trial directly compares effects of MT and ACT programs delivered to staff in the same (healthcare) organization. To address concern about representativeness of empirical evidence to real-world training practice, both programs were delivered in an abbreviated (4-session) format that is common in worksite mindfulness interventions (Bartlett et al., 2017, 2019; Klatt et al., 2009). The programs were open to all interested staff in the host organization, thereby promoting inclusivity and reflecting how these programs tend to be delivered outside of research trials. Responding to calls to expand the timeframe, we assess the effects of the two interventions (contrasted with each other and with a waiting list control group) over a six-month period with measures administered on five occasions. We capitalize on this research design to compare longitudinal influences of worksite applications of MT and ACT on indicators of employees' mindful self-regulation, stress, well-being, and work productivity.

Effects of cultivating mindfulness in the workplace: a self-regulation perspective

We draw from Glomb et al.'s (2011) widely cited theory of the mindfulness processes proposed to influence self-regulation in work contexts (Glomb et al., 2011; Good et al., 2016). We perceive advantages to adopting this theoretical framework when evaluating worksite mindfulness interventions. First, the theory is contextualized to functioning in the workplace, and delineates influences of mindfulness on employee well-being and work performance. Second, this process-based model aligns with a conceptual trend in the general mindfulness literature towards clarifying common psychological and behavioural processes that are theorized to be targeted by both MT and ACT (Rogge & Daks, 2020). Third, consistent with multidimensional conceptualizations of mindfulness (Baer et al., 2006; Shapiro et al., 2006), this theory extends beyond accounts of workplace benefits linked to improved attentional capacities (e.g., Dane, 2011), emphasizing how core mindfulness processes are also characterized by a nonjudgemental and nonreactive relationship with difficult thoughts and emotions (Glomb et al., 2011). Finally, Glomb et al.'s account provides

links to companion constructs and theories familiar to work and organizational psychology researchers, including recovery from work-related stress, discrete aspects of job performance, and self-determination theory.

Glomb et al.'s theory posits that mindfulness interventions benefit employees' functioning via activation of three core processes: (a) decoupling self from experience, (b) reducing automaticity of mental processes, and (c) interoceptive awareness. These three processes are expected to activate a set of secondary self-regulatory processes, including response flexibility, decreased rumination, affective regulation, and increased self-determination and persistence. This theory has guided selection of outcome variables to capture the proposed effects of strengthening mindfulness processes. For example, Glomb et al.'s (2011) assertion that these processes translate into improved coping with stressful events supports tests of the stress-reducing effects of worksite mindfulness interventions. Improvements in *perceived stress* (capturing stress appraisals and coping) have thus far provided among the most consistent evidence for worksite MT programs (Bartlett et al., 2019; Janssen et al., 2018; Vonderlin et al., 2020); and researchers have investigated effects of ACT programs on employees' stress perceptions (Brinkborg et al., 2011; Frögéli et al., 2016). Hence, when directly comparing effects of MT and ACT in the same organizational context, it seems logical to assess change in perceived stress as a theoretically and empirically grounded construct.

In addition, links between mindfulness and recovery from stress in Glomb et al.'s model have been utilized in studies of mindfulness interventions for improving employees' *sleep quality* (Glomb et al., 2011; Hülsheger et al., 2015). Sleep quality is considered an important factor in employees' physical and mental health (Good et al., 2016). Epidemiological data indicate that around 1 in 4 members of the workforce in industrialized societies experience some degree of common sleep disturbance (e.g., difficulties falling asleep, premature awakening), with approximately 10% of working age adults estimated to experience a more chronic sleep problem (i.e., insomnia; Morin & Jarrin, 2022). Poor sleep places a heavy economic burden on employers and societies, largely due to higher rates of absenteeism and presenteeism (i.e., reduced productivity) found among employees reporting lower subjective sleep quality (Espie et al., 2018; Henderson & Horan, 2021; Rosekind et al., 2010).

Drawing from Glomb et al.'s model, Hülsheger et al. (2015) proposed that core mindfulness processes play an important role in healthy sleep experiences. For instance, decoupling self from experience corresponds with the mindfulness mechanism of *decentering*, which refers to the ability to notice difficult or stress-related thoughts as temporary products of the mind, without necessarily becoming overly entangled in the content of those cognitions (Bernstein et al., 2015; Shapiro et al., 2006). Employees who possess this type of meta-cognitive awareness should be better able to relate to undesirable or intrusive thoughts in a way that reduces associated emotional reactivity and need for suppression or cognitive elaboration (e.g., rumination). Research has shown that this capacity lowers the risk of becoming caught in vicious cycles of (potentially sleep-impairing) bouts of cognitive perseveration, such as worry and rumination (Wu et al., 2022). Insomnia theory and research underscore decentring's role in improving people's relationship with cognitions arising in response to difficulties falling or staying asleep (e.g., anticipatory thoughts about possible negative consequences for the next working day; Ong & Moore, 2020). Given that cognitive hyperarousal and perseverative cognition are potent vulnerability factors in sleep impairment, mindfulness programs have been endorsed for their potential to improve people's subjective sleep experiences (Ong & Moore, 2020; Ong et al., 2012, 2018; Van Laethem et al., 2015).

Other prominent features of Glomb et al.'s (2011) model have (to our knowledge) received little attention from workplace intervention researchers. Of note, the focal mindfulness processes are posited to improve employees' tendency to link actions to personal values: an adaptive behavioural self-regulatory capacity labelled *values-based action* (Barney et al., 2019). Specifically, mindfulness generates response flexibility, referring to the propensity to utilize a momentary pause or "mental gap" before responding to workplace stimuli (Good et al., 2016, p. 121). Flexible responding is contrasted with more habitual, rigid, or automatic patterns of reacting to events and interactions, which might be less contextually sensitive, incongruent with personal goals and values, and therefore not always offering the most effective behavioural response. A postulated consequence of mindfulness-based response flexibility is that it "allows one the power to act in alignment with one's goals, needs and values" (Glomb et al., 2011, p. 129).

Testing whether worksite applications of MT and ACT increase this theorized capacity for values-based action seems warranted for the following reasons. First, besides Glomb et al., the link between mindfulness and values-based action is discussed in other theoretical accounts of mindfulness, pertaining to both MT and ACT interventions (Hayes et al., 2006; Rogge & Daks, 2020; Shapiro et al., 2006). Second, aligning values and action is assumed to play an important role in the influence of mindfulness on self-determined behaviour and autonomous motivation (Brown & Ryan, 2003; Donald et al., 2020; Glomb et al., 2011). Third, compared to the predominant focus on stress and mental health symptoms in the mindfulness literature, values-based action represents a more eudaimonic marker of well-being; in that aligning one's daily behaviour with personal values is expected to foster a sense of life purpose, meaning, and direction (Ryan et al., 2008). Hence, assessing values-based action as a potential intervention outcome may contribute to debate about synergy between the mindfulness literature and employees' eudaimonic experiences (Bojanowska et al., 2022; Flaxman et al., 2023; Lomas et al., 2019).

It is informative to explore changes in values-based actions within the specific research context of comparing worksite MT and ACT programs. Glomb et al. (2011) developed their model in relation to meditation-based MT programs. However, they cautioned against unthinkingly adopting this approach in workplace settings, suggesting that alternative intervention approaches may be equally effective at enhancing mindful self-regulation and values-based behaviour (Glomb et al., 2011, p. 144). In principle, ACT appears potentially more tailored than MT for targeting the tendency to align actions with values. ACT's intervention model includes values clarification and committed action (in the service of those values) as components

contributing to the development of psychological flexibility (Hayes et al., 2006). Unlike MT programs, a practical feature of ACT involves explicitly helping employees clarify their personal values, and then to practice noticing what it is like to use those values as a more prominent guide to behaviour in daily life (Dahl, 2015; Flaxman et al., 2013). Hence, alongside scrutinizing the underexamined proposition that workplace mindfulness interventions increase the propensity for values-based action, it seems worth also examining the question of whether ACT and MT differ in their impact on this indicator of eudaimonic well-being.

