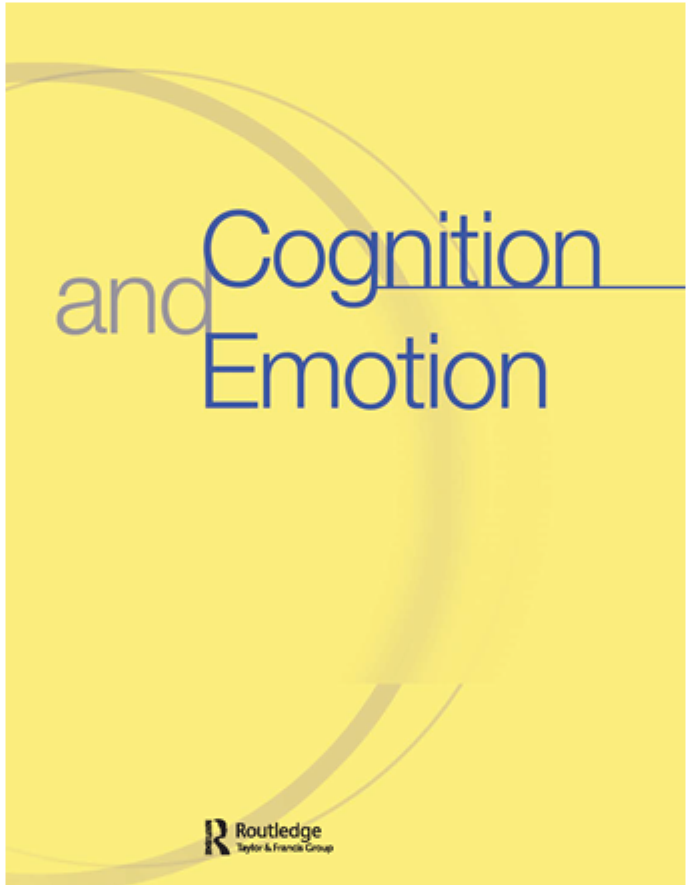

The mindful gaze: Trait mindful people under an instructed emotion regulation goal selectively attend to positive stimuli

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Keywords:	attention, mindfulness, eye tracking

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Supplemental Methods

Apparatus

Eye gaze was tracked as participants viewed stimuli on a 22”, 32 bit, AMD Radeon HD 6630M computer monitor. Participants viewed the display from a distance of approximately 24” (with all angular extents below calculated based on this distance), so that the display subtended 42.16° (width) by 27.64° (height). Each image subtended 9.53° x 7.15°. Stimuli were presented using Experiment Center software (Version 2.1, 2010, SensoMotoric Instruments, 2010). Binocular gaze was recorded using a SensoMotoric Instruments (SMI) RED250 eye tracker with a dark pupil tracking system, 250-Hz sampling rate, 0.03° spatial resolution, and gaze position accuracy sharper than 0.4°. All analyses examine data recorded from the right eye. The eye tracker compensated for head movements of up to 25 cm/s, and in the case of more robust head movements, it had a 115-ms recovery time back to full tracking ability after an offset or after the pupil was lost. Tracking was recovered after an eye blink within 6 ms. Continuous eye movement data were collected using iView X software (Version 2.4.19, 2009).

Image placement for eye tracking trials

Half of each type of experimental pairing (i.e., Positive-Neutral, Negative-Neutral, Positive-Negative pairings) was positioned such that one image was in the top half of the screen and the other in the bottom half (with their nearest horizontal borders separated by 2.39°), and half positioned such that one image was in the left half of the screen and the other in the right half (with their nearest vertical borders separated by 2.39°). Images of each type (Positive, Negative, Neutral) occurred in each of these four positions (top, bottom, left, right) equally often. To ensure that images appeared in a variety of locations and prevent rote patterns of scanning, images in the top-bottom orientation were then each randomly assigned their horizontal placement on the screen (always separated from the nearest horizontal edge of the display by 1.49° and with the constraint that they be placed no more than 1.79° from the vertical edge of the display), while images in the left-right orientation were randomly assigned their vertical placement on the screen (always separated from the nearest vertical edge of the screen by 1.79° and with the constraint that they be placed no more than 1.49° from the horizontal edge of the screen).

Validation of images

To validate the three types of images on valence and arousal ratings prior to their experimental administration, 110 participants (age 18-59, M=32.75; SD=9.01) were recruited online via Amazon Mechanical-Turk (MTurk; Buhrmester, Kwang, & Gosling, 2011). Participants scored images using the 9-point Self-Assessment Manikin rating scales (from 1 [very unpleasant/very calm] to 9 [very pleasant/very excited]) that have previously been used to validate the IAPS images (Hodes et al., 1985; Lang, Bradley, & Cuthbert, 2008). For valence ratings, in paired t test comparisons, the Positive images were rated as significantly more positive than the Neutral images, which in turn were rated more positive than the Negative images (ps<.04). For arousal ratings, though Positive and Negative images were equated on arousal (p = .36), the Positive and Negative images each had significantly higher arousal ratings than the Neutral images (ps <.04), as is standard with emotional images (e.g. Caseras et al., 2007; Kellough et al., 2008).

Phase scrambling procedure

Phase scrambling was done using a 2D Fast Fourier Transform manipulation in MATLAB to randomize its phrase spectrum while maintaining its amplitude spectrum – thus eliminating semantic content while preserving low-level visual features such as mean contrast, luminance, and color distribution.

