Beauty lies in the eye of the mindful: Does mindfulness intensify aesthetic experience by freeing working memory resources?

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Aesthetic experiences often go hand-in-hand with demands on working memory because they require maintaining an attentional focus while at the same time integrating context, memory, and sensory qualities. This enhances the processing of aesthetic attributes, leading to higher engagement and pleasure. Conditions that deplete working memory resources have been shown to be associated with a reduced intensity of aesthetic experiences. In turn, dispositional mindfulness as well as mindfulness training have been found to be associated with better working memory capacity. In this study, we investigated the relationship between dispositional mindfulness and aesthetic experiences and examined whether people with higher levels of dispositional mindfulness had more intense experiences after a brief mindfulness intervention. We also investigated whether the effect would be mediated by working memory capacity. Participants performed self-reports on their dispositional mindfulness and underwent a brief mindfulness intervention. Afterwards, they performed an aesthetic judgement task. Working memory capacity was assessed at the baseline and after the investigation. The observing facet of dispositional mindfulness was positively related to aesthetic savoring. We found no mediating effect of working memory capacity. However, individuals who improved on the working memory task rated the pictures more beautiful. The results may provide important evidence for helping individuals benefit more from the positive effects of their aesthetic experiences.

Keywords: aesthetic experience; beauty; working memory; mindfulness; meditation

Aesthetic experiences are manifold (see, e.g., Menninghaus et al., 2019). In a basic version of the concept, the term *aesthetic experience* refers to an experience in which a sensory entity triggers a process of evaluation with respect to a particular concept (e.g., the beauty dimension; Jacobsen, 2006). Aesthetic experiences have always fascinated researchers because of their simultaneous stability and variability. For endeavors to take this into account, it has been proven helpful to adopt several vantage points when approaching the psychology of aesthetic experiences (Jacobsen, 2006). For example, all episodes of aesthetic appreciation manifest as an interaction of person and situation variables modified by different content domains. In addition, aesthetic experiences can be approached based on psychophysical pragmatic dualism, that is, using the perspectives of both the mind and the brain (Jacobsen, 2006, 2010a).

At the cognitive level, aesthetic experiences can be distinguished from other experiences based on an "aesthetic mode of processing." This mode can be characterized by an attentional focus on the stimulus while an integration of context, certain memory systems, and sensory qualities of the stimulus simultaneously occurs. During this process, self-referential concerns or everyday life perceptions are neglected (Chatterjee & Vartanian, 2014; Cupchik et al., 2009; Menninghaus et al., 2017; Weigand & Jacobsen, 2021a). People can voluntarily switch to the aesthetic mode and contemplate or evaluate stimuli in terms of their aesthetic properties. Involuntary transitions to the aesthetic mode are also equally possible via the process of aesthetic distraction (e.g., in view of a beautiful sunset; Jacobsen, 2010b).

Covarying with the number of simultaneous integration and maintenance processes, the aesthetic mode requires working memory resources. On the most basic level, the term *working memory* refers to the mechanisms and processes that hold available for processing those mental representations that are currently most needed for an ongoing

cognitive task (Oberauer, 2019). Cowan (1999) suggested that working memory refers to the focus of attention and other activated information in long-term memory. Because working memory is critical for guiding attentional processes in the service of current goals, it should be easier to maintain an attentional focus on an aesthetic stimulus when working memory resources are free. In line with this assumption, there is evidence that the ability to focus attention enhances the processing of aesthetic attributes, leading to more engagement and pleasure (Chatterjee, 2004; Leder et al., 2004). Of course, not all instances of aesthetic reception require all working memory resources. The extent of necessary working memory resources in the aesthetic mode covaries with concentration; it should depend on the extent to which controlled processes (compared to automatic processes; Craik & Lockhart, 1972) are required for processing the aesthetic stimulus. In this regard, there is variation on both the stimulus side and the situation side. For example, some aesthetic stimuli (e.g., operas, complex music) require more resources than others (e.g., simple visual stimuli), and some situational scripts (e.g., opera, theater, museums) allow for more immersion than others (e.g., supermarkets) and thus require more resources. In contrast, other instances should be able to trigger aesthetic experiences relatively independently of the observer's mental state, even when working memory resources are (relatively) depleted: In line with Näätänen (1990), for example, such a process may arise from a mechanism for selectively attending to stimuli defined by certain features, along with a variable threshold setting (i.e., intensity and suddenness; Fechner, 1876; Näätänen, 1992).

In a previous series of studies, we found that with reduced working memory resources, when individuals were mentally engaged with a second unfinished task or when they felt stressed, were experiencing chronic pain, or ruminated about work-related issues, the beauty and savoring felt from art was diminished (Weigand & Jacobsen, 2021a,

2021b). In addition, the cognitive load of everyday life has been shown to interfere with aesthetic experiences (Weigand & Jacobsen, 2021c). In the same vein, distraction from a preloaded working memory has been found to reduce the understanding of artworks (Mullennix et al., 2018) and the beauty felt from beautiful stimuli (Brielmann & Pelli, 2017). In sum, it appears that when working memory resources are occupied, aesthetic experiences seem to be hampered—with due regard to the previously mentioned covariation, exceptions, or perhaps restrictions. Based on this, the following can be conjectured: If a limitation of working memory resources has a negative effect on aesthetic reception, it is reasonable to assume that a release of working memory resources will lead to more intense aesthetic experiences, if these increased working memory resources help in concentrating on the aesthetic mode of processing. In line with this conception, the accomplished artist Marina Abramović has developed a method for making aesthetic experiences more authentic, moving, and profound (Phelan, 2004): Prior to exposing an audience to works of art, she engages them in mindfulness exercises.

