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Peak Experiences During Insight Mindfulness Meditation Retreats and Their Salutary and Adverse Impact: A Prospective Matched-Controlled Intervention Study

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Objective: We sought to address a growing debate regarding the adverse and salutary impact of unusual, extraordinary or intense subjective experiences during meditation-based interventions. To do so, we empirically characterized such peak experiences during an intensive meditation intervention and their impact postintervention. ***Method:*** We conducted a preregistered prospective intervention study among 96 adults who registered for 6-day insight (Vipassana) mindfulness meditation retreats and 47 matched controls. Controls were selected from a pool of 543 people recruited from the same community of meditators as retreat participants and systematically matched to retreat participants on age and lifetime meditation experience. Measures included the novel Peak Meditative Experience Scale and the Impact of PMES. ***Results:*** Seventeen peak experiences that were primarily pleasant (e.g., deep and unusual peace, aha! Moment) occurred more frequently among retreat participants than among matched controls in daily living ($ps < .05$; mean $\phi = .33$). In contrast, 14 peak experiences that were mostly unpleasant (e.g., flashbacks, overwhelming sadness) occurred at similar rates in both groups ($ps > .05$). At 2-week follow-up, the perceived impact of all pleasant and most unpleasant peak experiences was more salutary than adverse ($ps \leq .015$; M Cohen's $d = 1.61$). ***Conclusions:*** Peak experiences that resulted from meditation retreats were primarily pleasant and had a large salutary impact postretreat. Inconsistent with conclusions from uncontrolled retrospective studies, findings document that intensive insight mindfulness meditation training in retreats may not contribute to unpleasant peak experiences and even when they occurred their impact was typically more salutary than adverse.

What is the public health significance of this article?
In light of the exponential adoption of meditation training in interventions and treatments for a variety of mental health disorders and problems, it is critical for public health to better understand the positive and harmful impacts of meditation training. The study provides evidence that intensive insight mindfulness meditation training may lead to unusual experiences which are primarily pleasant and have a large positive impact on participants' lives. Critically, findings challenge widely held assumptions in the science of mindfulness and meditation by documenting that intensive insight mindfulness meditation training may not contribute to unusual and harmful unpleasant experiences.

Keywords: adverse effects of meditation, altered states of consciousness, meditation retreats, mindfulness mechanisms, phenomenology of meditation

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Meditation training is now widely implemented in a variety of settings, most notably in clinical mindfulness-based interventions as well as third-wave and process-based cognitive behavioral therapies (Creswell, 2017; Hayes & Hofmann, 2021; Van Dam et al., 2018). Moreover, a growing body of empirical evidence supports the salutary effects of mindfulness meditation training on mental health outcomes (Goldberg, Riordan, et al., 2022). Accordingly, over the past 2 decades, research has sought to study the mechanisms of

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action of mindfulness and meditation training. One promising yet understudied approach has focused on, what we refer to here as, peak experiences during meditation training. These are meditation-related subjective experiences that have been conceptualized as unusual and uncommon in a day-to-day life and as intense, strong, very meaningful or touching (Timmermann et al., 2023; Vieten et al., 2018). Multidisciplinary theories relate to a variety of extraordinary and unusual subjective experiences during meditation and to their important roles in the salutary effects of meditation (Anālayo, 2003; Sedlmeier, 2018; Timmermann et al., 2023). Scholars have also argued that intense and unusual unpleasant experiences during meditation may contribute to meditation-induced adverse effects (Baer et al., 2019; Lindahl et al., 2017; Sedlmeier, 2018). Yet, despite how important peak experiences may be for understanding the salutary and adverse effects of mindfulness and other forms of meditation, our empirical understanding of these phenomena is limited. As meditation training is exponentially applied across a variety of sectors and clinical applications, research on peak experiences during meditation training is essential for better understanding the potential clinical risks and benefits of these interventions. To date, only a limited body of research has focused on these experiences during meditation training.

A preliminary set of mostly retrospective and uncontrolled studies has focused on unusual or extraordinary subjective experiences during meditation. A large cross-sectional survey (N = 1,120) indicated that meditators practicing a variety of meditation styles commonly reported a broad range of extraordinary experiences during meditation, including bodily sensations not clearly caused by the physical environment, altered sense of time, and altered identity (Vieten et al., 2018). Several smaller qualitative studies among experienced Western Buddhist meditation practitioners have also documented extraordinary subjective experiences during meditation such as weakening of self-boundaries during meditation (Ataria, 2015), sensation of electricity like "currents" through the body, and distortions in time and space (Lindahl et al., 2017).

Another set of studies focused on unpleasant or adverse subjective experiences during meditation. Unpleasant thoughts, emotions, and sensations inevitably arise during mindfulness and other forms of meditation practice and are common among novice meditators who represent the large majority of people receiving mindfulness and meditation interventions (Aizik-Reebs et al., 2021; Britton et al., 2021). However, these experiences may not necessarily lead to adverse effects and may be important opportunities to practice adaptive responses to these unpleasant internal states (e.g., self-compassion and acceptance; Baer et al., 2019). Nevertheless, critical clinical questions have arisen regarding the potential adverse effects of unpleasant experiences during mindfulness and meditation-based interventions (Baer et al., 2019; Van Dam et al., 2018).

To date, a number of retrospective and uncontrolled studies have examined the potential roles of intense and unusual unpleasant experiences during meditation practice in meditation-related adverse effects. For example, in a selected sample of 60 experienced Western Buddhist meditation practitioners that had distressing or impairing experiences related to their meditation practice, participants reported a variety of challenges attributed to meditation in interviews. These include problems with executive functioning, delusional beliefs, hallucinations, anxiety, depression, reexperiencing of traumatic memories, pressure and tension in the body, and social impairment (Lindahl et al., 2017). In another qualitative cross-sectional study among 240 current and past meditators practicing a variety of meditation styles, approximately 20% reported a particularly bad or frightening experience during or as a direct result of meditation. Common unpleasant experiences and/or adverse outcomes included psychological adversity (e.g., fear, sadness, worry), negative health outcomes (e.g., pain, insomnia), and stressful personal changes (e.g., existential dread; Anderson et al., 2019). In a recent cross-sectional study among 434 participants with lifetime experience in a variety of meditation styles, the most common meditation-related unpleasant experiences were anxiety, traumatic reexperiencing, and emotional sensitivity. Furthermore, while for most participants, meditation-related adverse effects were relatively transient, a subgroup of participants (10.4%) reported adverse effects lasting more than 1 month (Goldberg, Lam, et al., 2022). However, these retrospective and cross-sectional studies are limited because they require participants to report on experiences that they had months/years before the study and therefore are susceptible to recall biases. These methods may thus limit rigorous and accurate assessments of subjective features, prevalence, and putative impact of meditation-related experiences.

Accordingly, in recent years, a number of prospective intervention studies of meditation-related unpleasant and adverse experiences have been conducted. A prospective study among 96 participants in an 8-week mindfulness-based group program indicated that 58% of the sample reported at least one meditation-related unpleasant experience, 37% reported meditation-related negative impact on functioning, and 6%–14% reported negative effects lasting at least

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The study was preregistered at https://clinicaltrials.gov/ct2/show/NCT04749264. All reported data will be made available upon request. Meditation retreats are nonmanualized interventions, and therefore, no intervention manual is available for the study retreats. The structure and content of the study retreats are described in the "Insight Mindfulness Meditation Retreats" subsection.

Yuval Hadash and Tatyana Veksler share first authorship.