Measures

The Trait Mindful Attention Awareness Scale (MAAS) is a 15-item self-report questionnaire frequently used to capture trait mindfulness. Participants use a Likert scale to respond to items such as "I find myself doing things without paying attention." Scores are averaged and range from 1 to 6, with higher scores indicating greater trait mindfulness. Internal consistency of the present study was good (α = .85).

The modified Discrete Emotion Scale (mDES) has subscales for positive and negative affect. Each scale asks participants to indicate on a Likert scale the extent to which they currently feel each given emotional experience. The positive affect scale consists of 10 items such as "glad, happy, joyful," and had good internal consistency at both baseline and post-viewing (T1: α *= .82;* T2: α = .88). The negative affect scale consists of eight items such as "angry, irritated, annoyed," and had good internal consistency as well (T1: α = .83*;* T2: α = .89).

Emotion malleability belief articles for concomitant study

As part of a concomitant study, before the image viewing, participants were randomly assigned to read one of three passages formatted to look like online news articles from *NPR*. Articles were either about emotions being fixed, emotions being malleable, or minimalist design (see Kneeland et al., 2016 for more on these passages). Participants were told that the eye tracker would measure the speed and pattern of their gaze while reading text. Participants were allowed to read at their own pace and indicate to the experimenter when they were ready to move on.

Data Reduction and Analyses

For eye-tracking analysis, the viewing area was defined as the entire screen display, and the two areas of interest (AOIs) on each trial were defined by the boundaries of the two images. Dwell Time was defined as the total time spent fixating and making saccades within a given AOI (computed and reported as a percentage of the total trial duration). A fixation was defined as any period for which gaze was still (varying less than 1°) for more than 100 ms. In using this variable as a measure of sustained attention, we follow previous attention and emotion research (see Armstrong & Olatunji, 2012; e.g., Wiebe et al., 2017).

To capture Gaze Biases for one emotional image type relative to the other, the outcome measure of Dwell Time was calculated based on a "difference score" between the two images. To compute difference scores, we first averaged Dwell Time for each AOI (e.g., Dwell Time on each Positive image on Positive-Neutral trials was averaged to create a single score). Then, average Dwell Time for the valenced image on one type of trial was subtracted from Dwell Time of the other valence image on that type of trial. For example, to compute a Positivity bias on Positive-Neutral trials, average Dwell Time for the Neutral images on the Positive-Neutral trials was subtracted from the average Dwell Time for the Positive images on the same Positive-Neutral trials.

Reliability of eye-tracking measures

To estimate reliability of our attentional measures, we calculated Cronbach's alphas in two ways. First, we calculated one capturing Gaze Biases to the relatively positive image across all trials, $\alpha = .91$, and one capturing Bias Scores to the relatively negative image across all trials, $\alpha = .90$. Second, we calculated one for each Dwell Time measure (before Gaze Biases were calculated; as done in Lazarov, Abend & Bar-Haim, 2016; Skinner et al., 2018). That is, each gaze type (e.g., Negative Dwell Time across Negative-Neutral trials) is treated as a "scale" and each trial (e.g., trial number two out of 12) as an "item." The six Cronbach's alphas are as follows: Negative (in Negative-Neutral trials) α = .85, Negative (in Positive-Negative trials) α = .81, Neutral (in Negative-Neutral trials) α = .82, Neutral (In Positive-Neutral trials) α = .58 , Positive (in Positive-Neutral trials) α = .66, and Positive (in Positive-Negative trials) α = .82. Reliability was generally good, though reliability on the Positive-Neutral trials for both gaze types was low to adequate.

Supplemental Results

No passage group differences in mindfulness or mood

To ensure that the groups who had read three different kinds of passages did not differ in our key measures of interest, we conducted one-way, between subjects ANOVAs to compare the groups on trait mindfulness (MAAS) and on positive and negative affect (both baseline and post-viewing mDES positive affect [PA] and negative affect [NA]). There was no main effect of Passage Group on MAAS (F = .26, p = .768), baseline mDES PA (F = .15, p = .860) or NA (F = 2.10, p = .128), or post-viewing mDES PA (F = 1.41 , p = .249) or NA (F = 1.59 , p = .209). To test whether the groups differed on their gaze biases, three separate one way ANCOVAs were run to compare the groups on the three Gaze Biases (Positive-Neutral, Positive-Negative, and Negative-Neutral). The three Scrambled Image Bias Scores were included as covariates to control for the variance driven by the images' low-level visual features. There was no main effect of Passage Group on any of the three Gaze Biases: neither Positive-Neutral (F = .32, p = .730), Positive-Negative (F = .01, p = .990), or Negative-Neutral (F = .19, p = .826). Although there were no significant differences between the groups on either our self-report measures of interest or our gaze variables, we tested whether controlling for Passage Group influenced results. To do so, Passage Group (Fixed, Malleable, and Control) was coded into three dummy variables (Keppel & Zeddeck, 1989). The pattern of results remains the same whether or not Passage

Groups are also included in the analyses; reported results do not include them.