Mindfulness can be referred to as the process of "bringing one’s complete attention to the present experience on a moment-to-moment basis" (Marlatt & Kristeller, 1999, p.68), as well as "paying attention in a particular way, on purpose, in the present moment, and nonjudgmentally" (Kabat-Zinn, 1994, p. 4). A growing number of investigations over the past few years suggest that mindfulness training might have various benefits, not only in the emotional domain (Bartlett et al., 2019; Eberth & Sedlmeier, 2012), but also in the cognitive domain. For instance, a recent meta-analysis of randomized controlled trials (Casédas et al., 2019) showed that mindfulness-based interventions benefit executive functioning and working memory in adults. In addition, Jha and colleagues (2021) reported salutary effects of mindfulness training on measures

of working memory. Mindfulness training has been shown to prevent the deterioration of working memory during periods of high stress (Jha et al., 2010). Mrazek et al. (2013) showed that a two-week period of mindfulness training could elicit increased working memory performance and that this improvement resulted from a dampening of distracting thoughts and an enhanced attentional focus. A growing body of evidence also suggests that higher levels of self-reported *dispositional mindfulness*—a relatively stable characteristic that is not expected to change greatly unless an individual engages in mindfulness training—is positively related to working memory capacity and sustained attention (Anicha et al., 2012; Riggs et al., 2015; Ruocco & Wonders, 2013).

In the present study, we operationalized dispositional mindfulness in order to investigate whether concentration on the aesthetic mode is more pronounced, that is, whether aesthetic experiences are enhanced, when more working memory resources are available. In line with this prediction, a previous online survey found levels of dispositional mindfulness to be associated with the frequency of intense emotional responses to the arts (Harrison & Clark, 2016). Diaz (2013) also found that a brief mindfulness meditation positively modified a music listening experience by increasing participants' ability to focus on the music without distraction. Liu et al. (2021) showed that mindfulness meditation training promoted beautiful musical experiences in individuals with no musical training. In the visual art domain, there is evidence from Zabelina et al (2020) that mindfulness-based practices may not only result in a deeper art viewing experience, but also may go along with more creative and expressive personal art. Also, Igdalova and Chamberlain (2023) found that "slow looking" in the context of art-viewing contributed to more pleasant experiences and a greater feeling of calmness.

Importantly, in scientific studies on mindfulness it is an important, yet complex, issue to distinguish between state and trait aspects of mindfulness. An individual may display varying degrees of state or trait mindfulness at different points in time. A higher trait/dispositional mindfulness has been shown to allow individuals to enter the state of mindfulness, for example via meditation, more readily (e.g., Ortner et al., 2007).

In our study, we aimed to investigate whether dispositional mindfulness is related to a higher working memory capacity and more intense aesthetic experiences after a mindfulness intervention.

H1: Dispositional mindfulness is positively related to the savoring of aesthetic experiences.

H2: Mediation hypothesis: The influence of mindfulness on aesthetic experiences is mediated by working memory capacity.

By shedding light on those issues, we also hope to offer important starting points for easy interventions to foster more, and more intense, aesthetic experiences.

Method

Sample

According to Fritz and MacKinnon (2007), a sample size of approximately 75 is needed to detect a medium mediation effect with 80% power given medium path effects between the predictor and the mediator and the mediator and the criterion. Based on Anicha et al. (2012), who reported medium- to large-size effects of the observing facet of mindfulness on working memory capacity (partial η^2 = .07–.09), and Harrison and Clark (2016), who reported a large-size effect of trait mindfulness on emotional responses to the arts (partial η^2 = .39), we can also assume larger path effects. Given these requirements, we invited 80 students of the Helmut Schmidt University /

University of the Federal Armed Forces Hamburg to participate in our study in exchange for a partial fulfilment of course requirements. Seven of these students were excluded from further analysis: Two participants experienced technical errors in the working memory task, and five individuals were unable to perform the second part of the working memory task due to time constraints. The remaining 73 participants included 21 women, 51 men, and one nonbinary person. The mean age was 24.18 years (*SD* = 2.92; range: 19–36). Twenty-seven participants (37%) reported no previous experience with mindfulness. All participants were required to abstain from taking substances or medications that could potentially influence their concentration. Prior to the experiment, all of the students received written information about the study procedure and gave their informed written consent.

Materials

Mindfulness Intervention

Participants were asked to listen to a 10-min guided breath meditation provided by Paulina Thurm (https://paulinathurm.com/podcast/). The length of the meditation was in accordance with other brief meditation practices that have shown positive outcomes in a variety of variables, including pain, anxiety, attentional resources, and alcohol consumption, using meditation sessions ranging from 10 to 20 min (e.g., Garland et al., 2017; Kamboj et al., 2017; Moore et al., 2012). The meditation included instructions such as “Focus your awareness on the moment between breathing in and breathing out.” Participants were asked to direct all of their attention to the present, feel their breathing, and be mindful of their bodily sensations.

Five-Facet Mindfulness Questionnaire (FFMQ)

Dispositional mindfulness was assessed through the FFMQ, a 39-item self-report questionnaire that measures five facets of mindfulness: *observing, describing, acting with awareness, nonjudging of inner experience*, and *nonreactivity to inner experience* (Baer et al., 2006). Participants indicated the degree to which each item applied to them using a 5-point Likert-type scale ranging from 1 (*never or very rarely true*) to 5 (*almost always or always true*; Cronbach's $\alpha = .89$). The scores were then added to form a total score, with high scores indicating more mindfulness.

Aesthetic Stimuli

Out of a stimulus set of 80 artistic and naturally colored Western paintings, we chose 40 pictures for the present study (Cheung et al., 2019). The original stimulus set was categorized into four types of painting (impressionist art, post-impressionist art, abstract art, surrealist art) with 20 in each group. Of the 20 paintings in each group, 10 were considered beautiful and 10 not beautiful by participants of a pilot study (Cheung et al., 2019). For the present study, we chose 10 pictures of each category, specifically comprising an equal distribution of half beautiful and half not beautiful pictures.

Figure 1 depicts eight examples from the stimulus set.

[insert Figure 1]

Working Memory Capacity

Working memory capacity (WMC) was assessed via the widely used operation span task (OSPAN). Compared to other measures of WMC, complex span tasks such as the OSPAN are highly predictive of an individual's performance across a range of

contexts (Unsworth el al., 2005). In this complex span task, presentations of to-be-remembered stimuli were alternated with an unrelated processing task (i.e., participants were asked to verify the accuracy of presented equations).