Yuval Hadash played a lead role in writing–review and editing, a supporting role in funding acquisition, investigation, project administration, and writing–original draft, and an equal role in conceptualization, formal analysis, and methodology. Tatyana Veksler played a lead role in writing–original draft, a supporting role in investigation and writing–review and editing, and an equal role in conceptualization, formal analysis, and methodology. Omer Dar played a lead role in investigation and project administration and a supporting role in conceptualization, funding acquisition, methodology, and writing–review and editing. Romi Oren-Schwartz played a supporting role in investigation and writing–review and editing. Amit Bernstein played a lead role in supervision, a supporting role in project administration, and an equal role in conceptualization, formal analysis, funding acquisition, methodology, resources, writing–original draft, and writing–review and editing.

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1 day (Britton et al., 2021). However, this study was uncontrolled, and study participants suffered from mild-to-severe levels of depression and high levels of negative affect and thus may have experienced similar unpleasant experiences and negative effects even in the absence of the mindfulness intervention. Indeed, data from several randomized controlled trials indicate no evidence for harm in mental or physical health outcomes in response to mindfulness-based group or mobile intervention programs (Hirshberg, Frye, et al., 2022; Hirshberg, Goldberg, et al., 2022). Moreover, clinical trials that formally recorded adverse events during group mindfulness-based programs (e.g., self-harm, suicidality) did not find evidence that they led to adverse events (Galante et al., 2018; Kuyken et al., 2016). Thus, controlled intervention studies indicate that previous uncontrolled studies of meditation-related distressing and potentially adverse experiences may have misattributed these experiences to meditation by not assessing the prevalence of these experiences among similar people not receiving the meditation intervention. However, these controlled studies focused on clinical harm as expressed in a subset of mental health and physical symptoms and did not assess the variety of meditation-related experience reported in previous uncontrolled studies (Van Dam & Galante, 2023).

A novel direction of research on extraordinary, unpleasant, and adverse experiences during meditation involves prospective intervention studies of these experiences during residential insight (Vipassana) mindfulness meditation retreats. In contrast to mindfulness-based group and mobile interventions which include 5-min to 1-hr daily mindfulness practice, insight mindfulness meditation retreats entail intensive, sustained, and standardized dose mindfulness practice over the course of the entire day in a secluded environment. Moreover, meditation practices during these retreats also include Buddhist deconstructive insight-oriented elements (e.g., noticing change; Dahl et al., 2015), which are conceptualized elicit extraordinary and unpleasant experiences with potential salutary and/or adverse impact (Lindahl et al., 2020). Accordingly, retreats are theorized to provide the optimal conditions for the occurrence of peak meditation-related experiences, including extraordinary and/or unpleasant experiences with potential adverse effects (Baer et al., 2019; King et al., 2019). Indeed, 72% of a selected sample of Western Buddhist meditators with distressing or impairing experiences reported that the onset of these experiences occurred during or immediately following intensive meditation practice in a retreat (Lindahl et al., 2017).

Recently, a preliminary nonrandomized controlled study ($n \approx$ 30 per group) assessed extraordinary experiences during a month-long residential insight mindfulness meditation retreat relative to control participants during daily living (Zanesco et al., 2023). Retreat participants reported a greater extent of insights, powerful positive emotional experiences, nonordinary sensory or perceptual events, as well as mystical experience than control participants. Furthermore, while some extraordinary unpleasant experiences were reported by both retreat and control participants, there were no significant differences between the groups on these unpleasant experiences nor on other distressing experiences. However, because of the limited sample size and because control participants were not systematically matched on key characteristics with retreat participants, these important findings are preliminary. Furthermore, this study did not test the postretreat impact of extraordinary experiences that occurred during the retreat.

To address these limitations and gaps in the literature, we set out to study peak experiences during insight mindfulness meditation retreats and their adverse and salutary impact using a prospective preregistered matched-controlled intervention study. The study assessed peak meditative experiences over the course of intensive 6-day residential insight mindfulness meditation retreats, relative to a parallel ~6-day period in daily living among a sample of matched controls. The study also assessed the perceived salutary and/or adverse impact of these experiences at 2 weeks postretreat. The study used two novel scales, Peak Meditative Experience Scale (PMES) and the Impact of PMES (I-PMES), to assess peak experiences and their impact. To ensure retreat and control groups are as similar as possible at baseline on key characteristics which may affect peak experiences, control condition participants were recruited from the same community of meditators and systematically matched on age and lifetime mediation experience to retreat participants.

The study had three aims. Aim 1: To detect meditation retreat-related peak experiences by testing which peak experiences are endorsed at a higher rate during the meditation retreats relative to matched controls in daily living and to map the hedonic tone of reported peak experiences (i.e., pleasant, unpleasant, neutral). Based on the reviewed literature, we expected that retreat participants would endorse more pleasant and neutral peak experiences related to positive emotions, insight, as well as altered perceptions, states of consciousness, and sense of self compared to matched-control participants. We also expected that, while retreat group participants would likely endorse unpleasant and distressing peak experiences, these peak experiences would be endorsed at similar rates among matched controls in daily living. Aim 2: To identify latent domains of meditation retreat-related and meditation retreat-unrelated peak experiences using factor analyses. Based on the reviewed literature, we expected factors would reflect positive emotions, negative emotions, altered perceptions, altered states of consciousness, dissociation, and insight (Anderson et al., 2019; Lindahl et al., 2017; Vieten et al., 2018). Aim 3: To empirically quantify the perceived salutary impact relative to the perceived adverse impact of endorsed peak experiences at 2 weeks postretreat among retreat participants. We expected that peak experiences during the retreat reflecting positive emotions and insight would be perceived as having predominantly salutary impact, whereas peak experiences reflecting intense unpleasant emotional experiences would be perceived as having a predominantly adverse impact.

Method

Participants

Ninety-six participants who registered for a 6-day residential insight mindfulness meditation retreat delivered by the Tovana Israel Insight Meditation Society, an established meditation retreat society, were recruited to the retreat group; 50 female, 45 male, one nonbinary, M_{age} (SD_{age}) = 33.46 (8.88) years. Forty-seven participants were selected and systematically matched on age and lifetime meditation experience to the retreat group based on a pool of 487 potential control participants recruited from the same insight meditation retreat society community in Israel; 30 female, 17 male, M_{age} (SD_{age}) = 34.62 (10.43) years; see Matching Methodology subsection for additional details. Importantly, the groups did not meaningfully differ on the matched variables (age Hedge's $g = -0.15$,

$p = .41$; lifetime regular meditation practice hours Hedge's $g = 0.11$, $p = .56$; lifetime meditation retreat days Hedge's $g = .06$, $p = .76$; see Supplemental Table S1, for details). Moreover, the groups did not significantly differ on demographic variables (see Baseline Between-Group Differences subsection in Supplemental Material) and did not significantly differ on any of the 25 baseline self-report (sub)scales administered in the parent study after controlling for false discovery rate (see Supplemental Table S1). By design, control group participants did not participate in a retreat during the period of the study.

Participants reported a wide range of lifetime regular meditation practice hours (*Mdn* = 78, range = 0–5,843 hr) and lifetime meditation retreats days (*Mdn* = 9, range = 0–557 days). Most participants identified as Jewish (95.8%) and did not have children (77.6%). Participants reported variable marital status (55.2% single, 21.0% cohabitation with partner, 18.2% married, 5.6% divorced or single parents) and variable socioeconomic status (51.1% below average income, 14.7% ~average income, 34.3% above average income).

Study sample size was determined a priori to enable detection of between-group effects of moderate magnitude (power = .80 for detecting Cohen's $d \geq 0.50$). A 2:1 sampling ratio between the retreat and matched-control groups was chosen a priori to ensure a large enough sample for within-group analyses among the retreat group (e.g., factor analysis, detection of relatively rare adverse effects).