Finally, Glomb et al.'s model has informed interest in the benefits of trait mindfulness and worksite mindfulness interventions for improving *work performance* (Good et al., 2016; Mesmer-Magnus et al., 2017). Specifically, they propose that mindfulness-based self-regulatory processes could enhance a set of performance criteria, including improved communication, task performance, decision-making, and concentration (Glomb et al., 2011; also see Good et al., 2016). Reflecting these criteria, various measures have been used to assess the influence of mindfulness on job performance, such as work engagement, task and contextual performance, work-related efficacy, and managers' performance ratings (Huang et al., 2022; Lomas et al., 2019; Shonin et al., 2014). When compared to stress and well-being outcomes, performance measures are less frequently included in controlled trials of worksite mindfulness interventions, and equivocal findings have hindered conclusions (Bartlett et al., 2019; Vonderlin et al., 2020).

We consider two complications linked to conceptualizing the impact of mindfulness interventions on work performance. A first complication stems from the apparent incongruence between 1) mindfulness development, especially via meditation practice, and 2) the behavioural repertoires that tend to signify performance in work settings. For instance, mindfulness practice supports an ability to shift from "doing" (or thinking) to "being" (or sensing) modes of mind (Williams, 2008). At first glance, being mode might seem at odds with goal-focused striving, mental analysis and problem solving, and achievement motivational profiles of many occupational environments. In this regard, programs such as MT might appear somewhat passive in their approach, with more intuitive appeal for recovering from frantic busyness and managing stress than for increasing work-related effectiveness (see Good et al., 2016 for discussion of this issue).

A second complication concerns the types of job performance scales that are commonly deployed as outcomes in mindfulness research. Most performance measures used in this area of research are detached from conceptualizations of how mindfulness development is theorized to modify people's relationship with stress-related (and other difficult) inner experiences. To elaborate, mindfulness processes are assumed primarily to alter the function (i.e., the impact, rather than the form, frequency, or intensity) of discomforting or unhelpful thoughts, feelings, and urges. An important marker of mindfulness-based change is that difficult inner experiences begin to exert a less disruptive influence on behaviour, well-being, and quality of life. Thus, following a mindfulness intervention, employees should be better able to remain productive and effective in their work, *even when* experiencing difficult thoughts, emotions, and sensations (Flaxman & Bond, 2006). This change in relationship with inner experience aligns with the notion that mindfulness interventions could reduce internal barriers to employees' effectiveness (Flaxman et al., 2013), and with the stress-buffering mechanism proposed to explain why mindfulness might be linked to job performance (Good et al., 2016).

One construct that appears to capture the link between these mindfulness mechanisms and work performance, is variously referred to as *presenteeism, work limitations*, and *work productivity loss* (Lu et al., 2021; Walker et al., 2017). These different terms refer to a similar construct (and cluster of outcome measures), representing the extent to which (mental or physical) ill-health symptoms or negative emotions have recently impaired a person's ability to be effective in the various task, workload, concentrative, and interpersonal demands of work (Lerner et al., 2001). This variable is common in investigations of the impact of common mental health conditions on work productivity (e.g., Toyoshima et al., 2020), but is rarely adopted as an outcome in controlled trials of workplace mindfulness interventions (Janssen et al., 2018; for exceptions see; Bartlett et al., 2017; Wolever et al., 2012). On the basis of these reflections surrounding mindfulness and job performance, the current study investigates whether worksite MT and ACT programs reduce work limitations, referring to the extent to which employees' difficult inner (e.g., emotional) experiences interfere with their ability to be productive at work.

Previous research on workplace MT and ACT programs

Systematic and meta-analytic reviews provide insight into the efficacy of worksite MT and ACT programs for improving the focal outcomes. Starting with the more extensively researched MT approach, there is consensus that MT reduces employees' perceived stress (usually assessed with the *perceived stress scale*; Cohen et al., 1983). Results indicate an aggregated positive MT effect on perceived stress (with between-group effect sizes in the region of .50 to .70) when compared with inactive (e.g., waiting list) control conditions (Bartlett et al., 2019; Lomas et al., 2019; Vonderlin et al., 2020). A lack of follow-ups in many workplace intervention studies has led to uncertainty about the durability of such effects (Bartlett et al., 2019). Nonetheless, results pooled across longer controlled trials indicate that between-group differences in perceived stress tend to be maintained for at least three months following MT program attendance (Vonderlin et al., 2020).

Compared to stress, sleep quality is less frequently assessed in workplace MT trials. For review purposes, sleep quality is commonly subsumed within broader health-related outcome clusters (e.g., Lomas et al., 2019; Vonderlin et al., 2020). Bartlett et al.'s (2019) meta-analysis revealed a small (statistically significant) pre-to-post effect (effect size = .26) on sleep quality in favour of MT compared to control conditions (based on 5 studies that assessed sleep). One study found that MT had a positive effect on employees' sleep quality at follow-up and not at post-intervention (Crain et al., 2017). This pattern of

change is congruent with the view that some benefits of mindful self-regulation take time to emerge.

As we have already noted, determining MT's effect on work performance has proved complicated. Lomas et al. (2019) detected greater improvement in job performance outcomes, such as work-related efficacy, among MT participants over control conditions (effect size = .43). By contrast, Bartlett et al. (2019) found insufficient data to draw a conclusion about performance or productivity benefits gained by attending workplace MT programs. Similarly, in Vonderlin et al. (2020) review, initial indication of MT's influence on performance disappeared after adjusting for an outlier. Bartlett et al. (2019) concluded that the promise of MT programs for enhancing work performance is not yet supported by RCT evidence.

Other reviews have synthesized effects of ACT-based training in the workplace (Flaxman et al., 2023; Prudenzi et al., 2021; Reeve et al., 2018; Rudaz et al., 2017; Towey-Swift et al., 2023; Unruh et al., 2022). Researchers have focused primarily on investigating ACT's influence on stress, burnout, and distress outcomes, with most studies involving staff working in healthcare, social care, and other helping professions. Pooled findings indicate that ACT-based training is moderately effective for reducing symptoms of stress and psychological distress. Effects on work-related variables (e.g., job burnout) have been less consistent, with indications that ACT may exert a delayed influence on work-related variables (i.e., at follow up assessments; Prudenzi et al., 2021).

Few workplace studies appear to have examined whether ACT improves sleep quality or work performance. Findings indicate that ACT programs increase job-related efficacy or personal accomplishment, particularly among staff in client-facing helping roles (Flaxman et al., 2023). ACT's specific influence on mindfulness in the workplace may have been obscured, in part because reviews have synthesized ACT's effects on mindfulness scales alongside change on other measures that are collectively assumed to capture the broader capacity of psychological flexibility (Prudenzi et al., 2021). However, a subset of primary studies reported significantly improved mindfulness scores among ACT participants, consistent with the proposition that ACT-based training cultivates the mindful self-regulation processes we described in the previous section (e.g., Frögéli et al., 2016; Jeffcoat & Hayes, 2012; Waters et al., 2018).

In sum, the extant body of evidence supports the use of MT and ACT programs for improving stress-related, well-being, and mental health outcomes. Results for work performance outcomes remain equivocal, which might be due to heterogeneity among performance indicators, detachment of performance measures from theorized mindfulness change processes, or lack of follow-up assessments. Recent years have seen burgeoning interest in the use of ACT-based training for workplace settings. Research has yet to compare workplace applications of MT and ACT to determine whether they are equally effective for targeting mindful self-regulation and associated outcomes. Hence, it seems timely to conduct a direct comparison of these approaches in the same organizational setting.

Present study

The overarching aim of the current study is to examine and compare the longitudinal effectiveness workplace applications of MT and ACT for: stress reduction, improving sleep quality, cultivating mindfulness, increasing alignment of behaviour with personal values (i.e., values-based action), and helping employees overcome internal barriers to effectiveness at work (i.e., reducing work limitations). We are particularly interested in testing these theorized benefits of mindful self-regulation in an ecologically valid context, in which the two programs were abbreviated versions of originating training protocols and accessible to all interested staff within the host organization.