No relationship between looking and mood

There were no significant correlations between post-viewing mDES PA and Positive-Neutral (r = .18, p = .119), Positive-Negative (r = .16 , p = .141), or Negative-Neutral (r = -.05, p = .636) Gaze Biases; nor between post-viewing mDES NA and Positive-Neutral (r = -.17, p = .113), Positive-Negative (r = -.16, p = .134), or Negative-Neutral (r = .08, p = .475) Gaze Biases. These were partial correlations that controlled for baseline mDES PA and NA and the corresponding Scrambled Image Gaze Bias.

Gaze biases do not mediate the relationship between mindfulness and post-viewing PA

To test whether Gaze Biases mediated the relationship between mindfulness and post-viewing PA, we used the PROCESS macro Version 4.0 (Hayes, 2017) and a Sobel test; with the indirect effect tested using a percentile bootstrap estimation approach with 5000 samples. The regression of MAAS on post-viewing PA, ignoring the mediator of Positive-Neutral Bias, was significant, β = 0.18, t(85) = 2.33, p = .022; and the regression of MAAS on the mediator of Positive-Neutral Bias was significant, β = 5.08, t(85) = 2.59, p = .011. However, the mediation process showed that the mediator, controlling for MAAS, was not significant, β = 0.00, t(84) = 1.01, p = .315. And, the regression of MAAS on post-viewing PA, controlling for Positive-Neutral Bias, was not significant, β = 0.16, t(84) = 1.97, p = .052. Overall, a Sobel test was conducted and found no mediation in the model, z = 0.92, p = .351. The pattern of results is the same testing the mediation of Positive-Negative Bias on the relationship between MAAS and post-viewing PA, and a Sobel test finds no mediation in this model either, z = 0.90, p = .370.

Supplemental Tables and Figures

Table S1.

Sample's Overall Gaze Biases Driven by Semantic Content Alone

	Positivity Bias Positive-Neutral Trials	Positivity Bias Positive-Negative Trials	Negativity Bias Negative-Neutral Trials
Bias (*M*)	**20.61%***	**15.22%***	**-12.02%***
t	13.67	6.74	-5.97
p	**<.001**	**<.001**	**<.001**

Note. * $p<.05$

Table S2.

Regression Coefficients for Predicting the Dependent Variable of Post-Viewing Positive Affect

Independent Variable	*B*	95% CI *LL*	95% CI *UL*	*SE*	β	*t*	*p*
(Constant)	-0.28	-1.16	0.61	0.45		-0.62	.538
MAAS	**0.14**	**0.02**	**0.29**	**0.07**	**.15**	**1.99**	**.050***
Baseline PA	**0.78**	**0.60**	**0.96**	**0.09**	**.66**	**8.71**	**<.001***
Baseline NA	0.10	-0.06	0.27	0.08	.10	1.26	.209

Notes. *N*=99. $R^2 = .461$, $p < .001$. *B* = unstandardized regression coefficient; CI = confidence interval of *B*; SE = standard error of *B*; β = standardized regression coefficient. This model includes MAAS score, and baseline mDES PA and NA.
* indicates p < .05

Table S3.

Regression Coefficients for Predicting the Dependent Variable of Positive-Neutral Gaze Bias

Independent Variable	*B*	95% CI		*SE*	*β*	*t*	*p*
		LL	*UL*				
(Constant)	-24.64	-49.37	.09	12.44		-1.98	.051
MAAS	**5.04**	**1.12**	**8.97**	**1.98**	**.26**	**2.55**	**.012***
Bias for Scrambled Images	0.14	-0.47	0.74	0.31	.05	0.45	.650
Baseline PA	**6.84**	**2.00**	**11.68**	**2.43**	**.28**	**2.81**	**.006***
Baseline NA	1.72	-2.62	6.05	2.18	.08	0.79	.434

Notes. *N*=90. $R^2 = .144$, $p = .008$. *B* = unstandardized regression coefficient; CI = confidence interval of *B*; SE = standard error of *B*; *β* = standardized regression coefficient. This model includes MAAS score, corresponding Scrambled Positive-Neutral Image Bias Score, and baseline mDES PA and NA.
* indicates p < .05

Figure S1.

An Example of a Positive-Neutral Control Trial (i.e., With Phase-Scrambled Images).