Exclusion Criteria

Potential participants were excluded if (a) they were not available to participate in scheduled phone calls or baseline (preretreat) assessments or (b) they did not have a personal computer, smartphone, and headphones to conduct the web-based tasks and record audio (needed for the parent study). To ensure validity of the cognitive and behavioral tasks in the larger parent study, potential participants were excluded if (a) they were <18 or >65 years old or (b) had a mother tongue other than Hebrew or self-reported nonfluent understanding or speaking in Hebrew. To reduce contamination or carryover effects of intensive meditation training other than the studied retreats, potential participants were excluded if they (a) participated in a meditation retreat at any point during the 4 weeks prior to the 6-day study retreat for retreat group participants or during the equivalent 5-weeks prior to assessment of peak experiences for the matched-control group; (b) participated in a meditation session with ≥3 continuous practice hours between baseline assessments and the beginning of the retreat for retreat group participants or between baseline assessments and assessment of peak experiences for matched-control group participants; or (c) planned to participate in a meditation retreat at any point between assessment of peak experiences and assessment of the impact of peak experiences for both groups (~2 weeks).

Retreat Group

The retreat group sample was selected from an initial 147 potential retreat group participants who registered for the study retreats and completed the screening questionnaire. Based on the exclusions criteria, 96 participants were selected and assigned to the retreat group. Due to dropouts and additional exclusion of participants, a final sample of $n = 89$ retreat group participants completed peak experiences assessments and were included in analyses in this article. Two participants did not complete all retreat days and were included in analyses to capture potential unpleasant peak experiences and adverse effects among partial intervention completers. See Supplemental Figure S1 for a Consolidated Standards of Reporting Trials flow diagram with more details on retreat group participant exclusion and prospective retention.

Matched-Control Group

Five hundred forty-three potential control participants completed a screening questionnaire to assess their eligibility to participate in the study. The matching algorithm was applied to 487 potential control participants that did not meet exclusion criteria to select a ratio of one matched-control participant for each two retreat participants. Following selection of matched-control participants and additional exclusion of participants, a final sample of $n = 47$ matched-control participants completed peak experiences assessments and were included in analyses in this article. See Supplemental Figure S1 for a Consolidated Standards of Reporting Trials flow diagram with more details on control group participant exclusion and prospective retention.

Measures

PMES

We developed the PMES to provide a brief self-report measure of peak experiences. Participants were asked to report on a list of 32 possible peak experience items defined in the scale's instructions as experiences that are unusual and uncommon in your day-to-day life, which may be intense or strong, or very meaningful or touching. See Table 1 for PMES item descriptions and Supplemental Material for a full version of the PMES. Participants completed the PMES following the retreat and at parallel time points among matched controls. Participants indicated whether each peak experience occurred (yes/no) and for each endorsed experience they subsequently reported its hedonic tone (−4 *extremely unpleasant* to 0 *neutral* to 4 *extremely pleasant*), frequency (number of times experiencing each endorsed experience), and duration (longest duration of each endorsed experience in minutes). Retreat participants were asked to report on their experiences during the insight mindfulness meditation retreat, whereas matched-control participants were asked to report on their experiences during an equivalent time period in daily living.

The 32 PMES items were based on the reviewed literature (e.g., Anderson et al., 2019; Lindahl et al., 2017; Vieten et al., 2018). These included experiences related to positive emotions, negative emotions, altered perceptions, altered states of consciousness, dissociation, and insight (see Table 1). A preliminary version of the scale was sent for feedback to four experts in phenomenology and adverse effects of meditation as well as meditation teachers with extensive experience in leading meditation retreats and then were iteratively revised based on their feedback.

I-PMES

The I-PMES was designed to measure the perceived salutary and/or adverse impact of the previously endorsed PMES peak experiences on participants' lives following the retreat. Retreat participants completed the I-PMES as part of the follow-up assessment ~2 weeks following the retreat. For each peak experience endorsed by

Table 1

PMES Item-Level Descriptive Statistics, χ^2 Tests of Items by Group, and One-Sample t Tests of Hedonic Tone of Items

	Retreat					Matched control		χ^2 test of % endorsement by group			
			One-sample *t* test of hedonic tone								
PMES item description	% endorsement	Hedonic tone *M* (*SD*)	*t*	*df*	*p*	% endorsement	Hedonic tone *M* (*SD*)	χ^2	*df*	*p*	ϕ [95% CI]
1. Uncontrollable distressing thoughts	44.9%	−3.16 (0.90)	−21.42	36	<.001*	44.7%	−3.15 (0.88)	0.001	1	.977	.00 [.00, .09]
2. Aha! moment	76.4%	2.33 (2.20)	8.42	62	<.001*	34.0%	0.50 (2.71)	23.37	1	<.001*	.41 [.25, .59]
3. Intense longing for a person/s	66.3%	1.09 (2.04)	3.97	54	<.001*	38.3%	0.89 (2.95)	9.81	1	.002*	.27 [.13, .44]
4. Strong happiness	62.9%	3.60 (0.82)	31.52	51	<.001*	17.0%	3.25 (0.71)	26.01	1	<.001*	.44 [.28, .61]
5. No boundary between myself and the world	40.4%	2.76 (1.82)	8.70	32	<.001*	8.5%	1.50 (1.73)	15.11	1	<.001*	.33 [.19, .51]
6. Intense anger or rage	28.1%	−3.04 (0.81)	−18.48	23	<.001*	17.0%	−3.62 (0.52)	2.05	1	.152	.12 [.00, .30]
7. Overwhelming sadness	47.2%	−1.87 (1.94)	−6.12	39	<.001*	36.2%	−2.65 (1.17)	1.52	1	.217	.11 [.00, .29]
8. Feeling I am not real	20.2%	−0.67 (2.32)	−1.11	14	.284	8.5%	−1.25 (2.22)	3.11	1	.078	.15 [.00, .33]
9. Deep release of tension	67.4%	3.04 (1.16)	19.68	56	<.001*	23.4%	3.09 (0.83)	23.88	1	<.001*	.42 [.27, .59]
10. Flashbacks	22.5%	−2.37 (1.34)	−7.69	18	<.001*	10.6%	−3.00 (1.16)	2.87	1	.090	.15 [.00, .32]
11. Unusual surge of energy in the body	42.7%	2.31 (1.91)	7.18	34	<.001*	14.9%	1.86 (1.77)	10.74	1	.001*	.28 [.14, .46]
12. Intense unpleasant physical sensations	38.2%	−2.66 (1.73)	−8.67	31	<.001*	19.1%	−3.11 (1.05)	5.16	1	.023*	.19 [.09, .37]
13. Hearing sounds not from my physical environment	19.1%	0.06 (1.77)	0.14	15	.889	10.6%	1.00 (1.87)	1.63	1	.202	.11 [.00, .29]
14. Returning from an unconscious state	22.5%	0.65 (2.64)	1.01	16	.328	2.1%	2.00[a]	9.75	1	.002*	.27 [.13, .44]
15. Strong gratitude	77.5%	3.35 (0.67)	40.74	65	<.001*	34.0%	3.20 (1.27)	24.82	1	<.001*	.43 [.27, .60]
16. My body not feeling as mine	21.3%	1.94 (1.77)	4.68	17	<.001*	4.3%	−0.50 (0.71)	6.88	1	.009*	.22 [.10, .40]
17. Intense anxiety	24.7%	−3.00 (1.73)	−7.94	20	<.001*	14.9%	−3.29 (1.25)	1.77	1	.183	.11 [.00, .29]
18. Extraordinary love and compassion for others	73.0%	3.28 (0.71)	36.06	60	<.001*	38.3%	3.22 (1.00)	16.60	1	<.001*	.34 [.19, .51]
19. Strong and unusual pleasant physical sensations	52.8%	3.11 (1.34)	15.77	45	<.001*	17.0%	3.25 (0.89)	16.36	1	<.001*	.35 [.20, .52]
20. Continuous change in sensations throughout the body	49.4%	1.80 (1.77)	6.43	39	<.001*	14.9%	1.67 (2.25)	15.66	1	<.001*	.34 [.19, .51]
21. Deep and unusual peace	83.1%	3.37 (1.17)	24.12	69	<.001*	29.8%	3.21 (1.05)	38.35	1	<.001*	.53 [.37, .70]
22. Feeling the world is not real	19.1%	0.20 (1.90)	0.41	14	.689	12.8%	1.17 (2.14)	0.88	1	.349	.08 [.00, .26]
23. Feeling unable to control my body or actions	9.0%	−2.14 (1.95)	−2.91	6	.027*	10.6%	−2.60 (1.52)	0.10	1	.756	−.03 [−.20, .00]
24. Feeling my emotions and thoughts do not belong to me	37.1%	1.48 (1.84)	4.33	28	<.001*	21.3%	0.50 (2.76)	3.55	1	.059	.16 [.00, .34]
25. Extraordinary love and compassion for myself	73.0%	3.33 (0.79)	32.90	60	<.001*	27.7%	3.15 (1.07)	25.89	1	<.001*	.44 [.28, .61]
26. Seeing things not in my physical environment	7.9%	1.71 (1.80)	2.52	6	.045	2.1%	0.00[a]	1.83	1	.176	.12 [.00, .30]
27. Strong desire to commit suicide	1.1%	−4.00[a]				0%					.06 [.00, .25]
28. Feeling that time is moving extremely quickly	10.1%	0.67 (1.50)	1.33	8	.219	19.1%	−0.78 (1.79)	2.19	1	.139	−.13 [−.31, .00]
29. Intense shame or guilt	23.6%	−3.05 (1.15)	−11.90	19	<.001*	23.4%	−3.36 (0.67)	0.001	1	.980	.00 [.00, .09]
30. Feeling of floating or lack of gravity	24.7%	2.82 (1.53)	8.63	21	<.001*	6.4%	3.00 (1.00)	6.89	1	.009*	.23 [.10, .40]