Aesthetic Experience

To assess savoring, we used items from Schall et al. (2017). Participants were asked to report their agreement with three items following the phrase "When I see this picture ...": "I am savoring the present moment," "I am thinking about things that make me feel happy," and "I am thinking about things that make me feel pleasure," on a 7-point Likert scale ranging from 1 (*not at all*) to 7 (*very much*). All savoring items were strongly correlated with one another and demonstrated high internal consistency (Cronbach's $\alpha = .90$). By calculating the mean across the three items, they were combined into one scale. Beauty was measured using the question "Is this a beautiful picture?," which was rated on a 7-point Likert scale ranging from 1 (*not at all*) to 7 (*very much*).

Mood

To control for mood effects, the self-report scales Positive and Negative Affect Schedule (PANAS; Krohne et al., 1996; Watson et al., 1988) and the Self-Assessment Manikin (SAM; Bradley & Lang, 1994) were administered at the beginning and at the end of the experimental session in a paper-and-pencil format. The SAM assesses valence, dominance, and arousal ratings using 9-point scales with pictorial anchors. The PANAS consists of 10 positive and 10 negative affective states. Participants rated the intensity of each affective state during the experience on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*extremely*). The reliability measure Cronbach's alpha ranged from $\alpha = .75$, for negative affect (NA), to $\alpha = .90$, for positive affect (PA).

Mindfulness Training Expertise

For descriptive purposes, participants were asked to indicate their level of experience with mindfulness training by answering the following questions:

1. Do you have previous experience with any kind of mindfulness training? This may include Tai Chi, Yoga, meditation, or other related practices.
2. If your answer was yes, since when have you been practicing this?
3. If your answer was yes, how often do you practice?

Procedure

Figure 2 shows the study procedure. This study consisted of one laboratory session that took about 120 min. Participants were tested individually. They were told that the purpose of the experiment was to test the influence of cognitive training on auditory and visual discrimination. Upon their arrival in the lab, in order to ensure that participants had no urgent unfinished tasks in mind, the experimenter read the following instructions in a neutral tone:

> You will now participate in a laboratory experiment. In order to assure your full concentration, please mute your mobile phones for the duration of the experiment. If you have any urgent thing to do (e.g., texting someone, going to the bathroom), please do it before the experiment begins.

[insert Figure 2]

First, participants filled out the mood questionnaires and the FFMQ. Then their baseline working memory capacity was assessed with the OSPAN task. In each of 15 trials, the to-be-remembered items were sets of 3 to 7 letters chosen from a pool of 12 letters that were presented for 250 ms each. At the end of each trial, participants

selected the presented items in the order in which they had appeared. Stimuli for the OSPAN were chosen randomly from a list of letters and equations, ensuring that participants did not encounter the same pattern of stimuli across the two testing sessions. Following standard procedures, we defined accuracy rates less than 85% on an unrelated processing task as an exclusion criterion (counting as errors any responses that exceeded the mean latency for 15 practice items by more than 2.5 standard deviations; Unsworth et al., 2005). Working memory capacity was calculated as the proportion of total letters recalled across all trials. Afterwards, participants underwent the meditation intervention. The aesthetic judgement task consisted of 40 trials, the order of which was randomized. Also, the order of questions was randomized. The stimuli were presented using Presentation (Neurobehavioral Systems, Albany, CA, USA), which also registered the judgment responses and latencies. One practice trial preceded the main experiment. The practice stimulus was not included in the main experiment. Each experimental trial started with a centered fixation cross presented for 1000 ms on a gray background. The subsequent presentation of the stimulus picture lasted 4000 ms before the first item appeared under the stimulus. Each item remained on the screen until a response was given and was then followed by the next item. After the last response, the stimulus was followed by a 2000-ms interstimulus interval before the fixation cross appeared again. This was identical to the procedure in Weigand and Jacobsen (2021a). Afterwards, participants underwent the OSPAN task again and filled out the mood questionnaires. At the end of the session, participants were fully debriefed.

Statistical Analyses

IBM Statistics SPSS for Mac, version 27 (IBM Corp., Armonk, NY, USA), and R Statistical Software, version 4.0.5 (Foundation for Statistical Computing, Vienna,

Austria), were used to analyze the data. All analyses employed the conventional .05 alpha level.

Results

Preliminary Analyses

Table 1 depicts the means and standard deviations of the study variables. The dispositional mindfulness scores were comparable to or even higher than scores from other student samples (e.g., Baer et al., 2008; Dundas et al., 2013). We found that the scores are distributed across a wide range (78 to 174) and that the distribution exhibits a bell-shaped pattern, indicating reasonable variability among participants.

We ran several paired-samples *t*-tests with a Bonferroni adjustment to compare the pre- and post-experimental mood measurements. There was a significant difference between the pre- and post-experimental scores for PA ($t(71) = 4.93$, $p < .001$, Cohen's $d_z = .56$.), with a decrease from a PA mean score of $M = 3.05$ ($SD = .63$) pre intervention to $M = 2.74$ ($SD = .77$) post intervention. There was no change in NA ($p = .138$). For the SAM scales, we found an increase in pleasure from the pre-intervention assessment ($M = 3.24$, $SD = 1.53$) to the post-intervention assessment ($M = 3.83$, $SD = 1.80$); $t(71) = -2.85$, $p = .006$, Cohen's $d_z = -.34$. To consider the experience with mindfulness in more detail, we created the additional ordinal variable "experience" from the open answers with possible answers between 1 (*no experience at all*) and 4 (*more than once a week for more than a year*). This variable did not correlate with any other study variable.

Hypothesis 1: Relationship Between Dispositional Mindfulness and Aesthetic Experience

To test whether dispositional mindfulness was positively related to savoring of aesthetic

experiences, we performed bivariate correlations and hierarchical regression analyses. Table 1 presents the study correlations. In line with our hypothesis, there was a significant correlation between the observing facet of mindfulness and savoring of aesthetic experiences ($r = .32$, $p = .006$). The other facets as well as the total score did not correlate significantly with beauty or savoring. In addition, we found a positive correlation between working memory performance difference and beauty ratings, which is addressed in more detail in the "Post Hoc Analysis" subsection.