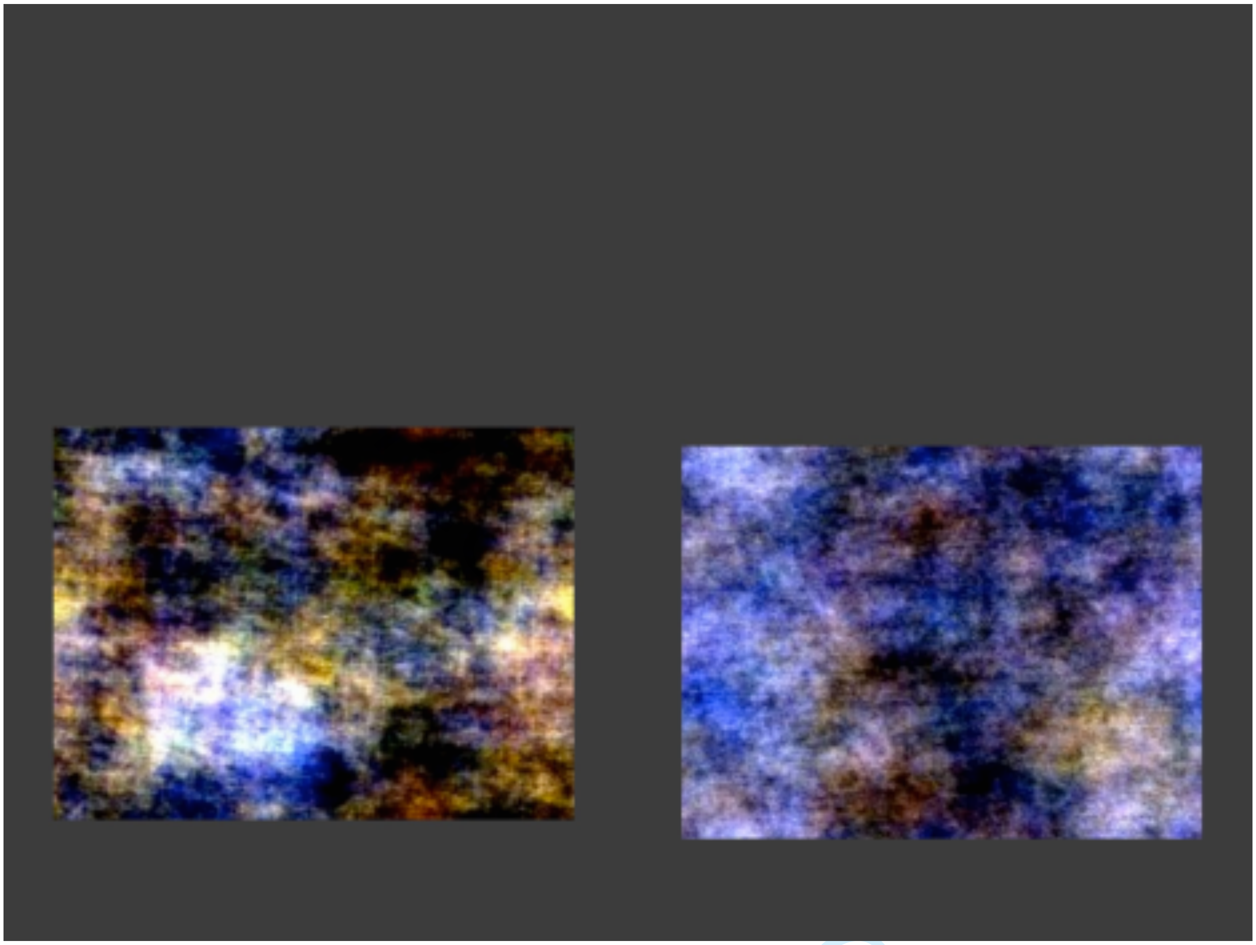
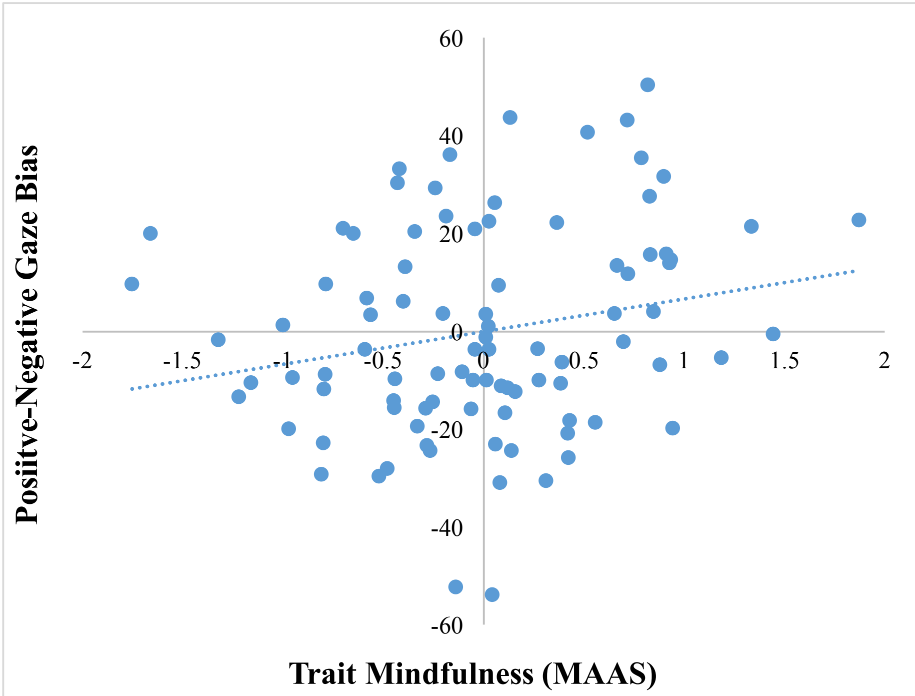


Figure S2.