Guided by purported overlaps and distinctions between MT and ACT, we test a combination of equivalence and difference hypotheses. Specifically, given the putative functional links between mindfulness and 1) stress coping and 2) stress recovery in Glomb et al.'s (2011) theory, we test the assumption that MT and ACT are equally effective for reducing perceived stress and improving sleep health.

Hypothesis 1: Both MT (*hypothesis 1a*) and ACT (*hypothesis 1b*) will reduce employees' levels of perceived stress over a six-month period, when compared to a waiting list control group.

Hypothesis 2: Both MT (*hypothesis 2a*) and ACT (*hypothesis 2b*) will improve employees' sleep quality over a six-month period, when compared to a waiting list control group.

We have highlighted uncertainty in the literature regarding whether ACT is viewed as a worksite mindfulness intervention approach. To help resolve this uncertainty, we compare the effectiveness of these two approaches for enhancing mindfulness among staff working in the same organizational context. In line with Glomb et al.'s account, we conceptualize mindfulness as a combination of present moment attention coupled with a nonjudgemental and nonreactive relationship with difficult inner experience.

Hypothesis 3: Both MT (*hypothesis 3a*) and ACT (*hypothesis 3b*) will increase employees' mindfulness over a six-month period, when compared to a waiting list control group.

Beyond these equivalence hypotheses, we test two hypotheses that were derived from theoretical and program-level differences between MT and ACT. Unlike MT, ACT is explicitly oriented towards behavioural activation in the presence of difficult or unwanted thoughts and feelings (i.e., the essence of psychological flexibility from an ACT perspective; Strosahl et al., 2012). On this basis, we reasoned that ACT might prove superior to MT in reducing work limitations, operationalized as the extent to which stress-related inner experiences (e.g., negative emotion) interfere with work effectiveness.

Hypothesis 4: ACT will elicit a superior reduction in work limitations, when compared to both MT (*hypothesis 4a*) and a waiting list control group (*hypothesis 4b*).

Our final hypothesis reflects the specific type of values-based behavioural activation cultivated by ACT, which involves helping employees clarify and use personal values as a guide to daily behaviour. Values exercises are a prominent component of workplace ACT interventions but are not part of most MT programs. To investigate whether this difference translates into different learning experiences derived from the two programs, we test the proposition that ACT is superior in cultivating employees' values-based action.

Hypothesis 5: ACT will elicit a superior improvement in values-based action, when compared to both MT (*hypothesis 5a*) and a waiting list control group (*hypothesis 5b*).

Method

Participants

Participants worked for a large healthcare organization in London (UK), recruited via an advertisement flyer for a staff well-being training entitled "Strengthen your well-being and personal resilience". The flyer was circulated by an organization-wide internal email system to more than 5000 staff members. The study included employees who had (a) been randomized to one of three conditions (i.e., MT, ACT, or waiting list control group), and (b) went on to complete Time 1 (pre-intervention) measures. No exclusion criteria were applied apart from being employed by the host organization and being aged 18 years or older.

An a priori power analysis was calculated using G*Power 3.1 (Faul et al., 2007) for linear multiple regression with a fixed model, defining nine predictors, a medium effect size (f = 0.15), power of .80, and an alpha of .05, recommending a sample of $N = 114$.

A total of 303 employees sent an email to obtain information (see Figure 1 for Flow Diagram). There were 63 withdrawals due to: training schedule clashing with work rotas; plans to leave current organization; reluctance to attend staff training as part of a research; lack of staffing cover for training release; or for unknown reasons. The remaining 240 employees were randomly allocated to the MT, ACT, or control groups, via block randomization (www.randomizer.org), prior to the administration of pre-intervention (i.e., Time 1) measures. Participants in all conditions, including the waiting list condition, were informed of their condition allocation and received an email detailing study information, dates, times, and locations of scheduled training sessions.

A final sample of 199 participants completed Time 1 measures that required signed informed consent and marked formal entry into the study. Of these 199 participants, 63 had been randomly allocated to the MT program, 67 to the ACT program, and 69 to the waiting list control group. Randomization proved

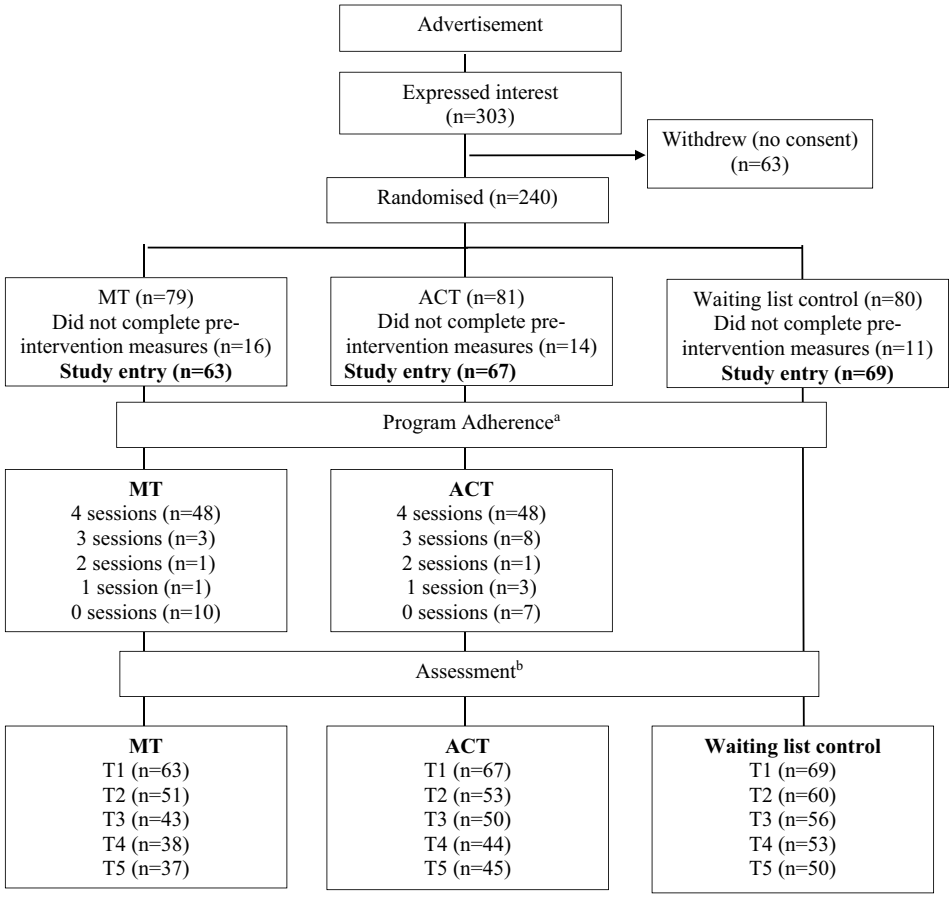

Figure 1. Flow diagram. Note. [a]Total number of training sessions attended. [b]Total number of participants responding to study assessments at each time point.

effective, in that there were no significant Time 1 differences between the three groups on any variables. Most participants (77%) were female, with a mean age of 42 years ($SD = 10.40$; range = 21 to 62); 35% ($n = 70$) had worked for the host organization for 3 years or less, 13% ($n = 26$) between 3 and 5 years, 21% ($n = 43$) between 5 and 10 years, while 30% ($n = 60$) had been employed by the organization for more than 10 years. Participants' job roles included nursing and related healthcare assistance, medical practice, departmental management, psychotherapy, administrative and clerical support, and various other health-related services (e.g., pharmacy, occupational therapy, and physiotherapy).

Procedure

The study received ethical approval from a local research ethics committee linked to the participating healthcare organization, and from City, University of London (PSYETH 11/12 007); the RCT was registered with the ISRCTN registry (ISRCTN13871025).

Both programs were delivered to small groups (of 5 to 10 staff) on the organization's premises. The first three sessions occurred in consecutive weeks, with the fourth session occurring six weeks after session 3. Training sessions lasted two hours and were offered during work hours or early evenings. If participants were unable to attend a prescheduled session, they could attend that session at a different time in the same week. If participants could not attend a session, they were able to request a pre-recorded video of the trainer delivering the session.