Prior to conducting the hierarchical multiple regression, we tested the relevant assumptions of this statistical analysis. The assumption of singularity was met, as the predictor and control variables were not a combination of other predictor and control variables. An examination of correlations revealed that no predictor or control variables were highly correlated. A histogram of the standardized residuals indicated that the data contained approximately normally distributed errors, as did the normal P-P plot of standardized residuals, which showed points that were very close to the line. A scatterplot of standardized residuals showed that the data met the assumptions of homogeneity of variance and linearity. Table 2 presents the results of the hierarchical regression analysis. The analysis revealed that at stage one, the control variables of age, gender, education, mood, and experience with mindfulness training did not contribute significantly to the regression models for beauty or savoring. Overall, the control variables accounted for 0% of the variation in beauty or savoring. Introduction of the observing facet explained an additional 6.5% of the variation in savoring, and this change in R^2 was significant, $F(1, 60) = 6.488$, $p < .013$, indicating that individuals with a higher ability to mindfully observe savored more during the aesthetic experience.

Hypothesis 2: Mediation Analysis

To test whether the relationship between mindfulness and aesthetic experience was

mediated by working memory capacity, we performed mediation analyses. For these analyses, we used the PROCESS macro (version 4.1) developed to assess statistical mediation and moderation (Hayes, 2016, 2017). We conducted a mediation analysis with dispositional mindfulness as the predictor, beauty/savoring as the outcome, and the difference between pre- and post-experiment working memory scores as the mediator. We used a bootstrapping procedure with 5,000 resamples together with heteroscedasticity-consistent standard errors (Davidson & MacKinnon, 1993). The effects were deemed significant when the confidence interval (CI) did not include zero. Bootstrapping analyses did not reveal a significant mediating effect of working memory capacity on the effect of dispositional mindfulness on savoring, *IE* = .0005, 95% CIs (-.0039, .0144). Also, for all five facets of mindfulness, all indirect effects were nonsignificant, *IE* = -.0002 to .0022, and all 95% CIs included zero. In addition, the analysis did not reveal any significant mediating effect of working memory capacity on the effect of dispositional mindfulness on beauty, *IE* = .0009, 95% CIs (-.0022, .0045). Moreover, for all five facets of mindfulness, all indirect effects were nonsignificant, *IE* = -.0003 to .0042, and all 95% CIs included zero.

Table 1

Means, Standard Deviations, and Correlations

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 Savoring	3.46	.68																		
2 Beauty	3.90	.70	.66**																	
3 WMC 1	15.58	5.47	-.11	-.17																
4 WMC 2	17.08	4.78	.10	.18	.40**															
5 Diff.[a] WMC	1.51	5.56	.19	.32**	-.66**	.43**														
6 Diff. PA	-.31	.53	.12	.09	-.00	.15	.13													
7 Diff. NA	-.05	.29	-.00	.13	-.14	-.03	.12	-.50**												
8 Diff. SAM1	.60	1.78	.01	.09	.04	-.13	-.15	-.61**	.49**											
9 Diff. SAM2	.13	1.74	.08	-.09	-.07	-.05	.03	.27*	-.27*	-.33**										
10 Diff. SAM3	-.06	1.57	-.01	-.10	-.02	-.07	-.03	.52**	-.48**	-.44**	.37**									
11 FFMQ Sum	136.74	17.19	.15	-.06	-.07	-.00	.07	-.08	.19	-.05	.07	.19								
12 Observe[b]	27.26	5.27	.32**	.18	.06	.11	.03	-.09	.09	.13	.13	.09	.41**							
13 Describe	29.73	5.79	.07	-.08	-.09	.03	.11	-.07	.08	-.02	-.14	.21	.66**	.36**						
14 Act aware	26.60	5.35	-.10	-.07	-.06	-.04	.02	.11	.07	-.16	.01	.18	.69**	.01	.31**					
15 Nonjudge	28.77	7.74	.03	-.15	-.16	-.14	.05	-.08	.19	-.07	.04	.13	.64**	-.15	.17	.41**				
16 Nonreact	24.38	4.73	.15	.01	.11	.12	-.01	-.11	.11	.00	.22	-.06	.55**	.16	.15	.30*	.17			
17 Age	24.26	2.94	.04	-.04	.15	.11	-.06	.02	-.08	-.27*	.06	-.03	.04	.10	.15	-.10	-.07	.08		
18 Male[b]	.31	.50	.22	.23	-.23	.06	.28*	.10	.15	-.17	-.00	-.06	.18	.02	.12	.11	.07	.24*	.12	
19 Experience[d]	1.51	1.56	.14	.06	-.02	.07	.08	.01	-.18	-.03	-.18	.17	.04	.22	.06	-.18	.02	-.02	.03	.02

Note. $N = 73$.

[a]All difference scores: post - pre. [b]For the nonreact facet, the range of possible scores is 7–35. For all other facets, the possible range is 8–40. [c] 0 = other, 1 = male. [d] Experience with mindfulness, 0 = not at all, 1 = seldom, 2 = monthly for at least one year, 3 = once a week for at least one year, 4 = more than once a week for at least one year.

* $p < .05$. ** $p < .01$.

Table 2

Results of Hierarchical Regression Analyses

Variable	Step 1 (control variables)			Step 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Criterion: Savoring						
Age	-.005	.032	-.020	-.015	.031	-.064
Male	.735	.727	.500	.251	.722	.171
Experience	.018	.183	.013	-.048	.177	-.034
Diff. PA	.332	.219	.257	.339	.210	.263
Diff. NA	-.050	.369	-.021	-.126	.355	-.054
Diff. SAM1	.064	.068	.168	.031	.067	.082
Diff. SAM2	.041	.054	.104	.015	.053	.039
Diff. SAM3	-.035	.068	-.081	-.054	.066	-.124
Observ.	-	-	-	.042	.016	.323*
R^2	-	.125	-		.210	-
F for change in R^2	-	.870	-		6.49*	-
Criterion: Beauty						
Age	-.013	.032	-.053	-.020	.032	-.083
Male[a]	.401	.742	.265	.061	.757	.041
Experience[b]	-.016	.187	-.011	-.062	.186	-.043
Diff. PA[c]	.452	.223	.341	.457	.220	.345
Diff. NA	.269	.377	.112	.216	.372	.089
Diff. SAM1	.066	.070	.169	.043	.070	.110
Diff. SAM2	-.021	.055	-.051	-.038	.055	-.095
Diff. SAM3	-.040	.070	-.089	-.053	.069	-.119
Observ.	-	-	-	.029	.017	.220
R^2	-	.139	-		.178	-
F for change in R^2	-	.983	-		2.90	-

Note. $N = 73$.