(*table continues*)

Table 1 (*continued*)

PMES item description	Retreat		One-sample *t* test of hedonic tone			Matched control		χ^2 test of % endorsement by group			
	% endorsement	Hedonic tone *M* (*SD*)	*t*	*df*	*p*	% endorsement	Hedonic tone *M* (*SD*)	χ^2	*df*	*p*	ϕ [95% CI]
31. Intense craving for substances[b]	5.6%	−2.00 (1.23)	−3.65	4	.022*	23.4%	−1.36 (1.21)	9.37	1	.002*	−.26 [−.44, −.13]
32. Feeling time is not moving	22.5%	1.00 (2.15)	1.92	16	.073	12.8%	1.50 (2.38)	1.87	1	.171	.12 [.00, .30]

Note. See Supplemental Material for a full version of the PMES. Negative hedonic tone values represent unpleasant hedonic tone and positive values represent pleasant hedonic tone (−4 to 4 Likert scale). The one-sample *t* tests of hedonic tone compared the mean hedonic tone score of retreat participants that endorsed each item relative to zero (neutral hedonic tone score). Items with gray shading were classified as meditation retreat-related peak experiences because % of endorsement among the retreat group was significantly greater than in daily living among matched controls. Items in italic were classified as pleasant peak experience because they demonstrated a significantly pleasant hedonic tone among retreat participants. Items in bold were classified as unpleasant peak experience because they demonstrated a significantly unpleasant hedonic tone among retreat participants. In all χ^2 tests, $n_{retreat} = 89$ and $n_{control} = 47$. Phi coefficient confidence intervals are exact analytical confidence intervals computed from noncentrality parameter of noncentral χ^2 distributions (Hentschke & Stüttgen, 2011). χ^2 = chi-square; ϕ = Phi coefficient. PMES = Peak Meditative Experience Scale; CI = confidence interval.

[a] *SD* could not be computed because only one participant endorsed these items. [b] Item was endorsed at a higher rate in daily living among matched controls and therefore was not classified as a meditation retreat-related peak experience.

* Significant after applying a false discovery rate of 32 comparisons (hedonic tone $p < .038$; endorsement by group $p < .026$). All specified false discovery rate corrected α thresholds controlled for a $q = .05$ (a maximal risk that 5% of significant results will be false positives; Benjamini & Hochberg, 1995).

a participant on the PMES, she/he were asked to rate the perceived salutary/positive impact of the experience since the retreat on a Likert-type scale from 0 (*no positive impact at all*) to 4 (*extremely positive impact*) as well as its perceived adverse/negative impact since the retreat on a Likert-type scale from 0 (*no negative impact at all*) to −4 (*extremely negative impact*). See Supplemental Material for a full version of the I-PMES.

Assessment of Lifetime Meditation Experience: Online Questionnaire and Structured Interview

To enable selection of matched-control participants, all potential control group participants ($n = 543$) completed a brief online questionnaire assessing lifetime meditation experience. The retreat group ($n = 89$) and selected matched-control participants ($n = 47$) completed a structured phone interview assessing lifetime meditation experience. See Supplemental Material for a description of the questionnaire and structured interview.

Procedure

People who registered for one of five 6-day residential insight mindfulness meditation retreats held by an established insight meditation retreat society in Israel were recruited to the retreat group (see retreat details in Insight Mindfulness Meditation Retreats subsection). They received an email inviting them to participate in the study and to complete a brief online screening questionnaire to assess study eligibility. An initial pool of potential control group participants was recruited from the same meditation retreat society community through messages sent via email and posts on the community's social media pages. Interested adults were asked to fill out a brief online questionnaire to assess their eligibility to participate in the study and their lifetime meditation experience for the purpose of matching. Control group participants were selected by matching to retreat group sample on age and lifetime meditation experience (see Matching Methodology subsection, for detailed matching information). Eligible participants in both groups participated in a study orientation phone call with an experimenter in which they answered additional screening questions and signed a web-based informed consent. Importantly, to minimize experimental demand characteristics, control group participants were not informed that the study also included a retreat group and thus were blind to their condition.

As part of the larger parent study, participants completed several questionnaires and behavioral tasks before and after the retreat (see study preregistration, for description of all assessments, at https://clinicaltrials.gov/ct2/show/NCT04749264). Participants in the retreat group completed the PMES questionnaire online at home after the retreat, at the ending day of the retreat or 1 day afterward. Matched-control participants completed the PMES questionnaire online at home at a parallel time point to retreat participants. An online follow-up assessment which included the I-PMES was conducted 11–17 days (i.e., ∼2 weeks) postretreat or at a parallel time point for matched-control participants. All questionnaires in the study, including PMES and I-PMES, were administered online via Qualtrics. Over the course of the study, participants in both groups completed a structured phone interview conducted by a trained interviewer to comprehensively assess their lifetime meditation experience. Participants received compensation (∼$120) for the time

they invested in completing the measures in the parent study and received personalized feedback after completing their participations in the study based on some of the measures in the parent study. The study received institutional review board human subjects research ethics approval (Number 272/20).