Participants received the same battery of self-report measures at 1.5- month (6 week) intervals spanning the six-month evaluation period (five measurement occasions in total). The measures were sent to participants as personalized email links via Qualtrics survey software. Table 1 displays the timeline of the project.

MT and ACT programs

The programs were delivered by the same trainer (VC), a licenced counselling psychologist with the British Psychological Society (BPS) and the Health and Care Professions Council (HCPC), and an accredited psychotherapist with the British Association for Behavioural and Cognitive Psychotherapies (BABCP). They were trained in MBSR (eight-week protocol) and experienced in delivering ACT protocols. The trainer attended regular supervision with a team of clinical and occupational health psychologists (PF, EM, JO). The MT and ACT programs were similar in terms of their duration, group size, and delivery format.

MT: The MT program (Table A1) was based on MBSR (Kabat-Zinn & Hanh, 2013; Stahl et al., 2019). Each session was organized around a theme and contained at least two guided mindfulness exercises (approximately 30 minutes duration). Participants were provided with a booklet including information on each session's theme, handouts, and audio material for home practice. Participants were encouraged to practice daily meditation, including both formal and informal practices.

ACT: The program (Table A2) was based on a workplace protocol offering training in two interrelated skills: mindfulness and values-based action (Flaxman et al., 2013). The stated purpose was "to learn how to use personal values as a guide to daily behaviour". Each session was organized around a theme, included at least one guided mindfulness practice (approximately 10 minutes in duration), a values exercise, and presentation of an ACT metaphor. Participants were provided with a booklet conveying the session theme, handouts for the exercises and audio material. Some mindfulness practices were similar to those used in MT, but of a shorter duration, and participants were encouraged to practice at least three times per week, along with values-based action exercises.

Measures

Perceived Stress Scale (PSS-4) (Cohen et al., 1983)

The PSS asks respondents to reflect on life demands, sense of overload and (un)controllability over the past month (e.g., *In the last month, how often have you felt that you were unable to control the important things in your life?)*. Responses are captured on a five-point response scale, ranging from 0 (*never*) to 4 (*very often*) and scores could range from 0 (lowest) to 16 (highest). A higher score indicates greater perceived stress. The PSS is widely used in worksite studies (Aikens et al., 2014). PSS-4 Cronbach's alpha (α) coefficients were: .75 (pre-intervention), .75 (post-intervention), .71 (follow-up).

Work Limitations Questionnaire-Short Form (WLQ-SF) (Lerner et al., 2001)

Work limitations were assessed with the WLQ-short form, which measures on-the-job impact of health and emotional difficulties on specific job demands (Allaire, 2003; Lerner et al., 2001). We excluded the physical demands scale (2 items). The remaining six items evaluated difficulties with time management and scheduling, mental-interpersonal demands (assessing cognitively demanding tasks and work-related social interactions), and output demands (assessing work productivity) (e.g., *How much of the time did your physical health or emotional problems make it difficult for you to concentrate on your work?*). Participants reported on the past two weeks with a higher score indicating higher limitations. WLQ items were rated on a response scale ranging from 1 (*difficult none of the time – 0%)* to 5 (*difficult all of the time – 100%)*. Cronbach's alpha reliability coefficients: .89 (pre-intervention), .91 (post-intervention), and .92 (follow-up).

Sleep quality (Schat et al., 2005)

Sleep quality was measured using the 4-item sleep disturbance subscale from the physical health questionnaire (PHQ). The

Table 1. Timeframe of study.

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Intervention	T1	T1	**S1**	**S2**	**S3**	X	T2	T2	**S4**	X	T3	T3	X	X	X	X	T4	T4	X	X	X	X	T5	T5

Note. T=Time of measurement, S= Intervention session number, X= No intervention.

scale captures different aspects of sleep disturbance, including difficulties falling asleep, premature awakening, and whether sleep has been peaceful and undisturbed (e.g., *How often have you had difficulty getting to sleep?)*. Participants rated their sleep over the past two weeks, on a scale ranging from 1 (*not at all*) to 7 (*all of the time*). Items were reverse- scored so that a higher score indicated better sleep quality. Cronbach's α: .76 (pre-intervention), .77 (post-intervention), .83 (follow-up).

Five facet mindfulness questionnaire (Baer et al., 2006)

We measured mindfulness with three of the five FFMQ facets (23 items in total) which have been previously proposed as mediators of mindfulness (Carmody & Baer, 2008; Querstret et al., 2017): acting with awareness; non-judging; and non-reactivity. The *acting with awareness* facet captures (in)attentiveness during present moment activities (e.g., *I find myself doing things without paying attention*). The *non-judging* subscale captures the degree to which a person makes (self-)critical evaluations about the presence of unwanted thoughts and feelings (e.g., *I think some of my emotions are inappropriate and I shouldn't feel them*). *Non-reactivity* to inner experience captures the ability to step back from difficult thoughts, feelings, and sensations without necessarily reacting upon them (e.g., *When I have distressing thoughts or images, I am able just to notice them without reacting)*. Items were rated on a response scale ranging from 1 (*never or very rarely true*) to 5 (*very often or always true*). Consistent with previous worksite studies (Roeser et al., 2013), we summed across the three subscales to create an overall mindfulness measure. The composite scale showed good internal reliability (Cronbach's α): .73 (pre-intervention), .94 (post-intervention), and .94 (follow-up).

Valuing Questionnaire (VQ) (Smout et al., 2014)

We employed a pre-published eight-item version of the VQ to measure recent engagement in values-based action (Davies et al., 2011). Six of the items were identical to those included in a published version and were retained. The VQ assesses a person's recent progress in a personally valued life direction (e.g., *I made progress in the areas of my life I care most about*), and the experience of encountering internal obstacles to expressing personal values in one's daily behaviour (e.g., *Difficult thoughts or feelings got in the way of what I really wanted to do*). Three progress and three obstruction items were combined to create a 6-item measure of values-based action. Participants were asked to respond over the past week, on a scale ranging from 0 (*not at all true*) to 6 (*completely true*). Cronbach's α = .82(pre-intervention), .86 (post-intervention), .87 (follow-up).

Data analysis

Statistical analyses were completed using linear mixed modelling (LMM) in SPSS IBM 28. These analyses incorporate an intention-to-treat approach through the Maximum Likelihood procedure, so that all participants are included in the analysis via their Time 1 scores, despite attrition, resulting in less biased effects (Heck et al., 2011). Little's MCAR test was performed to confirm that data were missing at random ($p = .478$), supporting this procedure. Different functions of time were tested (i.e., linear and quadratic) and Akaike information criterion (AIC) was used to choose the best fitting model (Burnham & Anderson, 2004). Smaller AIC values and simpler models are preferred, although both data and theory should be considered when making decisions. If the AIC difference falls between > 2 and < 4, then it is assumed that a model with additional parameters may contain important information and could be investigated. Any difference > 7 is thought to be unlikely to provide useful information. This study pursued the inclusion of both linear and quadratic functions of time if the difference between models was < 4. Time and intercept were entered as random effects and time as a repeated measure. Fixed effects were condition, functions of time and condition by time interactions. Covariance structure for the model was set as autoregressive and for the random effects as scaled identity for models with one covariate and unstructured for the rest. For each analysis, we tested three models: Model 1: a null model with no predictors testing inter-individual variation without accounting for time, which needed to indicate variation over .25 to proceed with the next steps. Model 2: a baseline growth curve model accounting for two functions of time (i.e., linear and quadratic). Model 3: testing the uncontrolled effect of the predictor (Condition). Model 3 examined the effect of condition on different parameters such as intercept, linear or quadratic slope on study variables and the interactions between group and time. This paper reports on the Group X Time interaction as an outcome of interest. Given the complexity of the models, this interaction is explored in a full factorial model (including all conditions), and then the intervention conditions were compared to each other in secondary analyses. Cohen's *d* (Cohen, 1988) effect size was calculated based on scores at different measurement occasions by dividing the mean difference by the pooled standard deviation. Given the plethora of analyses, this paper reports results from Models 2 and 3 given that Model 1 provided sufficient results to proceed.