[a] 0 = other, 1 = male. [b]Experience with mindfulness, 0 = not at all, 1 = seldom, 2 = monthly for at least one year, 3 = once a week for at least one year, 4 = more than once a week for at least one year. [c]All difference scores: post - pre.

* $p < .05$. ** $p < .01$.

Post Hoc Analysis

The working memory performance difference and beauty ratings were positively related ($r = .32$, $p = .006$), which indicates that individuals who performed better on the OSPAN task after the meditation intervention found the pictures to be more beautiful. However, given the order of tasks and the correlational nature of the data, an alternative explanation is also possible. To rule out the possibility that a low perceived beauty of the images could have led to a feeling of boredom and tediousness, which could have negatively affected performance after the rating task, we performed a median split on the performance difference. We then examined whether the association between the performance difference and beauty was evident only in the group that performed better before the intervention than afterwards. This was not the case ($r = .26$, $p = .119$). On the contrary, the association was only present in the group that performed better after the intervention ($r = .38$, $p = .021$).

Discussion

As an indicator of increased savoring in aesthetic experience via increased working memory resources, we studied the relationship between dispositional mindfulness and aesthetic experiences in a laboratory setting. The key objective of this study was to investigate whether higher dispositional mindfulness was associated with more intense aesthetic experiences and a better working memory capacity. We predicted a positive correlation between dispositional mindfulness and savoring of aesthetic experiences, and we hypothesized that this relationship would be mediated by working memory capacity.

As hypothesized, the results suggest that dispositional mindfulness goes along with more savoring of aesthetic experiences. Specifically, participants with higher values on the observing facet of mindfulness savored the paintings more. According to Baer et al. (2006), observing means attending to sensory stimuli that derive either from external sources or the body as well as related cognitions and emotions. This finding fits well with Harrison and Clark (2016), who found that the observing facet of mindfulness predicted the frequency of aesthetic experiences evoked by the arts. Our findings suggest that the positive relationship between the observing facet and aesthetic experiences might refer not only to the frequency of aesthetic experiences, but also to their intensity. Evidence suggests that the observing facet of dispositional mindfulness is specifically related to perceptual awareness (Anicha et al., 2012). Perceptual analysis of stimulus features (e.g., symmetry, color, complexity) is an important stage in the process of aesthetic experience (e.g., Chatterjee, 2011; Leder et al., 2004; Nadal et al., 2008). Individuals with higher scores on the observing facet may be able to conduct a more profound analysis of the perceptual features of a stimulus, fostering not only more frequent (Harrison & Clark, 2016), but also more intense aesthetic experience.

There was no evidence for a relationship between aesthetic experience and other facets of mindfulness, such as the facets of describing, acting with awareness, nonjudging of inner experience, and nonreactivity to inner experience. This is in line with Harrison and Clark (2016), who also did not find an association between the facets of describing and acting with awareness and aesthetic experience. However, they found that nonreactivity, i.e., the acceptance of ongoing experiences without pushing them away (Baer et al., 2006), was a unique predictor of the frequency of aesthetic experiences. Possibly, this facet is able to predict the frequency of aesthetic experiences rather than their intensity because it may be involved in the onset of aesthetic episodes.

Further studies are needed to elucidate the precise nature of this association. The finding that nonjudging (i.e., accepting thoughts and feelings without evaluating them; Baer et al., 2006) was not related to aesthetic experiences may be explained by the fact that in the present study, participants were explicitly asked to make an aesthetic judgment, which conflicts with the inclination not to judge the experience. Interestingly, Harrison and Clark (2016) even found a negative association between nonjudging and the frequency of aesthetic experiences.

Contrary to our expectations, there was no mediating effect of working memory capacity on the relationship between dispositional mindfulness and aesthetic experience. Specifically, dispositional mindfulness (and its facets) was not associated with higher working memory performance. This finding contrasts with other studies (e.g., Anicha et al., 2012; Riggs et al., 2015; Ruocco & Wonders, 2013) that found evidence for such a relationship. But in line with our prediction that mindfulness might lead to an improved working memory performance, individuals who performed better on the OSPAN task after the meditation intervention found the pictures to be more beautiful. This finding implies that people who benefited from meditation ins terms of their working memory capacity improving perceived the artworks as more beautiful. This supports the hypothesis that processing in the aesthetic mode depends on an availability of sufficient working memory resources and is also in line with a growing amount of evidence suggesting that mindfulness interventions improve cognitive functioning (e.g., Casédas et al., 2019; Jha et al., 2021; Mrazek et al., 2013). We ruled out the alternative explanation that people who gave very low beauty ratings might display lower working memory performance ratings because they were more bored or annoyed after the aesthetic task by showing that an association between working memory performance and beauty ratings was only present in the group that performed better after the

intervention. More specifically, there was no negative relationship between working memory performance and beauty ratings in the group that performed worse after the aesthetic task. Nevertheless, to validly attribute our finding to the mindfulness intervention, further studies are needed to examine the association in a controlled study design in which participants are randomly assigned to the mindfulness group and a control group. Such a design would allow investigating whether an effect of the intervention on aesthetic experiences would be larger for individuals higher in dispositional mindfulness. It must be kept in mind, however, that one single brief mindfulness intervention might not be enough to observe an effect on working memory capacity. For example, Quek et al. (2021) showed in two experimental approaches that a 15-minute mindfulness exercise did not lead to improvements in working memory. Taken together with findings by Basso and colleagues (2019), who found that four weeks of mindfulness training (13 min daily) did not demonstrate improvements in working memory compared with eight weeks of training, which did, one conclusion might be that an extended practice period (i.e., at least more than four weeks) may be necessary to yield a positive impact on working memory.