Matching Methodology

Control group participants were matched to the retreat group sample on age, lifetime regular meditation practice hours, and lifetime meditation retreat days based on the questionnaire of past mediation experience administered when signing up for the study. Due to the long duration of the study, matching was conducted in two cohorts—one for Retreats 1–3 and another for Retreats 4–5. Matching was conducted in two stages. First, to select a ratio of one primary matched-control participant for each two retreat participants, cardinality matching was performed using the MatchIt package in R with the optimization performed by GNU Linear Programming Kit (Ho et al., 2011). Cardinality matching was conducted because it tends to outperform propensity scores matching in prematched samples of similar sizes to our study (Fortin et al., 2021). Second, to select a secondary or backup matched-control participant for each two retreat participants, in the event that a selected primary cardinality matched-control participant would drop out or be excluded, nearest neighbor subject-level matching with Mahalanobis distance and Caliper[1] was performed in R, using the MatchIt package (Ho et al., 2011).

Insight Mindfulness Meditation Retreats

We collected retreat group data over five insight (Vipassana) mindfulness meditation residential retreats run by the Tovana Israel Insight Meditation Society, M (SD) = 19.2 (8.4) participants per retreat. Retreats had a similar structure and setting to retreats in previous intensive meditation intervention studies (King et al., 2019) and to retreats held in large and established insight meditation retreat centers (e.g., Insight Meditation Society, Spirit Rock, Gaia House). Retreats varied in size between 30 and 100 participants. Each retreat was 6 days in duration and led by two to three senior teachers from the Tovana Israel Insight Meditation Society with many years of experience in meditation instruction. Retreats were held in a meditation center which provided food, sleeping accommodation, meditation hall(s), and spaces for meditation practice outside. Participants were asked not to leave the center but were free to move within the center area between the meditation sessions. Retreats were held in silence (although eye contact was not discouraged), and participants could not use their phones or any other computer or mobile device over the course of the retreat. Participants were also requested not to engage in reading or writing and to avoid smoking during the retreat.

All study retreats had the same meditation practice format. Participants were instructed and encouraged to practice mindfulness over the course of the entire day on retreat—during meditation and during all other activities. Participants practiced according to a practice schedule that included at least 10 daily ~45-min sessions of guided or unguided sitting and walking meditation and could also choose to practice meditation individually beyond these sessions (i.e., a minimum of 7:30 meditation practice hours/day). Participants initially practiced focused attention mindfulness meditation in which they focused on a meditation anchor (e.g., mindfulness of the breath). Later during the retreat, participants also practiced expanding their field of awareness to other experiences beyond their meditation anchor (e.g., whole body awareness, awareness of thoughts, choiceless awareness). Mindfulness meditation practices also included Buddhist deconstructive insight-oriented elements (e.g., deconstructing experiences into components and noticing how they constantly change; Dahl et al., 2015). Most retreat days also included a 30-min loving-kindness meditation session, a mindful movement practice (e.g., Yoga, Qigong), and a period of mindful work (e.g., kitchen, cleaning).

Each day, retreat teachers delivered one to two group talks on the principles of insight and mindfulness meditation based on Buddhist traditions, gave meditation instructions, and/or answered participant questions. All participants had two group meetings (5–10 participants/group) with a teacher during the retreat, in which they were asked to share their experiences and received personalized guidance. Participants could also request to have a personal meeting(s) with a teacher. At the end of the retreat, participants were encouraged to continue practicing mindfulness meditation at home.

Data Analytic Approach

Aim I. Identifying Meditation Retreat-Related Peak Experiences and Their Hedonic Tone

First, we conducted planned χ^2 independence tests of PMES item endorsement (yes/no) by group to empirically identify which PMES items represent meditation retreat-related peak experience (endorsed significantly more during the meditation retreat relative to daily living among matched controls) or meditation retreat-unrelated peak experiences (no significant difference between the groups). Second, to test the robustness of this classifications of meditation retreat-related and meditation retreat-unrelated peak experience in this matched-controlled study, we also conducted logistic regressions predicting endorsement of peak experiences by group with propensity score-based inverse probability of treatment weighting (Austin, 2011). This enabled an additional and rigorous test of the effects of the retreat on peak experience by statistically minimizing between-group differences in all 28 baseline variables assessed in the larger parent study using weighting. Third, we conducted planned one-sample t tests comparing the average hedonic tone of PMES items among retreat participants to zero (neutral hedonic tone) to identify predominantly pleasant and unpleasant peak experiences during meditation retreats. Peak experiences that were neither significantly pleasant nor unpleasant were classified based on the descriptive statistics of their hedonic tone as having a predominantly mixed/neutral/pleasant/unpleasant hedonic tone.

Aim II. Identifying Latent Domains of Peak Experiences in Retreats: Factor Analysis

To empirically identify latent factors reflecting domains of peak experiences and compute PMES subscale scores, we conducted two

[1] We defined Caliper as the minimal standardized difference between any primary matched-control participant and backup matched-control participant that allowed us to select at least one backup matched-control participant per primary matched-control participant. The chosen values were age = 0.8, lifetime regular meditation practice hours = 0.6, and lifetime meditation retreat days = 0.3.

planned exploratory Principal Axis Factor analysis (PAF)—one analysis for all meditation retreat-related peak experiences and a separate analysis for all meditation retreat-unrelated peak experiences. To protect against overextraction of pseudofactors (Hayton et al., 2004), we conducted a parallel analysis based on the random permutation of the raw data (matched to the item/variable distributions) of the unrotated solutions. Specifically, factors can be extracted when research data factor scores are greater than the 95th percentile eigenvalue of the random data, indicating that extracted factor(s) represent a substantive, nonspurious factor (Fabrigar et al., 1999; Horn, 1965; O'Connor, 2000). To characterize and identify differences in peak experience domains during insight mindfulness meditation retreats relative to daily living, we also conducted planned independent samples *t* tests between the mindfulness retreat and matched-control groups on % endorsement, mean hedonic tone, frequency, and duration of each PMES domain subscale score.

Aim III. Perceived Impact of Peak Experiences Postretreat

First, to evaluate whether peak experiences had a predominantly salutary perceived impact or a predominantly adverse perceived impact during the 2 weeks postretreat, we conducted planned paired-samples *t* tests among retreat participants comparing the mean perceived salutary impact relative to mean perceived adverse impact of each peak experience domain (measured by I-PMES). Second, to evaluate whether participants reporting perceived substantial adverse impact of peak experiences may also experience substantial salutary impact, we conducted an exploratory paired-samples *t* tests among such participants comparing the average reported salutary impact of all endorsed peak experiences to the average reported adverse impact.

Transparency and Openness

This article follows the APA publications and communications board journal article reporting standards. The study was preregistered at https://clinicaltrials.gov/ct2/show/NCT04749264. All reported data will be made available upon request. Meditation retreats are nonmanualized interventions (King et al., 2019), and therefore, no intervention manual is available for the study retreats. The structure and content of the study retreats are described in the "Insight Mindfulness Meditation Retreats" subsection. See Supplemental Material for the PMES and I-PMES. Data were analyzed using SPSS Version 27.0.1, MATLAB Version R2023a, or R Version 4.3.2.

Results

Aim I. Identifying Meditation Retreat-Related Peak Experiences and Their Hedonic Tone

Differences in Item-Level Endorsement Rates Between Groups

Among retreat participants, 97.8% experienced at least one peak experience, and *M* (*SD*) = 9.09 (3.89) peak experiences were reported per participant. Table 1 reports PMES item-level statistics, including rate of endorsement by group.[2] The most common experiences in the retreat group were Item 21—deep and unusual peace (83.1% of endorsement), Item 15—strong gratitude (77.5%), Item 2—aha! Moment (76.4%), Item 25—extraordinary love and compassion for myself (73%), and Item 18—extraordinary love and compassion for others (73%).