Results

Attrition

Out of the 63 participants allocated to the MT program, 57 attended at least 3 of the 4 training sessions while 56 attended at least 3 sessions in the ACT program. Across the entire study, 133 of 199 study participants completed measures at all time points (an attrition rate of 33%). A chi-squared test revealed no significant relationship between drop-out and condition, χ^2 (2, n= 199) = 3.66, $p = .16$, phi = .14, indicating that the attrition rate was equivalent across the MT, ACT, and control groups. A series of independent t-tests on the completer dataset revealed that participants who provided a full set of data reported higher work limitations at Time 1, t (197) = −2.47, $p = .01$. Aside from this difference, these tests generally indicate that attrition had minimal impact on the profile of the final sample or pattern of findings.

Tests of hypotheses

The analysis first presents the overall main effects of the LMM and the Group X Time interaction in Table 2 (modelling Time 1 to Time 5). Second, it shows the estimates for pairwise slope

Table 2. Results of the mixed-effects linear models.

Effect	*F*	*df*	*p*
Perceived Stress			
Condition	.79	2, 493.60	.454
Linear time	21.71	1, 275.08	<.001
Quadratic time	11.19	1, 257.22	<.001
Condition X Linear time	3.30	2, 274.46	.039
Condition X Quadratic time	2.86	2, 256.40	.059
Sleep Quality			
Condition	.28	2, 193.51	.756
Linear time	26.70	1, 154.12	<.001
Condition X Linear time	5.98	2, 153.77	.003
Work Limitations			
Condition	.34	2, 186.28	.715
Linear time	32.82	1, 152.86	<.001
Condition X Linear time	1.69	2, 152.52	.187
Mindfulness			
Condition	1.46	2, 441.86	.235
Linear time	24.19	1, 295.62	<.001
Quadratic time	10.13	2, 271.95	.002
Condition X Linear time	2.06	2, 294.75	.130
Condition X Quadratic time	0.84	2, 270.84	.433
Values-based action			
Condition	0.36	2, 191.42	.687
Linear time	36.21	1, 153.38	<.001
Condition X Linear time	3.77	2, 153.06	.025

Note. Condition = Between-group initial status of variable at Time 1; Quadratic time = $Time^2$.

comparisons (i.e., the fixed effects) along with their confidence intervals (CIs) in Table 3. Table 4 presents means and standard deviations for study variables, along with the between-group effect sizes at each measurement occasion.

Hypothesis 1: perceived stress

It was predicted that both MT and ACT (compared to the waiting list control group) would reduce employees' perceived stress over a six-month period. Model 2 for perceived stress supported the inclusion of both linear [F (1, 271.165) = 19.56, *coef.* = −1.00, $p < .001$] and quadratic [F (1, 253.44) = 9.77, *coef.* = .12, $p = .002$] time trajectories (with AIC < 4 supporting the inclusion of both functions of time). When including all conditions in Model 3, the Group X Linear time interaction was significant, indicating a significant gradual linear decrease of perceived stress in the two intervention conditions over time compared to the waiting list (see Table 2). The quadratic time effect showed a trend towards significance, suggesting some loss of effect over time. These effects were not associated with initial status in perceived stress across conditions. Figure 2 shows the linear decrease in perceived stress over the timeframe of the study according to fitted linear estimates. Both MT and ACT had a significant Group X Linear time interaction effect as shown in pairwise comparison statistics (see Table 3). Effect sizes for both programs were of a small to medium magnitude. As expected, the two intervention conditions were largely equivalent in their effects, since Group X Linear time interaction was not significant when comparing MT to ACT in a separate analysis [Linear time: F (1, 94.61) =.55, $p = .46$].

Hypothesis 2: sleep quality

It was predicted that both MT and ACT would improve employees' sleep quality compared to the control group. Although Model 2 indicated both a significant linear, F (1, 303.27) = 9.13, *coef.* = 1.t, $p = .003$) and quadratic effect, F (1, 288.865) = 4.20, *coef.* = −.15, $p = .04$), the model including the linear time trajectory had a superior fit (AIC >7). Model 3 resulted in a significant Group X Linear time interaction when including all conditions, indicating a linear growth in sleep quality for the intervention conditions compared to the waiting list condition (see Table 2). This effect was not associated with initial sleep quality status across conditions. Both MT and ACT resulted in a significant Group X Linear time interaction as shown in pairwise comparison statistics (see Table 3). Figure 3 shows the linear growth in sleep quality over the timeframe of the study using fitted linear estimates. Effect sizes for the MT group were of a moderate magnitude and for ACT of a small to moderate magnitude on this outcome variable. As expected, the Group X Linear time interaction was not significant when comparing MT and ACT conditions in a separate analysis [Linear time: F (1, 327.53) = .00, $p = .99$].

Table 3. Estimates of fixed effects, confidence intervals, and Standard Errors for Group X Time Interactions.

			Assessment period (T1 to T5) Group X Time interaction				
Measure		Parameter	*b*	*SE*	95% CI (LL-UL)		*p*
Perceived Stress	Linear	Intercept	11.53	0.52	10.50	12.55	<.001
		ACT	−1.10	0.54	−2.32	−0.21	.019
		MT	−1.10	0.55	−2.18	−0.01	.049
	Quadratic	ACT	0.19	0.09	0.01	0.36	.035
		MT	0.18	0.09	0.00	0.36	.051
Sleep Quality	Linear	Intercept	18.25	0.65	16.97	19.53	<.001
		ACT	0.62	0.22	0.19	1,04	.005
		MT	0.68	0.23	0.24	1,13	.003
Work Limitations	Linear	Intercept	22.64	0.62	21.43	23.85	<.001
		ACT	0.19	0.23	−0.26	0.64	.399
		MT	0.43	0.24	−0.03	0.90	.068
Mindfulness		Intercept	74.04	1.77	70.55	77.52	<.001
	Linear	ACT	4.26	1.98	0.35	8.17	.033
	Quadratic	ACT	−0.45	0.32	−1.08	1.18	.110
	Linear	MT	1.44	0.52	0.42	2.47	.006
values-based action	Linear	Intercept	27.55	1.15	25.29	29.80	<.001
		ACT	4.26	1.18	1.94	6.59	<.001
		MT	2.31	1.22	−0.10	4.72	.060

Note. [a]Intervention entered as a factor, Condition vs Waiting list control group; CI=Confidence Intervals; LL=Lower Limit; UL=Upper Limit.

Table 4. Means, Standard Deviations, and between-group effect sizes.

	MT ($n = 63$)		ACT ($n = 67$)		Waiting List Control ($n = 69$)		*d*	
Variables	Mean	*SD*	Mean	*SD*	Mean	*SD*	MT vs Control	ACT vs Control
Perceived Stress								
Time 1	10.73	2.44	11.14	2.65	11.26	2.64		
Time 2	9.61	2.07	10.15	2.64	11.10	2.62	0.63	0.36
Time 3	9.47	2.34	9.48	2.41	10.64	2.61	0.47	0.46
Time 4	9.18	2.50	9.63	2.45	10.63	2.66	0.56	0.39
Time 5	9.24	2.18	9.40	2.31	10.24	2.68	0.41	0.34
Sleep Quality								
Time 1	18.73	4.92	17.66	4.72	18.22	5.74		
Time 2	19.98	4.01	20.26	4.37	18.24	5.21	0.37	0.42
Time 3	20.45	4.82	19.94	4.30	18.11	4.97	0.48	0.39
Time 4	21.55	3.82	20.02	4.36	18.43	4.56	0.74	0.36
Time 5	21.51	4.90	20.87	4.81	17.88	4.82	0.75	0.67
Work Limitations								
Time 1	22.40	5.22	22.64	4.40	22.97	4.66		
Time 2	24.20	3.95	24.62	4.01	23.02	4.97	0.26	0.35
Time 3	25.12	3.84	25.00	4.63	24.04	4.70	0.25	0.21
Time 4	24.87	4.32	24.80	3.95	24.27	4.50	0.14	0.13
Time 5	26.46	3.35	25.37	5.11	24.18	5.34	0.51	0.23
Mindfulness								
Time 1	76.24	14.69	72.82	13.51	74.49	14.77		
Time 2	79.21	12.74	76.33	10.63	75.37	14.65	0.30	0.08
Time 3	83.07	13.51	79.58	13.10	76.42	15.34	0.46	0.22
Time 4	84.89	13.68	80.40	12.42	79.00	15.16	0.41	0.10
Time 5	86.08	14.35	81.60	13.49	76.75	15.61	0.62	0.33
values-based action								
Time 1	26.84	5.84	25.60	5.61	26.97	6.23		
Time 2	28.84	5.34	29.06	4.53	26.81	5.97	0.32	0.38
Time 3	28.90	5.43	29.08	6.06	26.98	7.10	0.30	0.32
Time 4	30.70	4.72	29.75	5.57	27.09	6.42	0.64	0.44
Time 5	31.37	4.93	30.07	5.62	28.16	6.52	0.55	0.31