In sum, the correlation between the pre-post difference in working memory scores and the beauty ratings is in line with our theory and strengthens the notion that appreciation of beauty requires working memory resources. In previous research, we found that when working memory resources were occupied by interruptions, stress, rumination, or the cognitive load of everyday life, the beauty and savoring felt from aesthetic experiences was diminished (Weigand & Jacobsen, 2021a, 2021b, 2021c). The present findings confirm and extend the underlying theory of mental modes and concentration. They suggest that if appreciation of beauty requires working memory resources, the availability of sufficient working memory resources is a necessary

condition for concentration on the aesthetic mode. Accordingly, the aesthetic experience is not only reduced by an active restriction of working memory resources (Weigand & Jacobsen, 2021a), but also intensified by a release of working memory resources.

Our study has several limitations that should be considered when interpreting the results. First, the nonexperimental nature of the study limited our ability to establish causality between the variables of interest. While we were able to identify relationships between the observing facet of mindfulness and aesthetic experiences as well as between working memory capacity and aesthetic experiences, we cannot definitively establish that one variable caused the other. Secondly, we had limited control over extraneous variables, such as individual differences or contextual factors, that could potentially affect the outcome of the study. For example, individual differences in art expertise might have influenced the results of our investigation, as expertise in art has been found to influence the frequency of aesthetic responses (Kozbelt & Seeley, 2007), and individuals scoring high in aesthetic expertise have reported higher aesthetic experience scores (Silvia & Nusbaum, 2011). Presumably, for individuals with more experience in visual art, a release of working memory capacity would be more likely to lead to increased savoring of visual art than for individuals who are unfamiliar with visual art. A previous investigation using a sample from the same university found that art interest and art knowledge were very low (Weigand & Jacobsen, 2021a). Possibly, the effects might be more pronounced in a sample with more expertise in the relevant art domain, and the chances of finding an effect in this study were therefore reduced by the sample selection.

A third limitation concerns the fact that we measured both predictors and outcome variables using self-report scales. Therefore, the issue of common method variance might be a concern (Podsakoff et al., 2003). However, the FFMQ contains

negatively worded items, and the FFMQ and the aesthetic task had different scale endpoints, both of which reduce common method variance (Podsakoff et al., 2003). A fourth limitation refers to the fact that we cannot definitively conclude whether it was the focus on presence, bodily sensations, or the breathing component of mindfulness that specifically influenced art experience. The meditation intervention utilized in our study, although primarily focused on breath awareness, encompassed all three aspects of mindfulness. This lack of specificity might be considered in future research. To ensure greater clarity and comparability across studies on mindfulness, it is crucial to provide detailed information about the specific methodology and components employed in mindfulness interventions (Van Dam et al., 2018).

Despite these limitations, our study provides valuable insights into the nature of the relationship between dispositional mindfulness and aesthetic experiences and highlights the need for further research in this area.

Future studies could investigate the same phenomenon in different aesthetic domains. For example, it is possible that the relation to the observing facet of mindfulness is only or especially evident in visual domains. Therefore, the domains of music, literature, nature, or the aesthetic experiences of everyday life could be subjects of future research. Also, an experience-sampling approach could be valuable, to investigate whether people with higher dispositional mindfulness experience more (intense) aesthetic experiences in their everyday lives. These findings would have implications for the use of mindfulness-based interventions in the context of art therapy or other forms of aesthetic engagement.

All in all, the findings of our study suggest that freeing working memory resources in the aesthetic mode can improve aesthetic experience, as demonstrated by the finding that the observing facet of dispositional mindfulness is associated with more

intense aesthetic experiences and that improved working memory performance after a meditation intervention is associated with higher beauty ratings when looking at visual artworks. These results support the theory that processing in the aesthetic mode requires working memory resources. Finally, our study provides a novel contribution to the literature by demonstrating that mindfulness and working memory capacity may work in concert to facilitate more intense aesthetic experiences.

References

Anicha, C. L., Ode, S., Moeller, S. K., & Robinson, M. D. (2012). Toward a cognitive view of trait mindfulness: distinct cognitive skills predict its observing and nonreactivity facets. *Journal of Personality, 80*(2), 255–285. https://doi.org/10.1111/j.1467-6494.2011.00722.x

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*, 27–45. https://doi.org/10.1177/1073191105283504

Baer, R. A., Smith, G. T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., Walsh, E., Duggan, D., & Williams, J. M. G. (2008). Construct validity of the five facet mindfulness questionnaire in meditating and nonmeditating samples. *Assessment, 15*(3), 329–342. https://doi.org/10.1177/1073191107313003

Bartlett, L., Martin, A., Neil, A. L., Memish, K., Otahal, P., Kilpatrick, M., et al. (2019). A systematic review and metaanalysis of workplace mindfulness training randomized controlled trials. *Journal of Occupational Health Psychology, 24*(1), 108–126. https://doi.org/10.1037/ocp0000146

Basso, J. C., McHale, A., Ende, V., Oberlin, D. J., & Suzuki, W. A. (2019). Brief, daily meditation enhances attention, memory, mood, and emotional regulation in non-experienced meditators. *Behavioural Brain Research, 356*(1), 208–220. https://doi.org/10.1016/j.bbr.2018.08.023

Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The self-assessment manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry, 25*(1), 49–59. https://doi.org/10.1016/0005-7916(94)90063-9

Brielmann, A. A., & Pelli, D. G. (2017). Beauty requires thought. *Current Biology, 27*(10), 1506–1513. https://doi.org/10.1016/j.cub.2017.04.018

Cásedas, L., Pirruccio, V., Vadillo, M. A., & Lupiáñez, J. (2020). Does mindfulness meditation training enhance executive control? A systematic review and meta-analysis of randomized controlled trials in adults. *Mindfulness, 11*(2), 411–424. https://doi.org/10.1007/s12671-019-01279-4

Chatterjee, A. (2004). The neuropsychology of visual artistic production. *Neuropsychologia, 42*(11), 1568–1583. https://doi.org/10.1016/j.neuropsychologia.2004

Chatterjee A. (2011). Neuroaesthetics: a coming of age story. *Journal of Cognitive Neuroscience, 23*(1), 53–62. https://doi.org/10.1162/jocn.2010.21457

Chatterjee, A., & Vartanian, O. (2014). Neuroaesthetics. *Trends in Cognitive Sciences, 18*(7), 370–375. https://doi.org/10.1016/j.tics.2014.03.003

Cheung, M. C., Law, D., Yip, J., & Wong, C. W. (2019). Emotional responses to visual art and commercial stimuli: implications for creativity and aesthetics. *Frontiers in Psychology, 10*, 14. https://doi.org/10.3389/fpsyg.2019.00014

Cowan, N. (1999). An embedded-processes model of working memory. In A. Miyake & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive contro*l (pp. 62–101). Cambridge University Press.