Planned χ^2 tests of PMES item endorsement (yes/no) by group indicated that 17 of the 32 measured peak experiences were endorsed significantly more frequently among the retreat group than the matched-control daily living group and thus were classified as meditation retreat-related peak experiences (see items marked with gray shading in Table 1, for descriptive and χ^2 statistics, and Supplemental Material, for additional details). The effect sizes of the retreat on meditation retreat-related peak experiences varied in size and were moderate on average ($\phi_M = .33$; $\phi_{range} = .16–.53$). Chi-square tests also indicated that 14 items were not endorsed significantly more frequently among the retreat group than the matched-control daily living group and thus were classified as meditation retreat-unrelated peak experiences (see Table 1 and Supplemental Material, for additional information on classification of PMES items).

Logistic regression models predicting PMES item endorsement by group with propensity score-based inverse probability of treatment weighting supported the robustness of the χ^2 tests-based classification of the peak experiences as meditation retreat-related and meditation retreat-unrelated. Specifically, these models indicated that even after statistically minimizing between-group differences in all 28 assessed baseline variables using weighting, the 17 meditation retreat-related peak experiences were endorsed significantly more frequently in the retreat group than in the matched-control group, while the 14 meditation retreat-unrelated peak experiences were not (see text in Supplemental Material and Supplemental Table S2). Moreover, post hoc tests indicated that meditation practice during the time period for which the matched-control participants rated the PMES items could not have led to nonsignificant between-group differences in meditation retreat-unrelated peak experiences (see Supplemental Material, for post hoc tests).

Hedonic Tone of Peak Experiences in Retreats

Planned one-sample *t* tests comparing the average hedonic tone of PMES items among retreat participants to zero (neutral hedonic tone) indicated that 15 PMES items demonstrated a significantly pleasant hedonic tone (marked in italic in Table 1) and nine items demonstrated a significantly unpleasant hedonic tone (marked in bold in Table 1). The remaining seven items were neither significantly pleasant nor unpleasant among retreat participants and were classified based on the % of unpleasant, neutral, and pleasant hedonic tone ratings. Accordingly, five of these items demonstrated a mixed hedonic tone, one a predominantly pleasant hedonic tone, and one a predominantly neutral hedonic tone (see text in Supplemental Material and Supplemental Table S3, for descriptive statistics).

Importantly, 15 of the 17 items that were identified as meditation retreat-related peak experiences demonstrated a significantly pleasant hedonic tone (see Table 1). Of the 14 remaining PMES items that were identified as meditation retreat-unrelated peak experiences, eight demonstrated a significantly unpleasant hedonic tone. Critically, while endorsement of at least one of the nine unpleasant peak experiences was high among retreat participants (79.8%),

[2] Item 27—strong desire to commit suicide—was reported by one participant in the retreat group and so not endorsed at a rate that could be meaningfully included in subsequent analyses.

it was also high among matched controls in daily living (68.1%). A post hoc t test comparing the number of endorsed unpleasant peak experience items between the groups was nonsignificant, $t(134) = 1.18$, $p = .24$.

Aim II. Identifying Latent Domains of Peak Experiences in Retreats: Factor Analysis

Latent Domains of Meditation Retreat-Related Peak Experiences

We conducted a planned exploratory factor analysis of endorsement of the PMES meditation retreat-related peak experience items among retreat participants. PAF and parallel analysis indicated that six possible factors were greater than the 95th percentile random data eigenvalues and therefore up to six nonspurious factors may be extracted (O'Connor, 2000). A six-factor orthogonal solution demonstrated the best performance (see Supplemental Material text, for details about the factor solution, and Supplemental Table S4, for item-factor loadings and communalities). As expected for orthogonal factors, scores on the extracted factors demonstrated limited associations with one another (see Supplemental Table S5).

We labeled the six factors based on the pattern of observed item-factor loadings: F1 tranquility (Items 9, 19, 21, 25), F2 interpersonal connection (Items 3, 15, 18), F3 nonself (Items 5, 24), F4 altered states of consciousness (Items 14, 16, 30), F5 insight (Items 2, 4), and F6 intense physical sensations (Items 11, 12). The most prevalent domain or factor among retreat group participants was F1 tranquility (93.3% endorsed at least one subscale item), followed by F2 interpersonal connection (91.0%), F5 insight (82.0%), F6 intense physical sensations (56.2%), F3 nonself (52.8%), and F4 altered states of consciousness (39.3%). See Supplemental Material text and Supplemental Table S8 for descriptive statistics of these PMES domain subscale scores and planned independent samples t tests comparing % endorsement, mean frequency, duration, and hedonic tone of PMES domain subscale scores between the groups.

Latent Domains of Meditation Retreat-Unrelated Peak Experiences

We conducted a planned exploratory factor analysis of the endorsement of the PMES meditation retreat-unrelated peak experience items among retreat participants. PAF and parallel analysis indicated extraction of up to four possible factors. An eight-item three-factor orthogonal solution demonstrated the best performance (see Supplemental Material text, for details, and Supplemental Table S6, for item-factor loadings and communalities). As expected for predominantly orthogonal factors, scores on the extracted unpleasant experiences factors demonstrated limited associations with one another (see Supplemental Table S7).

We labeled the three factors based on the pattern of observed item-factor loadings: F1 dissociation (Items 8, 22, 23), F2 unpleasant emotional experiences (Items 1, 13, 29), and F3 unpleasant physical experiences (Items 12, 17). The most prevalent domain or factor among retreat group participants was F2 unpleasant emotional experiences (51.7% endorsed at least one subscale item), followed by F3 unpleasant physical experiences (44.9%), and then F1 dissociation (30.3%). See Supplemental Material text and Supplemental Table S8 for descriptive statistics of these PMES subscale scores. All planned independent samples t tests comparing % endorsement, mean frequency, duration, and hedonic tone of meditation retreat-unrelated PMES domains subscale scores between the groups were nonsignificant (see Supplemental Table S8).

Aim III. Perceived Impact of Peak Experiences Postretreat

See Figure 1 and Supplemental Table S9 for planned paired-samples t tests among retreat participants comparing the salutary versus adverse impact per peak experience domain as measured via the I-PMES at 2 weeks postretreat. In line with predictions, the perceived impact of all six meditation retreat-related peak experience domains was significantly more salutary than adverse, and effects sizes of these differences were mostly very large in magnitude (all ps $< .001$; M Cohen's $d = 1.99$). Surprisingly, the perceived impact of two out of the three meditation retreat-unrelated peak experience domains was significantly more salutary than adverse (F1 dissociation and F2 unpleasant emotional experiences; ps $< .05$; M Cohen's $d = 0.47$; see Figure 1).

Finally, the frequencies of I-PMES ratings were examined to test for potential adverse effects of peak experiences among individual retreat participants. All peak experiences were rated by at least some retreat participants as having a perceived adverse impact at 2 weeks postretreat (see Supplemental Material text and Supplemental Table S10). However, for the large majority of peak experiences, the most common response (i.e., the mode) was that the experience had no negative impact at all (27 of 32 peak experiences), and the first or second most common response was that it had a slightly negative impact (25 of 32 peak experiences; see Supplemental Table S10). Importantly, 20 retreat participants, comprising 22.5% of the retreat group sample, rated at least one of the 32 measured peak experiences as having a perceived substantial adverse impact—a "very negative" or an "extremely negative" impact at 2 weeks postretreat (see Supplemental Material text and Supplemental Table S10, for these peak experiences). However, 88% of the retreat group sample, including all 20 participants reporting a perceived substantial adverse impact, rated at least one of the 32 measured peak experiences as having a perceived substantial salutary impact—a "very positive" or an "extremely positive" impact. Furthermore, exploratory paired-samples t tests among the 20 participants reporting perceived substantial adverse impact of peak experiences indicated that the average reported salutary impact of all peak experiences they endorsed was far greater than the average reported adverse impact, $t(19) = 8.25$, $p < .001$, Cohen's $d = 1.84$, 95% CI [1.11, 2.56].