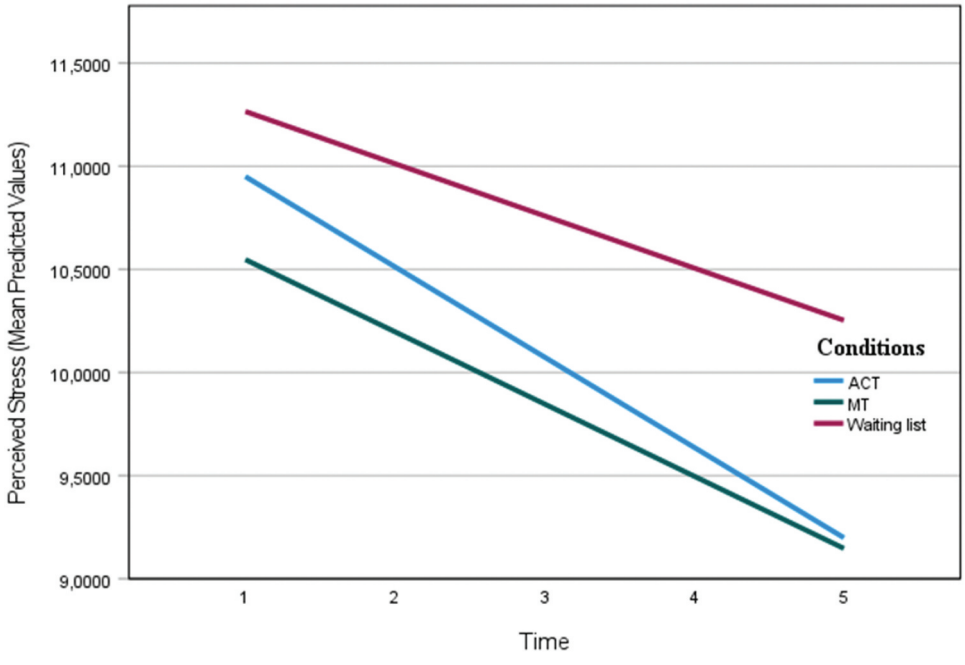

Figure 2. Fitted linear time trajectories of experimental conditions on perceived stress. *Note*. Time 1-5 represents the 5 measurement timepoints.

Hypothesis 3: mindfulness

We predicted that mindfulness would increase in both MT and ACT conditions, relative to the control group. Model 2 for mindfulness indicated a significant linear growth effect, F (1, 299.47) = 23.72, $p < .001$, and a significant quadratic effect, F (1, 272.87) = 10.21, $p = .002$) with quadratic being the best fitting model for Model 3 (the AIC difference was > 7, supporting inclusion of the more complex model). The Group X Linear time interaction was not significant when including all conditions in the model (see Table 2). However, in support of hypotheses 3a and 3b, both programs resulted in a significant Group X Linear time interaction effect when independently compared

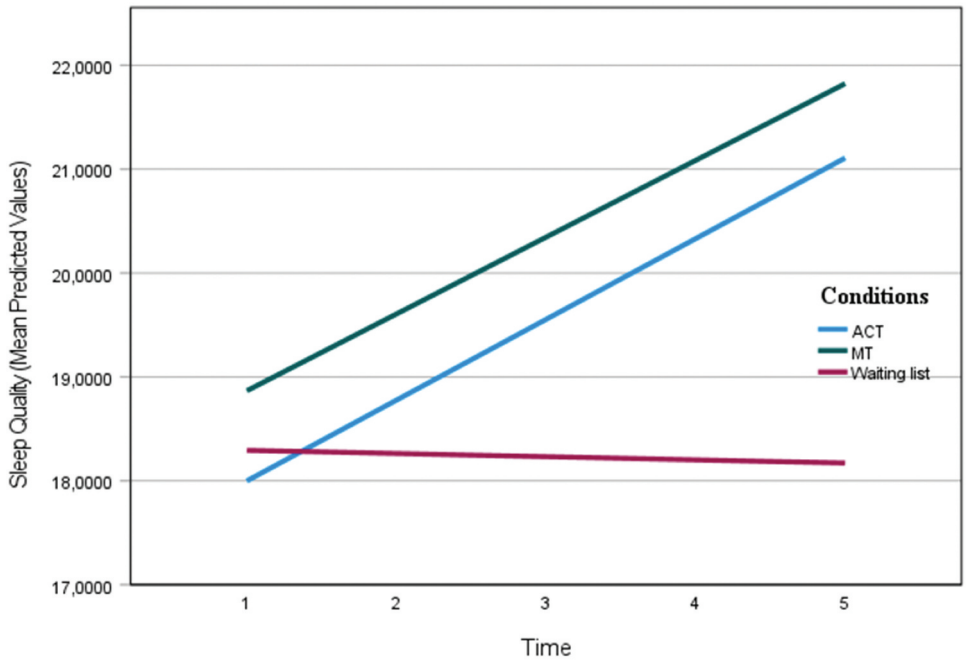

Figure 3. Fitted linear time trajectories of experimental conditions on sleep quality. *Note*. Time 1-5 represents the 5 measurement timepoints.

to the waiting list control condition (see Table 3). When comparing each intervention condition (MT and ACT) to the control condition, only ACT exhibited a significant effect for both functions of time (linear growth effect, F (1, 211.01) = 17.10, $p < .001$; quadratic effect, F (1, 188.65) = 8.20, $p = .005$). The most complex model, including both functions of time, was chosen for comparing the ACT to the control condition over time (AIC >7), resulting in a significant Group X Linear Time effect. When comparing MT to the control condition, only the linear function of time was significant at Model 2 (linear growth effect, F (1, 206.58) = 8.30, $p < .004$; quadratic effect, F (1, 194.99) = 3.46, $p = .064$). As shown in Table 3, Group X Linear Time effect was also significant for the MT condition when compared to the control group. Regarding between-group effect sizes, MT resulted in a small to moderate increase in mindfulness while ACT resulted in a small increase. However, the Group X Linear time interaction was not significant when comparing MT and ACT conditions to each other in a separate analysis excluding the waiting list condition [Linear time: F (1, 89.30) =.62, $p = .81$].

Hypothesis 4: work limitations

We predicted that ACT would be the superior approach for reducing work limitations, when compared to both MT (hypothesis 4a) and to the waiting list control condition (hypothesis 4b). Model 2 for work limitations indicated a significant linear effect, F (2, 159.42) = 13.21, *coef.* = 1.53, $p < .001$, and a significant quadratic effect, F (2, 154.36) = 5.96, *coef.* = –.174, $p = .016$. However, the model including only the linear effect had a superior fit (AIC >7) and was retained for the analysis. Contrary to hypotheses 4a and 4b, in Model 3 the Group X Linear time interaction was not significant, indicating a broadly similar time trajectory across the three conditions (see Table 2). To investigate further, pairwise comparisons did not reveal a significant Group by Linear time interaction for either of the two intervention conditions (see Table 3). Effect sizes for both intervention conditions were small except for Time 5 for the MT group. The Group X Linear time interaction was also not significant when comparing MT and ACT conditions in a separate analysis [Linear time: F (1, 372.56) = 1.11, $p = .293$].