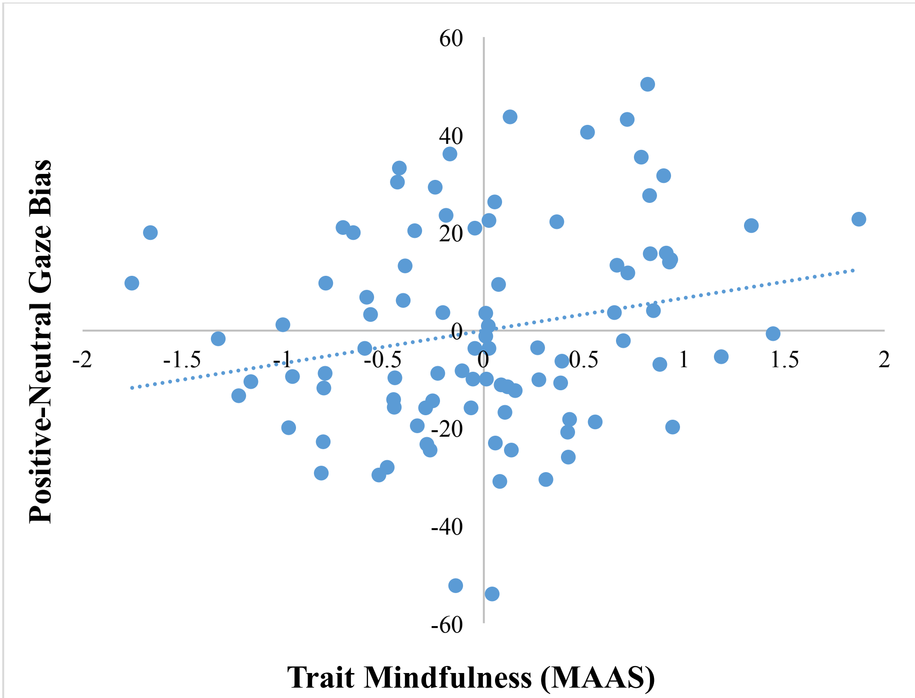
Partial Correlation between Trait Mindfulness and Positive-Negative Gaze Bias



Notes. Aligning with our regression model from Table 1, this partial correlation controls for Baseline PA, Baseline NA, and Scrambled Positive-Negative Image Bias. Scatterplot shows residuals for the measures of interest.

Figure S3.

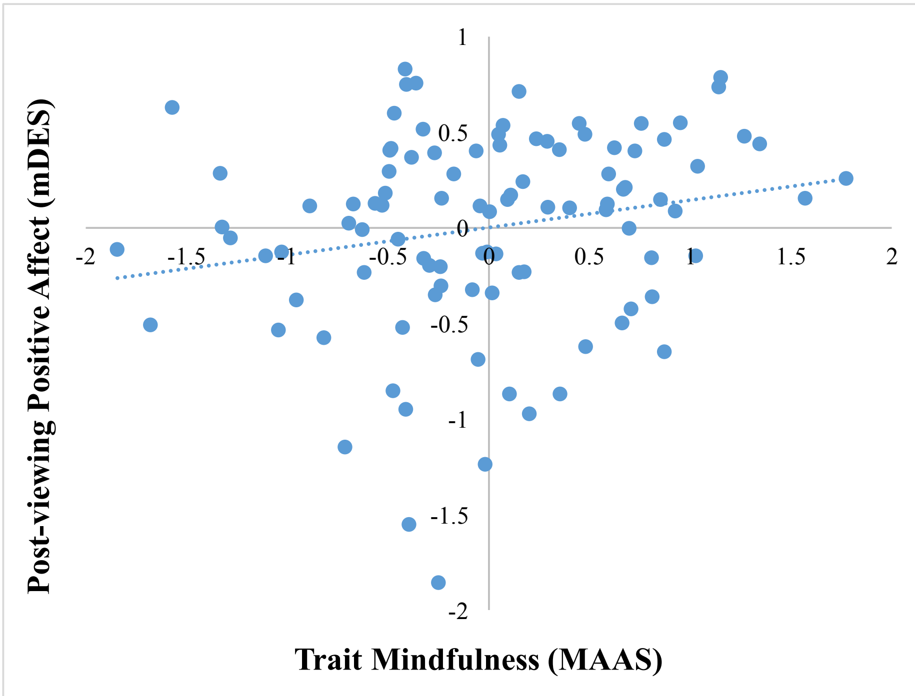
Partial Correlation between Trait Mindfulness and Positive-Neutral Gaze Bias



Notes. Aligning with our regression model from Table S3, this partial correlation controls for Baseline PA, Baseline NA, and Scrambled Positive-Negative Image Bias. Scatterplot shows residuals for the measures of interest.

Figure S4.

Partial Correlation between Trait Mindfulness and Post-viewing Positive Affect



Notes. Aligning with our regression model from Table S2, this partial correlation controls for Baseline PA and Baseline NA. Scatterplot shows residuals for the measures of interest.

Supplemental References

Beckmann, L. (2019). Exposure to family violence and adolescent aggression in multiple social contexts: Classroom social resources as moderators. *Journal of Family Violence*, *35*(5), 471–484. https://doi.org/10.1007/s10896-019-00102-x

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk a new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science*, *6*(1), 3-5.

Caseras, X., Garner, M., Bradley, B. P., & Mogg, K. (2007). Biases in visual orienting to negative and positive scenes in dysphoria: An eye movement study. *Journal of Abnormal Psychology*, *116*(3), 491.

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

Hodes, R. L., Cook, E. W., & Lang, P. J. (1985). Individual differences in autonomic response: Conditioned association or conditioned fear? *Psychophysiology*, *22*(5), 545-560.

Kellough, J. L., Beevers, C. G., Ellis, A. J., & Wells, T. T. (2008). Time course of selective attention in clinically depressed young adults: An eye tracking study. *Behaviour Research and Therapy*, *46*(11), 1238-1243.