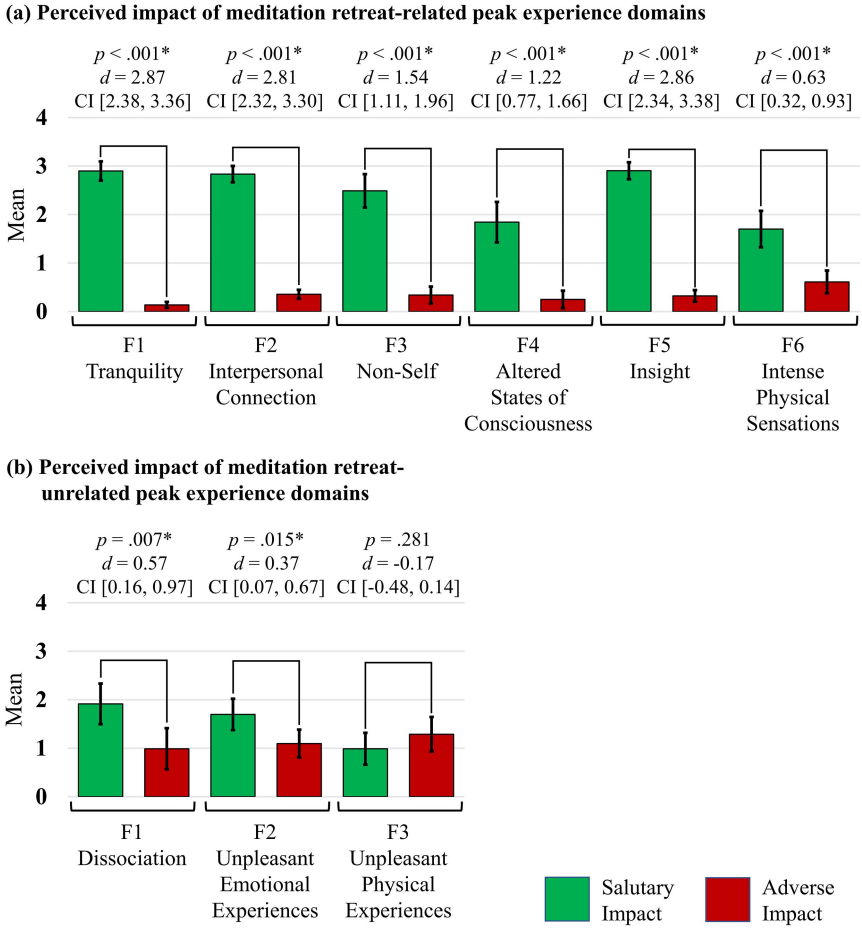
Discussion

Peak Experiences During Meditation Retreats

We found that peak experiences were very common in insight mindfulness meditation retreats (97.8% of retreat participants had at least one peak experience). Seventeen peak experiences from a pool of 32 total peak experiences were endorsed by retreat participants significantly more often than in daily living among matched controls and thereby were classified as meditation retreat-related peak experiences. Importantly, inverse probability of treatment weighted analyses, statistically minimizing potentially confounding differences in 28 baseline variables, provided strong support to the robustness of

Figure 1

Perceived Impact of Peak Experiences at 2-Week Postretreat per Domain



Note. Salutary and adverse impact reflect mean ratings on I-PMES items in each domain among retreat participants who endorsed peak experiences from the respective domain during the retreat (0–4 Likert scale). Paired-samples *t* tests were used to compare the magnitude of the salutary versus adverse impact. Error bars represent 95% confidence intervals of means. See Supplemental Table S9 for all statistics. *F* = factor; *d* = Cohen's *d*; CI = 95% confidence interval; I-PMES = Impact of Peak Meditative Experiences Scale. See the online article for the color version of this figure.

* Significant after applying a false discovery rate of six comparisons for meditation retreat-related peak experience factors ($p < .05$) and three comparisons for meditation retreat-unrelated peak experience factors ($p < .033$). All specified false discovery rate corrected α thresholds controlled for a $q = .05$ (a maximal risk that 5% of significant results will be false positives; Benjamini & Hochberg, 1995).

these findings. Although future randomized controlled retreat studies are needed for stronger causal inference, these between-group differences on the 17 peak experiences indicate that these experiences may be causally linked to insight mindfulness meditation retreat participation.

As predicted, the large majority (15 out of the 17) of meditation retreat-related peak experiences were experienced by retreat participants as predominantly pleasant. Yet these pleasant meditation retreat-related peak experiences included experiences which may not be typically experienced as pleasant in other contexts (e.g., intense longing for a person/s, my body not feeling as mine). Six latent orthogonal factors or domains accounted for the largely pleasant meditation retreat-related peak experiences (ordered according to their endorsement rates in descending order): F1 tranquility, F2 interpersonal connection, F5 insight, F6 intense physical sensations, F3 nonself, and F4 altered states of consciousness. Importantly, factors of meditation retreat-related peak experiences largely overlap with domains of positive and extraordinary experiences associated with meditation practice in previous studies, such as positive emotions, insight, altered states of consciousness, and altered sense of self (Anderson et al., 2019; Lindahl et al., 2017; Vieten et al., 2018; Zanesco et al., 2023).

Fourteen peak experiences were not endorsed more frequently in the retreat than in daily living among matched controls and thereby were classified as meditation retreat-unrelated peak experiences. In contrast to meditation retreat-related peak experiences which

were predominantly pleasant, eight of these 14 meditation retreat-unrelated peak experiences were predominantly unpleasant. Three latent orthogonal factors or domains accounted for the largely unpleasant meditation retreat-unrelated peak experiences among retreat participants (ordered according to their endorsement rates in descending order): F2 unpleasant emotional experiences, F3 unpleasant physical experiences, and F1 dissociation. Importantly, identified factors overlap with domains of unpleasant experiences in meditation reported in previous studies (typically referred to as meditation-related side effects or adverse effects) including negative emotional outcomes and somatic changes (Anderson et al., 2019; Britton et al., 2021; Lindahl et al., 2017).

The rates of endorsement of unpleasant peak experiences among the retreat group (~80% reporting at least one unpleasant peak experiences) were as high or higher than rates reported in past studies (Anderson et al., 2019; Britton et al., 2021; Goldberg, Lam, et al., 2022). Yet critically, the rates of endorsement of these unpleasant peak experiences were as high in daily living among the matched controls (~70% reporting at least one unpleasant peak experiences). Accordingly, and in line with preliminary findings from a recent smaller scale study (Zanesco et al., 2023), we found no differences between groups in mean hedonic tone, mean frequency, or mean duration of unpleasant peak experiences. Thus, the present matched-controlled intervention findings challenge conclusions from previous uncontrolled studies that mindfulness interventions in general, and intensive insight mindfulness meditation training during retreats in particular, are likely to lead to substantial meditation-related unpleasant peak experiences that would not otherwise occur in the absence of these interventions (Britton et al., 2021; Goldberg, Lam, et al., 2022; Lindahl et al., 2017). To the contrary, the present matched-controlled intervention findings are the first to document that intensive insight mindfulness meditation training may lead to peak experiences which are primarily pleasant.