Hypothesis 5: values-based action

We expected a superior increase in values-based action for the ACT condition when compared to MT (hypothesis 5a) and the waiting list control group (hypothesis 5b). Model 2 for values-based action indicated only a significant linear growth effect [F (1, 271.65) = 8.52, $p < .004$]. In Model 3 the interaction of Group X Linear time was significant when including all conditions indicating a significant growth in values-based action in the two intervention conditions compared to the control condition (see Table 2). Moreover, these effects were not associated with initial status in values-based action. Consistent with hypothesis 5a, pairwise comparisons indicated that ACT but not MT resulted in a significant Group X Linear time interaction, indicating growth in values-based action over time (see Table 3). However, effect sizes were small to moderate for both ACT and MT conditions. When comparing ACT to MT in a separate analysis the Group X Linear time interaction was not significant [F (1, 95.19) = .003, $p < .958$].

Discussion

This study's overarching aim was to examine theorized effects of two worksite mindfulness intervention approaches under ecologically valid (i.e., real-world) training implementation conditions. We tested hypotheses informed by a) Glomb et al.'s (2011) account of mindfulness processes posited to foster self-regulation in the workplace, and b) conceptual and practical

overlaps and distinctions between MT and ACT. We obtained support for our first two hypotheses, in that both MT and ACT were found to be effective in reducing perceived stress and improving employees' subjective sleep quality over the six-month study period. Moreover, as predicted, the two programs exhibited a similarly positive influence on mindfulness. Results provided only weak support for the notion that ACT offers a more targeted approach than MT for helping employees align their behaviour with personal values. Although results pivoted slightly in favour of ACT, the values-based action change trajectories did not differ significantly between the MT and ACT conditions. Contrary to the argument that mindfulness interventions might reduce internal barriers to work-related effectiveness, neither program was associated with a significant reduction in work limitations.

Theoretical implications

Given that both MT and ACT have been classified as worksite stress management interventions (Bond & Bunce, 2000; Richardson & Rothstein, 2008), it seemed logical to begin our investigation by examining and comparing these programs' longitudinal influence on perceived stress. Consistent with prior research, both programs exhibited utility for reducing stress in this working population (Bartlett et al., 2019; Prudenzi et al., 2021; Vonderlin et al., 2020). The positive impact on stress in both training conditions can be interpreted through the lens of the transactional model of stress (Lazarus & Folkman, 1984). Adopting this perspective, attendance at MT or ACT may have enhanced participants' repertoires of intrapersonal resources (e.g., via development of decentring skills), increasing their confidence in the capacity to cope with inner sequelae of work and life demands. PSS items closely reflect this appraisal-based interpretation, as the scale assesses confidence in the ability to handle and overcome problems and difficulties (Cohen et al., 1983; Lomas et al., 2019). Results also lend support to scholars pursuing integration of mindful self-regulation with other contemporary models of workplace functioning, such as job demands-resources (JD-R) theory (Bakker & Demerouti, 2017; Bartlett et al., 2019; Flaxman et al., 2023). A growing body of non-intervention research suggests that trait mindfulness functions as a personal resource, moderating detrimental associations between stressors and employees' health and well-being (e.g., Eddy et al., 2019; Grover et al., 2017). Our own findings complement this strand of research, offering arguably robust controlled trial evidence for the hypothesized stress-buffering functions of cultivating mindfulness at the worksite.

The design of the current study extends previous research on the use of mindfulness programs as stress management initiatives. First, we detected a significantly decreased trajectory in stress perceptions in both MT and ACT conditions (relative to the control group) across several months, indicating that lowered stress reactivity was a relatively durable outcome of these programs. Second, unlike a growing number of workplace intervention trials, we did not restrict access to employees exhibiting high stress or burnout scores at baseline (e.g., Hofer et al., 2018; Puolakanaho et al., 2020; Wolever et al., 2012). Although applying inclusion criteria is appropriate and useful for efficacy trials, we were interested in examining the comparative field effectiveness of abbreviated applications of these approaches. Under these conditions, it is noteworthy that we detected stress reduction in both training groups (relative to the control group) without attempting to minimize the "dilution" effect that can arise when recruiting heterogeneous samples of employees for stress management initiatives (Bunce, 1997; Flaxman & Bond, 2010).

In terms of the stage model of intervention development, we position this trial's approach at "Stage III"; in that we tested the two programs in a real-world setting, using an implementable format, while applying an RCT design to establish internal validity (Bartlett et al., 2019; Onken et al., 2014). Establishing these programs' utility for reducing stress reactivity under these conditions is considered a particularly important step, which should occur prior to recommending the same training approaches to work psychology practitioners and organizational stakeholders (i.e., Stage IV and V research initiatives). The results of this effectiveness study may help to reduce concern that workplace mindfulness program advocates overgeneralize findings obtained from different types of research (e.g., clinical, lab-based, or cross-sectional studies; Bartlett et al., 2019).

As predicted, we also found a positive influence of both MT and ACT on employees' sleep quality. This is another encouraging result, given that disrupted sleep is related to mental ill-health, poorer workday functioning, and reduced work productivity (Espie et al., 2018; Rosekind et al., 2010). The demonstrated efficacy of these intervention approaches for improving sleep health aligns with Ong et al.'s (2012) metacognitive model of insomnia. Their theory describes two interrelated levels of cognitive hyperarousal that can drive (and escalate) sleep problems. Primary arousal refers to thoughts and beliefs surrounding sleep difficulty, such as worry about next-day consequences of not getting enough sleep. Secondary arousal captures the person's *relationship with* thoughts about sleep (and with thoughts about other topics that might also affect sleep). This secondary level includes a degree of behavioural and emotional reactivity to having thoughts about not being able to sleep, and signs of excessive entanglement with troubling scenarios that might be portrayed by such thinking.

Adopting this theoretical perspective, we postulate that the MT and ACT programs helped to address secondary level processing, for instance by promoting meta-awareness and a mental stance characterized by less critical and less reactive responding to thoughts that might otherwise have potential to interfere with sleep quality (Ong & Moore, 2020; Ong et al., 2018). At the individual program level, we presume that MT improved this type of self-regulatory capacity through well-established meditation practices (drawn from the MBSR protocol), which were at the heart of the MT sessions, group discussions, and home practices. Attributing MT's effect on sleep quality to these exercises concurs with experimental research, indicating that mindfulness meditation has salutary effects on stress-related biological markers (e.g., Ooishi et al., 2021).

A similar improvement in sleep quality was reported by employees who received ACT, even though meditation was not such a prominent feature of this program. This finding

implies that other ACT techniques may have helped target the processes linked to improved sleep health. For example, ACT shows participants how to disentangle themselves from the content of unhelpful thoughts, by writing down the content of such thoughts, giving the mind a playful label for when it is producing such thoughts, and adopting unusual language practices designed to facilitate a psychological "step back" from cognitive content (e.g., by habitually stating "*I'm having the thought that* . . . ." prior to a thought). This cognitive defusion process can be equated with the concept of decoupling self from experience in Glomb et al.'s theory, and with the related concept of decentring (or reperceiving) in Shapiro et al.'s model of mindfulness mechanisms (Bernstein et al., 2015; Shapiro et al., 2006). Defusion has been proposed to play an influential when ACT is deployed as a clinical treatment for insomnia (Salari et al., 2020).

Our own study offers some potentially useful contributions to the literature linking workplace mindfulness interventions to sleep outcomes. First, the MT and ACT programs were offered as general well-being interventions (rather that specifically targeting insomnia), thereby attracting employees who might not have volunteered for a sleep-focused program. This study feature deserves mention, given that "subsyndromal" sleep disturbances appear to be widespread, and can have a detrimental impact on employees' mental health, quality of life, and work experiences (Morin & Jarrin, 2022; Vonderlin et al., 2020). Second, our study complements existing RCTs of worksite mindfulness interventions (e.g., Bartlett et al., 2017, 2019; Klatt et al., 2009), by demonstrating that improvements in sleep quality previously detected at post-intervention were maintained across multiple measurement time points. Finally, our study offers a first demonstration that ACT had a positive impact on employees' subjective sleep experiences (comparable with the impact of MT), when administered in the format of a relatively brief worksite training course.