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior, 11*(6), 671–684. https://doi.org/10.1016/S0022-5371(72)80001-X

Cupchik, G. C., Vartanian, O., Crawley, A., & Mikulis, D. J. (2009). Viewing artworks: contributions of cognitive control and perceptual facilitation to aesthetic experience. *Brain and Cognition, 70*(1), 84–91. https://doi.org/10.1016/j.bandc.2009.01.003

Davidson, R., & MacKinnon, J. G. (1993). *Estimation and inference in econometrics.* Oxford University Press.

Diaz, F. M. (2013). Mindfulness, attention, and flow during music listening: An empirical investigation. *Psychology of Music, 41*(1), 42–58. https://doi.org/10.1177/03057356114151

Dundas, I., Vøllestad, J., Binder, P. E., & Sivertsen, B. (2013). The five factor mindfulness questionnaire in Norway. *Scandinavian Journal of Psychology, 54*(3), 250–260. https://doi.org/10.1111/sjop.12044

Eberth, J., & Sedlmeier, P. (2012). The effects of mindfulness meditation: A meta-analysis. *Mindfulness, 3*(3), 174–189. https://doi.org/10.1007/s12671-012-0101-x

Fechner, G. T. (1876). *Vorschule der Aesthetik [Experimental aesthetics; "Pre-school" of aesthetics.* Breitkopf & Härtel.

Fritz, M. S., & MacKinnon, D. P. (2007). Required Sample Size to Detect the Mediated Effect. *Psychological Science, 18*(3), 233–239. https://doi.org/10.1111/j.1467-9280.2007.01882.x

Garland, E. L., Baker, A. K., Larsen, P., Riquino, M. R., Priddy, S. E., Thomas, E., Hanley, A. W., Galbraith, P., Wanner, N., & Nakamura, Y. (2017). Randomized controlled trial of brief mindfulness training and hypnotic suggestion for acute pain relief in the hospital setting. *Journal of General Internal Medicine, 32*(10), 1106–1113. https://doi.org/10.1007/s11606-017-4116-9

Harrison, N. R., & Clark, D. P. (2016). The observing facet of trait mindfulness predicts frequency of aesthetic experiences evoked by the arts. *Mindfulness,* 7(4), 971–978. https://doi.org/10.1007/s12671-016-0536-6

Hayes, A. F. (2016). PROCESS macro for SPSS and SAS (Version 4.1)[Computer software].

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford publications.

Igdalova, A., & Chamberlain, R. (2023). Slow looking at still art: The effect of manipulating audio context and image category on mood and engagement during an online slow looking exercise. *Psychology of Aesthetics, Creativity, and the Arts*. Advance online publication. https://doi.org/10.1037/aca0000546

Jacobsen, T. (2006). Bridging the arts and sciences: A framework for the psychology of aesthetics. *Leonardo, 39*(2), 155–162. https://doi.org/10.1162/leon.2006.39.2.155

Jacobsen, T. (2010a). Beauty and the brain: culture, history and individual differences in aesthetic appreciation. *Journal of Anatomy, 216*(2), 184–191. https://doi.org/10.1111/j.1469-7580.2009.01164.x

Jacobsen, T. (2010b). On the psychophysiology of aesthetics: Automatic and controlled processes of aesthetic appreciation. In I. Czigler & I.Winkler (Eds.), *Unconscious memory representations in perception, processes and mechanisms in the brain* (pp. 245–257). John Benjamins.

Jha, A. P., Stanley, E. A., Kiyonaga, A., Wong, L., & Gelfand, L. (2010). Examining the protective effects of mindfulness training on working memory capacity and affective experience. *Emotion, 10*(1), 54–64. https://doi.org/10.1037/a0018438

Jha, A. P., Zanesco, A. P., Denkova, E., MacNulty, W. K., & Rogers, S. L. (2021). The Effects of Mindfulness Training on Working Memory Performance in High-Demand Cohorts: a Multi-study Investigation. *Journal of Cognitive Enhancement, 6,* 192–204. https://doi.org/10.1007/s41465-021-00228-1

Kabat-Zinn, J. (1994). *Wherever You Go, There You Are*. Hyperion Books.

Kamboj, S. K., Irez, D., Serfaty, S., Thomas, E., Das, R. K., & Freeman, T. P. (2017). Ultra-brief mindfulness training reduces alcohol consumption in at-risk drinkers: A randomized double-blind active-controlled experiment. *International Journal of Neuropsychopharmacology, 20*(11), 936–947. https://doi.org/10.1093/ijnp/pyx064

Kozbelt, A., & Seeley, W. P. (2007). Integrating art historical, psychological, and neuroscientific explanations of artists, advantages in drawing and perception. *Psychology of Aesthetics, Creactivity, and the Arts, 1*(2), 80–90. https://doi.org/10.1037/1931-3896.1.2.80

Krohne, H. W., Eglo , B., Kohlmann, C. W., & Tausch, A. (1996). Investigations with a German version of the Positive and Negative Affect Schedule (PANAS). *Diagnostica, 42*(2), 139–156. https://doi.org/10.1037/t49650-000

Leder, H., Belke, B., Oeberst, A., & Augustin, D. (2004). A model of aesthetic appreciation and aesthetic judgments. *British Journal of Psychology, 95*(4), 489–508. https://doi.org/10.1348/0007126042369811

Liu, X., Liu, Y., Shi, H., & Zheng, M. (2021). Effects of mindfulness meditation on musical aesthetic emotion processing. *Frontiers in Psychology*, *12*, 648062. https://doi.org/10.3389/fpsyg.2021.648062

Marlatt, G. A., & Kristeller, J. L. (1999). Mindfulness and meditation. In W. R. Miller (Ed.), *Integrating spirituality into treatment* (p. 67–84). American Psychological Association.