Impact of Peak Experiences During Meditation Retreats on Participants' Lives

Furthermore, we found that, as predicted, meditation retreat-related peak experiences had a significantly and far more salutary than adverse perceived impact on participant's lives "off the pillow" at 2 weeks postretreat (*M* Cohen's $d = 1.99$). Surprisingly, retreat participants also reported that meditation retreat-unrelated peak experience domains which were predominantly unpleasant, namely, F1 dissociation and F2 unpleasant emotional experiences, also had a significantly more salutary than adverse perceived impact on participants' lives at 2 weeks postretreat, though these effects were moderate in magnitude (*M* Cohen's $d = 0.47$). The latter finding is remarkable because it indicates that participants who rated these peak experiences during the retreat as unpleasant, experienced the impact of these experiences as predominantly salutary in the 2 weeks following the retreat.

Furthermore, in line with rates of adverse effects reported in previous studies (Britton et al., 2021; Goldberg, Lam, et al., 2022), 22.5% of retreat participants reported that at least one of the 32 measured peak experience had a perceived substantial adverse impact at 2 weeks postretreat ("very negative" or "extremely negative" impact). However, all participants reporting substantial adverse impact also indicated that peak experiences had a substantial salutary impact postretreat. Moreover, to the best of our knowledge, this is the first study to document that, even among participants reporting substantial adverse impact, the overall salutary impact of their endorsed peak experiences was far greater than the overall adverse impact. Importantly, due to the lack of peak experience impact data (I-PMES) among control group participants, we were not able to attribute adverse impact of peak experiences to the meditation retreats per se, as peak experiences in daily living could be associated with similar rates and magnitude of adverse impact. Future studies may further investigate this question.

Collectively findings suggest that, in line with Buddhist and contemporary theory, peak experiences during meditation practice may be important salutary change processes or mechanisms of meditation training (Anālayo, 2003; Sedlmeier, 2018; Timmermann et al., 2023). Importantly, findings are also aligned with the idea that unpleasant peak experiences during intensive insight mindfulness meditation practice could in fact be constructive and may facilitate adaptive outcomes of mindfulness training (Baer et al., 2019; Timmermann et al., 2023). This may be because intensive mindfulness training during retreats enables multiple opportunities to practice more adaptive ways to process and respond to such peak unpleasant experiences when they occur during meditation (e.g., self-compassion and acceptance; Baer et al., 2019). Furthermore, deconstructive insight-oriented practices during the retreats may help participants create adaptive ways to understand and relate to unpleasant peak experiences (e.g., deconstructing difficult experiences into components and noticing how they constantly change; Dahl et al., 2015). Accordingly, we speculate that participants having unpleasant peak experiences during insight mindfulness meditation retreats may be better trained to more adaptively respond to similar unpleasant experiences in their lives following the retreat.

In light of rapid global implementation of mindfulness and meditation training in clinical interventions and the ongoing debate regarding the salutary and adverse effects of these practices (Hirshberg, Goldberg, et al., 2022; Van Dam et al., 2018; Van Dam & Galante, 2023), the present study and findings are timely and have important implications for clinical psychological science. First, findings suggest that intensive meditation training in 6-day residential insight mindfulness meditation retreats may not contribute to distressing and potentially harmful unpleasant peak experiences that would not occur in the absence of training. This may be clinically significant because it has been argued that, relative to intensive mindfulness meditation training in retreats, lower intensity mindfulness meditation training in clinical interventions likely has an even lower probability of leading to distressing experiences and adverse effects (Baer et al., 2019). Accordingly, future studies with matched- or randomized-control conditions and a comprehensive assessment of unpleasant peak experiences and adverse effects are needed to rigorously assess the degree to which clinical interventions with lower intensity mindfulness meditation training likely lead to distressing experiences and adverse effects.

Second, findings provide novel evidence that intensive meditation training in a 6-day residential insight mindfulness meditation retreat may lead to peak experiences which are primarily pleasant with a large positive impact on participants' lives. Moreover, even most unpleasant and difficult peak experiences during meditation training demonstrated a more salutary than adverse impact. While pleasant and unpleasant peak experiences during mindfulness-based group and mobile interventions may potentially have similar salutary impact, the lower intensity mindfulness meditation training and

different deconstructive meditation practices in these interventions may reduce the frequency and alter the impact of peak experiences (King et al., 2019). Accordingly, future studies could explore whether pleasant peak experiences, as well as unpleasant and difficult peak experiences, may also be integral to the therapeutic change process of clinical intervention with lower intensity mindfulness meditation training.

Limitations and Future Directions

The present study has a number of limitations that may inform future research. First, like other meditation retreat studies, in which random assignment is often logistically infeasible (King et al., 2019), in this study, participants could not be randomized to retreat and control groups. Instead, we relied on a matched-controlled intervention design in which control and retreat participants were sampled from the same community of meditators. Although the robustness of the effects was supported by inverse probability of treatment weighted analyses, statistically minimizing potentially confounding differences in 28 baseline variables, future research may nevertheless benefit from a randomized controlled design for stronger causal inference. Second, the study's effects are limited to the ~1-week insight mindfulness meditation retreat setting in which western participants practiced meditation ≥7:30 hr/day in a group format, while receiving guidance and support from meditation teachers (e.g., daily talks and guided meditation instructions as well as small group meetings for support and personalized guidance). While the studied retreat format resembles common insight mindfulness meditation retreats held in the West, future studies may examine peak experiences and their adverse or salutary impact during longer and more intensive retreat formats, retreats focused on other styles of meditation practice (e.g., loving-kindness meditation) as well as lower intensity mindfulness-based interventions.

Third, the study used novel measures to assess peak experiences (PMES) and their impacts (I-PMES) that were not previously psychometrically tested. Between-groups differences in peak experiences and analyses of hedonic tone and impact ratings provide initial support for the construct validity of these scales' ratings and scores. However, more research is needed to continue to test their validity and factor structure. Fourth, the study only assessed the impact of peak experiences during the 2 weeks postintervention. Future studies of peak experience in meditation interventions may examine the sustained impact of these experiences over a longer follow-up period. Fifth, although matched-control participants were blind to their condition, thus limiting demand characteristics, effects in this study may still be influenced by demand characteristics. Moreover, various factors in the retreat intervention context in addition to insight mindfulness meditation training may have also contributed to the retreat intervention effects (e.g., silence, seclusion). Future studies with active control conditions may be conducted to minimize and control for the effects of demand characteristics and the retreat intervention context. Sixth, the study was not powered to detect small sized effect which could also be clinically meaningful. Future studies with larger samples are needed to detect such effects. Seventh, while we define peak experiences as unusual and uncommon, endorsement rates among matched-control group participants indicated that some PMES items may not be unusual and uncommon in a day-to-day life among these group meditation practitioners. Future studies are needed to identify PMES items which may not be unusual and uncommon in daily living among nonmeditating samples. Finally, the present study did not test for possible mechanisms which may lead to the salutary or adverse impact of peak experiences. Future studies may test, for example, the mechanistic roles of the meaning or interpretations ascribed to experiences or the degree to which peak experiences are recollected or reexperienced postretreat (Lindahl et al., 2017; Zanesco et al., 2023).

Together, the present prospective matched-controlled study demonstrates that peak experiences are very common in insight mindfulness meditation retreats, are primarily pleasant, and may have a predominantly salutary impact on participants' lives beyond the retreat. Findings also suggest that insight mindfulness meditation retreats may not contribute to unpleasant peak experiences that would not have otherwise occurred in daily living and that even when these experiences occur during retreats their impact may be more salutary than adverse.

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