Given that both MT and ACT have been considered members of the mindfulness family (Hayes et al., 2011), it is important that these worksite applications were shown to elicit broadly equivalent improvements on a mindfulness variable. In line with measurement recommendations, we moved beyond capturing present moment attention, to ensure we were capturing change on a combination of attentional and acceptance-based self-regulatory strategies (Bergman et al., 2016; Lindsay & Creswell, 2017; Lomas et al., 2019). It was interesting to note that the level of mindfulness continued to increase across the successive timepoints (evident in both the MT and ACT groups), consistent with the notion that some mindfulness skills (such as acceptance of difficult inner states) may take time to fully emerge (Flaxman et al., 2023; Hofer et al., 2018). To our knowledge, the debate about distinctions and overlaps among different workplace mindfulness interventions has not been informed by a direct comparison of workplace MT and ACT programs, delivered in the same format, at the same time, and to staff in the same organizational context. Hence, we hope that the similar improvement in mindfulness reported across our two intervention groups will help resolve uncertainties about how to classify these programs, and whether aspects of these approaches might ultimately be merged to enhance employee outcomes (e.g., by adding ACT's values clarification techniques to worksite MT programs; Kinnunen et al., 2020; Vonderlin et al., 2020). The mindfulness improvements should also prove informative to practitioners and organizational stakeholders, who might wish to adopt an intervention approach that is most closely aligned to the interests of the target group (e.g., whether there is interest among staff in meditation or values clarification).

We failed to obtain support for our hypothesis that ACT would prove particularly effective for reducing work limitations. Neither program exerted a positive influence on WLQ scores across the duration of this study. We consider some possible interpretations of these null effects. One explanation relates to the nature of the WLQ. As set out in our introductory arguments, we adopted this scale because it captures the experience of inner experience interfering with key aspects of task, time management, and interpersonal effectiveness at work. This construct appears relevant to the assertion that workplace mindfulness interventions might prevent difficult inner states from "derailing" people's work-related effectiveness (Glomb et al., 2011). However, the scale instructions asked respondents to report the degree to which "health or emotional problems" had impaired different aspects of job performance. While these instructions are well-suited to studies of physical health conditions or common mood disorders, they may be less sensitive to mindfulness-based change in work effectiveness among a generally healthy sample of staff.

A second interpretation considers the organizational context. Participants were employed in a large public sector healthcare organization that specialized in mental health services for the local community. This type of healthcare setting may exhibit strong situational pressures (e.g., costs of poor concentration or consequences of ineffective interactions with service users) that may override any impact of a relatively brief individual-focused intervention. This interpretation aligns with work on the role of *situational strength*, which has been utilized to explain weak or inconsistent relationships between personality characteristics and job performance (Meyer & Dalal, 2009). The current study's healthcare setting would likely exhibit high situational strength, especially in terms of consequences for patients of staff behaviours or lapses that might elevate risk of negative outcomes (Meyer et al., 2009). This contextual feature may have reduced variability in work behaviour due to mindfulness skills and characteristics. To our knowledge, this contextual factor has not attracted much attention from workplace mindfulness researchers, and represents a viable avenue for further research. For example, researchers could investigate whether associations between trait mindfulness and work performance are moderated by markers of situational strength. Interestingly, emergent findings suggest that context may have been influencing mindfulness intervention outcomes. Specifically, Unruh et al. (2022) review revealed that employees in office environments (generally lower situational strength) gained greater benefit from ACT than employees in healthcare settings (likely higher situational strength). Ultimately, mindfulness interventions may simply be more appropriately utilized as psychological well-being programs, and claims of performance and productivity benefits may need to be downplayed. Such a conclusion seems appropriate, given the current disparity between well-being and work performance outcomes

among worksite RCTs (Bartlett et al., 2019; Vonderlin et al., 2020).

A final novel contribution of this study stems from our examination of MT and ACT program effects on values-based actions. While Glomb et al.'s model focuses primarily on the MT approach, we hypothesized that ACT might prove even more effective than MT for developing this self-regulatory capacity. We found partial support for this assertion, in that statistically significant growth in values-based action relative to the control group was found only in the ACT condition. However, when comparing MT and ACT, we did not detect a tangible difference between their effects on values-based actions. While these results suggest a small advantage to using ACT, there were also tentative signs of support for the notion that MT leads to an increase in values-guided behaviour. To our knowledge, this hypothesized benefit of mindfulness-based change, which is proposed in a number of influential theories (e.g., Glomb et al., 2011; Hayes et al., 2006; Rogge & Daks, 2020; Shapiro et al., 2006), has not previously been tested in this type of workplace intervention effectiveness trial. Inclusion of this outcome responds to calls to expand the focus from deficit-based symptom measures (e.g., distress), to capture more asset-based and eudaimonic dimensions of employees' well-being (Flaxman et al., 2023; Lomas et al., 2019).

Limitations and directions for future research

Our study exhibits some methodological strengths, including random allocation of employees to study condition, comparison of two mindfulness interventions in the same format and context, and five measurement occasions spread over a 6-month timeframe. Alongside these strengths, a number of potential limitations should be acknowledged.

First, we gathered study data through self-reports, and research in this area may be advanced by more objective assessments of both sleep quality and job performance. Second, only three of the FFMQ's subscales were administered to capture the overarching construct of mindful self-regulation. This decision was made at the trial's design stage to reduce participant burden, with *observing* omitted due to its inconsistent psychometric properties (Gu et al., 2016) and *describing* omitted because neither program explicitly targeted this skill (see Bergman et al., 2016) for a similar approach). However, given growing use of FFMQ short-forms, it would be logical for future worksite intervention studies to include a shorter version and examine change on all five facets. Third, the MT and ACT interventions were abbreviated (i.e., "low dose") versions of more lengthy programs (e.g., the 8-week MBSR protocol; Bartlett et al., 2019). Although abbreviated mindfulness programs are common in workplace settings (Klatt et al., 2009), it would be useful to see research directly comparing abbreviated and full-length versions of both these interventions. Recent reviews indicate that longer programs may prove more effective for reducing perceived stress, particularly for staff in healthcare settings (Prudenzi et al., 2021; Unruh et al., 2022). Fourth, the same trainer delivered MT and ACT, and it is possible the trainer exhibited a particular set of skills that helped to produce the salutary effects of these programs. It would be useful for future studies to utilize additional trainers in each condition, and to investigate the influence of trainer effects. Future studies would also benefit from video recording some sessions, in order to rate program fidelity using structured assessment tools (O'Neill et al., 2019). This would increase confidence that any differences between intervention outcomes are reflective of program components and not due to other factors (e.g., trainer style). Finally, the study's overall attrition rate was 33% across all conditions and timepoints, reflecting a common challenge in worksite intervention studies. This attrition rate is broadly similar to other workplace studies that included follow-up assessments (Flaxman & Bond, 2010; Manotas et al., 2014). Our utilization of linear mixed methods modelling should have reduced the impact of missing data on the observed pattern of results (Shek & Ma, 2014). Nonetheless, there remains scope for further research designed to provide insight into factors influencing employees' ability to participate throughout this type of longitudinal intervention study.

Conclusion

Despite the considerable body of research surrounding workplace mindfulness interventions, the field continues to face challenge and scrutiny. The current trial may help to address some of those challenges, by comparing the effectiveness of two prominent mindfulness approaches, extending the controlled evaluation period over several months, and exploring change on a work limitations variable that reflects links between mindfulness change mechanisms and work effectiveness. Overall, the findings indicate that MT and ACT can be viewed as alternative approaches, which successfully cultivate mindfulness processes, and deliver apparently durable improvements in stress-related and well-being outcomes. The lack of impact on work limitations means that our study must be added to the already mixed body of evidence surrounding job performance outcomes. We hope that our study motivates further research into the effectiveness of these popular worksite programs, ideally under conditions that closely resemble real-world implementation practice.

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Data availability statement

Data are available from the authors upon reasonable request.

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