Menninghaus, W., Wagner, V., Hanich, J., Wassiliwizky, E., Jacobsen, T., & Koelsch, S. (2017). The distancing-embracing model of the enjoyment of negative emotions in art reception. *Behavioral and Brain Sciences, 40*, e347. https://doi.org/10.1017/S0140525X17000309

Menninghaus, W., Wagner, V., Wassiliwizky, E., Schindler, I., Hanich, J., Jacobsen, T., & Koelsch, S. (2019). What are aesthetic emotions?. *Psychological Review, 126*(2), 171–195. https://doi.org/10.1037/rev0000135

Moore, A. W., Gruber, T., Derose, J., & Malinowski, P. (2012). Regular, brief mindfulness meditation practice improves electrophysiological markers of attentional control. *Frontiers in Human Neuroscience, 6*, 18. https://doi.org/10.3389/fnhum.2012.00018

Mrazek, M. D., Franklin, M. S., Phillips, D. T., Baird, B., & Schooler, J. W. (2013). Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychological Science, 24*(5), 776–781. https://doi.org/10.1177/0956797612459659

Mullennix, J. W., Pilot, K. M., Steeves, T. A., & Burns, J. C. (2018). The effects of cognitive load on judgments of titled visual art. *Psychology of Aesthetics, Creativity, and the Arts, 12*(2), 166–176. https://doi.org/10.1037/aca0000128

Nadal, M., Munar, E., Capo, M. A., Rossello, J., & Cela-Conde, C. J. (2008). Towards a framework for the study of the neural correlates of aesthetic preference. *Spatial Vision, 21*(3), 379–396. https://doi.org/10.1163/156856808784532653

Näätänen, R. (1990). The role of attention in auditory information processing as revealed by event-related potentials and other brain measures of cognitive function. *Behavioral and Brain Sciences, 13*(2), 201–233. https://doi.org/10.1017/S0140525X00078407

Näätänen, R. (1992). *Attention and brain function.* Psychology Press.

Oberauer K. (2019). Working Memory and Attention – A Conceptual Analysis and Review. *Journal of Cognition, 2*(1), 36. https://doi.org/10.5334/joc.58

Ortner, C. N., Kilner, S. J., & Zelazo, P. D. (2007). Mindfulness meditation and reduced emotional interference on a cognitive task. *Motivation and Emotion*, *31*, 271–283. https://doi.org/10.1007/s11031-007-9076-7

Phelan, P. (2004). Marina Abramović: Witnessing shadows. *Theatre Journal, 56*(4), 569–577. https://doi.org/10.1353/tj.2004.0178

Podsakoff, P. M., MacKenzie, S. B., Lee, J., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Quek, F. Y., Majeed, N. M., Kothari, M., Lua, V. Y., Ong, H. S., & Hartanto, A. (2021). Brief mindfulness breathing exercises and working memory capacity: Findings from two experimental approaches. *Brain Sciences, 11*(2), 175. https://doi.org/10.3390/brainsci11020175

Riggs, N. R., Black, D. S., & Ritt-Olson, A. (2015). Associations between dispositional mindfulness and executive function in early adolescence. *Journal of Child and Family Studies, 24*(9), 2745–2751. https://doi.org/10.1007/s10826-014-0077-3

Ruocco, A. C., & Wonders, E. (2013). Delineating the contributions of sustained attention and working memory to individual differences in mindfulness. *Personality and Individual Differences, 54*(2), 226–230. https://doi.org/10.1016/j.paid.2012.08.037

Schall, M., Goetz, T., Martiny, S. E., & Hall, N. C. (2017). It ain't over 'til it's over: The effect of task completion on the savoring of success. *Motivation and Emotion, 41*(1), 38–50. https://doi.org/10.1007/s11031-016-9591-5

Silvia, P. J., & Nusbaum, E. C. (2011). On personality and piloerection: Individual differences in aesthetic chills and other unusual aesthetic experiences. *Psychology of Aesthetics, Creativity, and the Arts, 5*(3), 208–214. https://doi.org/10.1037/a0021914

Unsworth, N., Heitz, R. P., Schrock, J. C., & Engle, R. W. (2005). An automated version of the operation span task. *Behavior Research Methods, 37*, 498–505.

Van Dam, N. T., Van Vugt, M. K., Vago, D. R., Schmalzl, L., Saron, C. D., Olendzki, A., ... & Meyer, D. E. (2018). Mind the hype: A critical evaluation and prescriptive agenda for research on mindfulness and meditation. *Perspectives on Psychological Science*, *13*(1), 36–61. https://doi.org/10.1177/1745691617709589

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070.

Weigand, R. & Jacobsen, T. (2021a). Interruption, Work Rumination, and Stress as Indicators of Reduced WorkingMemory Resources Affect Aesthetic Experiences. *Quarterly Journal of Experimental Psychology, 75*(7), 1272–1288. https://doi.org/10.1177/17470218211050194

Weigand, R., Moosmayer, A., & Jacobsen, T. (2021b). Does Self-Reported Chronic Pain Influence Savoring of Aesthetic Experiences? *PLOS ONE, 16*(11), e0259198. https://doi.org/10.1371/journal.pone.0259198

Weigand, R., & Jacobsen, T. (2021c). Beauty and the busy mind: Occupied working memory resources impair aesthetic experiences in everyday life. *PLOS ONE, 16*(3), e0248529.

Zabelina, D. L., White, R. A., Tobin, A., & Thompson, L. (2020). The role of mindfulness in viewing and making art in children and adults. *Mindfulness*, *11*, 2604-2612. https://doi.org/10.1007/s12671-020-01474-8

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Data Availability Statement

The data will be made available on PsychArchives. Requests for the materials can be sent via email to the lead author.

Figure 1

A selection from the stimulus set.

Figure 2

The study procedure.