Keppel, G., & Zedeck, S. (1989). *Data analysis for research designs*. Macmillan.

Kneeland, E. T., Nolen-Hoeksema, S., Dovidio, J. F., & Gruber, J. (2016). Beliefs about emotion's malleability influence state emotion regulation. Motivation and Emotion, 40(5), 740-749.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2008). International affective picture system (IAPS): Affective ratings of pictures and instruction manual. *Technical Report A-8*.

Lazarov, A., Abend, R., & Bar-Haim, Y. (2016). Social anxiety is related to increased dwell time on socially threatening faces. *Journal of Affective Disorders*, *193*, 282–288. https://doi.org/10.1016/j.jad.2016.01.007

Sears, C., Quigley, L., Fernandez, A., Newman, K., & Dobson, K. (2018). The reliability of attentional biases for emotional images measured using a free-viewing eye-tracking paradigm. *Behavior Research Methods*, *51*(6), 2748–2760. https://doi.org/10.3758/s13428-018-1147-z

Skinner, I. W., Hübscher, M., Moseley, G. L., Lee, H., Wand, B. M., Traeger, A. C., Gustin, S. M., & McAuley, J. H. (2017). The reliability of eyetracking to assess attentional bias to threatening words in healthy individuals. *Behavior Research Methods*, *50*(5), 1778–1792. https://doi.org/10.3758/s13428-017-0946-y

Waechter, S., Nelson, A. L., Wright, C., Hyatt, A., & Oakman, J. (2013). Measuring attentional bias to threat: Reliability of Dot Probe and eye movement indices. *Cognitive Therapy and Research*, *38*(3), 313–333. https://doi.org/10.1007/s10608-013-9588-2

Wiebe, A., Kersting, A., & Suslow, T. (2017). Deployment of attention to emotional pictures varies as a function of externally-oriented thinking: An eye tracking investigation. *Journal of Behavior Therapy and Experimental Psychiatry*, *55*, 1-5.

The mindful gaze: Trait mindful people under an instructed emotion regulation goal selectively attend to positive stimuli

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Abstract

Trait mindfulness confers emotional benefits and encourages skillful emotion regulation, in part because it helps people more deliberately attend to internal experiences and external surroundings. Such heightened attentional control might help skillfully deploy one's attention towards certain kinds of stimuli, which may in turn help regulate emotions, but this remains unknown. Testing how trait mindful people deploy attention when regulating their emotions could help uncover the specific mechanisms of mindfulness that confer its emotional benefits. The present study aimed to determine whether high trait mindfulness is associated with sustained attention biases to (i.e., longer gaze at) emotional scenes, when all participants are given the emotion regulation goal of staying in a positive mood. To measure this, we used eye tracking to assess selective attention to positive, neutral, and negative photographs. Higher trait mindfulness was associated with both a stronger attention bias for positive (vs. neutral and vs. negative) images, as well as greater success staying in a positive mood during viewing. Surprisingly, this attention bias towards the positive images did not mediate the relationship between mindfulness and maintenance of positive mood. Future work should compare visual attention to other emotion regulation strategies that may maximize positive affect for mindful people.

Keywords: mindfulness, attention, eye tracking

The mindful gaze: Trait mindful people under instructed emotion regulation selectively attend to positive stimuli

Mindfulness is characterized by maintaining focus on one's experiences as they unfold in the present moment and by a curious, nonjudgmental stance in response to what is unfolding (Quaglia et al., 2015). It a *state* that can be practiced, for example via mindfulness meditation, and as a *trait* wherein some people are predisposed to be more mindful in daily life (Kiken et al., 2015). This way of living – which emphasizes a sensitive awareness of what is occurring in the moment – is the opposite of moving through the day on "autopilot."

Mindfulness confers many benefits and is theorized to foster emotion regulation. High trait mindful people report greater happiness, lower overall anxiety and sadness, and a more stable mood (Brown & Ryan, 2003; Brown et al., 2007; Cash & Whittingham, 2010). Mindfulness is also relevant to clinical disorders, as it works directly against the automaticity of certain thoughts in psychopathology (Brown et al., 2007).

Despite substantial research on mindfulness, there is still ambiguity surrounding its connection to visual attention to one's environment. This is surprising, as attention is such a core feature of mindfulness. However, little is known about *what* mindful people visually attend to in their environment, particularly regarding emotional stimuli. Perhaps mindful people – because of their attentional predisposition – consume a different "diet" of visual information as they look around the world. And perhaps, since mindful people have better attentional control, they have an easier time using attention-redirection as an emotional regulation strategy.

Attention and Emotion

The ability to effectively direct one's attention is an important skill for regulating emotions. Visual attention selects content for further processing; it has correspondingly been referred to as the gateway to conscious awareness (Raila et al., 2015). Attentional biases to visual information are a critical component of emotion, and one can shape their emotional experience by deploying their attention to certain content (MacLeod et al., 2002; Sheppes et al., 2011).

This is the core of why attention is regarded as a fundamental, early-stage emotion regulation strategy (Gross, 2008). Emotion regulation refers to the many strategies used to amplify, reduce, or maintain an emotion. It is a vital component of mental health, and difficulties with it are associated with various forms of psychopathology (Gross, 2008; Sheppes et al., 2015). Attention's role as an emotion regulation strategy reflects its importance in determining our daily emotional experience.

Trait Mindfulness

The present study investigates correlates of trait mindfulness, or how one naturally attends to the world in a mindful way. It varies naturally across individuals and – though partially innate – can also be improved with mindfulness training (Brown et al., 2007; Quaglia et al., 2015). The trait Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) is frequently used to study mindfulness. Higher scores are correlated with a variety of emotional benefits including less emotional disturbance, lower negative affect and neuroticism, greater life satisfaction, and positive affect (Brown & Ryan, 2003; Quaglia et al., 2015; Wenzel et al., 2015).

Of the two main components of mindfulness, the MAAS is generally believed to capture the present-focused attention component (i.e., attending to the here and now) in particular, rather than the nonjudgmental stance component (i.e., neutral rather than valenced reactions to what is unfolding; Van Dam et al., 2010). Present focus may relate more closely to heightened attentional control (Malinowski, 2013), and whether present focus relates to the content people visually attend to remains an intriguing question.

Mindfulness and Attention.

Attentional control is a person's ability to choose what they pay attention to or ignore – in other words, the ability to concentrate (Loeffler et al., 2019). This ability, and specifically the ability to control attention to *emotional* stimuli, is perhaps unsurprisingly associated with the ability to regulate emotions (Feng et al., 2018; Loeffler et al., 2019). That is, people with better attentional control also seem to be better at regulating their emotions. Attentional control has been closely linked to mindfulness (Jha et al., 2007): mindfulness training improves performance of attentional control (Chambers et al., 2008), and higher *trait* mindfulness predicts greater attentional control (Walsh et al., 2009).

While trait mindfulness is associated with improved attentional control, less is known about whether mindfulness is associated with differences in *what* one attends to in the world – i.e., attention to different information in the environment. Mindfulness-based practices improve people's ability to direct their attention to stimuli deemed more important in the moment (Jha et al., 2017), and thus when people are aiming to stay in a positive mood, being mindful may enable them to direct attention to information that serves that purpose. Coupled with findings that mindfulness interventions reduce attention's negativity and general emotionality bias (Roca & Vazquez, 2020) and reduce attentional capture by emotional stimuli (Eddy et al., 2015), mindful people may deploy attention to emotional stimuli congruent with their emotion regulation goal.

One way of measuring sustained attention is eye tracking, which captures how long people dwell on certain information. Two eye tracking studies found that experienced mindful meditation practice reduced attentional biases to negatively-valenced faces (Blanco et al., 2020; Pavlov et al., 2015). Most relevant to the present study, two other recent eye tracking studies examined associations with trait mindfulness and found conflicting results – with one finding it positively correlated with viewing happy and threatening scenes, but not correlated with viewing sad scenes (Ford et al., 2021), and another finding it negatively correlated with viewing sad and threatening scenes, but not correlated with viewing happy scenes (Kraines et al., 2021). It should be noted that participants in these studies were not necessarily trying to regulate their emotions during image viewing. Overall, the state of evidence is far from clear, and better understanding of *what* mindful people attend to would help understand how mindfulness facilitates emotional benefits.

Maximizing Positive Affect with The Motivated Gaze

Like any emotion regulation strategy, attention may be deployed differently depending on one's emotion goals at the time (Millgram et al., 2019). People often have a goal of experiencing a positive mood, and we can test how emotion regulation strategies function during this goal (Xing & Isaacowitz, 2006). Without such instruction, individuals' emotional goals can vary widely (Sheppes et al., 2011), and it is difficult to parse apart whether differences in attention deployment are due to different emotion regulation approaches or simply different emotional goals at the time.

Previous work on visual attention has shown that gaze is motivated by goals of maintaining positive affect (the "motivated gaze;" Isaacowitz, 2006). For example, participants instructed to focus on managing their emotions gaze less at negative scenes than those told simply to gather information from the scenes (Xing & Isaacowitz, 2006). And, older people motivated to regulate their emotions in a positive direction show gaze preferences for positive stimuli (Isaacowitz et al., 2006). Indeed, a more negative mood in older adults, and thus ostensibly a greater motivation to regulate emotions, is associated with a stronger positivity bias

(Demeyer et al., 2017). Accordingly, given mindful people's awareness of the present moment and strong attentional control, they may be better able to use their gaze in service of maximizing positive affect.

The Current Study

The present study tests whether trait mindful people differentially gaze at emotional content when instructed to maintain a positive mood and if they are in a more positive mood after image viewing. To examine this, we measured selective visual attention to emotional scenes during instructed emotion regulation. Healthy adults viewed image pairs (Positive-Neutral, Positive-Negative, and Negative-Neutral) while their eye movements were tracked. Importantly, all participants were instructed to try to stay in a positive mood during image viewing. Each participant's attention bias for Positive, Neutral, and Negative images on the paired-image trials was computed and correlated with trait mindfulness (measured by the MAAS) while controlling for state affect and the images' low-level visual features. To test whether mindful people more effectively maintained a positive mood during image viewing, post-viewing mood (measured by the mDES) was associated with gaze biases and trait mindfulness.

This study aims to extend previous literature in two important ways. First, to our knowledge, it is the first investigation of the relationship between trait mindfulness and visual attention when all participants were instructed with a shared emotion goal: to maintain a positive mood. By motivating them to maintain a positive mood, participants could then vary in selected strategy, with some using visual attention as a strategy more so than others. Previous research measured how gaze is associated with trait mindfulness during passive viewing and found mixed results (Ford et al., 2021; Kraines et al., 2021). It is important to assess how gaze is allotted under certain emotion regulation goals, because emotion goals impact attention biases (Xing &

Isaacowitz, 2006), and studies have thus sometimes used verbal instruction to create shared emotion goals across participants and *then* measure gaze (van Reekum et al., 2007). Mindfulness practice reduces attentional capture by emotional stimuli (Eddy et al., 2015; Roca & Vasquez, 2020), which possibly makes way for greater influence of the emotion goals of the individual, and accordingly, this study induces a common emotion goal.

Second, this study extends two previous studies of eye tracking to emotional images (Ford et al., 2021; Kraines et al., 2021) by ensuring that low-level visual features (e.g., contrast, luminance) are controlled for. Existing studies (Raila et al., 2015) have found such visual features of emotional images to be confounds, and accounting for them may help uncover why previous studies correlating gaze with trait mindfulness have found conflicting results. Through both of the above, this study aims to clarify existing mixed results about connections between gaze and trait mindfulness.

Methods

Participants

103 young adults (primarily from a university in the northeastern United States) participated. Seventy-nine (76.7%) completed the study in exchange for course credit; the remaining 24 were compensated $10. Two participants were excluded from the analysis due to equipment failure, resulting in a final sample of 101 participants. Sample size was based on an average of typical samples in previous eye tracking studies linking visual attention to trait emotion measures (e.g., Quigley et al., 2012; Raila et al., 2015). Of the sample of 101, ages ranged from 18–27 (M = 19.49; SD = 1.50), and 62 (61%) were female. Self-reported ethnicities were: 41.6% Caucasian/White, 25.7% Asian-American/Asian, 7.9% African-American/Black, 10.9% Latino/Hispanic, 8.9% multiracial, and 5.0% other. Nine of these 101 subjects had

unreliable eye-tracking data (defined as less than 80% of eye data being successfully recorded in the viewing area on more than one-third of the trials; Raila et al., 2015) and were therefore excluded from analyses that included gaze measures. Two others did not complete all self-report measures, and they were therefore excluded from analyses that included the final affect measure. Thus, due to listwise deletion, analyses involving measures of affect but not gaze include 99 subjects, analyses involving measures of gaze but not affect include 92 subjects, and analyses involving both types of measures include 90 subjects.

Stimuli

Eye gaze was tracked as participants viewed images. For eye tracking apparatus details, see supplemental material. On each of 36 experimental trials, participants viewed two images. Twelve trials consisted of a Positive image (e.g., an Olympic medal) paired with a Neutral image (e.g., file cabinets), 12 consisted of a Negative image (e.g., a pile of human bones) paired with a Neutral image, and 12 consisted of a Positive image paired with a Negative image. Each trial had unique images, for a total of 72 experimental images. Two images at a time were presented in counterbalanced locations on a dark gray background (see Figure 1). For details on image placement in eye tracking trials, see supplemental material. Prior to their experimental administration, all images were validated on valence and arousal ratings; for details on validation, see supplemental material.

A phase-scrambled control image was generated for each experimental image. For details on phase scrambling procedure, see supplemental material. When presented during the experiment (see supplementary Figure S1), each phase-scrambled image was always presented in the same position as its experimental counterpart. Thus, they viewed a full set of 36 matched control trials. Overall, each participant viewed 144 total images (72 experimental; 72 phase-scrambled control) across 72 trials (36 experimental; 36 phase-scrambled control).

Measures

Participants completed two measures: the Trait Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) used to capture trait mindfulness, and the modified Discrete Emotion Scale (mDES; Fredrickson et al., 2003) used to capture positive and negative affect. For details on these measures, see supplemental material.

Procedure

Participants were given a heart rate monitor chest strap and told that it would monitor their heart rate and breathing during the study. They were instructed to "try to keep as calm, content, and happy as possible" while viewing the images. They were told that physiological measurements would indicate their mood, though no heart rate or breathing data was actually collected. The inclusion of a sham heart rate monitor was to further motivate this instruction, as participants were told that we could use it to estimate whether they had achieved this emotional goal. The baseline mood measurement was given after the emotion goal instruction, because we did not want mood change caused merely by the instruction alone to be captured within this measure. We were interested in the mood change connected to the *task*, while the instruction was to create a shared emotional goal that may influence cognition and behavior during the task, attempting to control for peoples' otherwise widely differing emotional goals (Sheppes et al., 2011).

Next, participants completed the mDES (Time 1) at a desktop computer. They were then brought to a separate room and seated in front of the eye tracker. They were instructed to view the screen as if they were at home watching television and asked not to wander their gaze around the room. To avoid demand characteristics, we aimed to disguise the study purpose by including a sham task and stating a false study purpose: participants were told that the study was to determine whether eye movements differ between reading an article, viewing simple shapes, and viewing more complex visual scenes. After these instructions, the experimenter closed the door and turned off the lights. The eye tracker was calibrated to each participant using five-point calibration dots. As part of a concomitant study and the sham task, participants first read a passage (for details see supplemental material), and then they completed the sham shape task in which they were shown a series of five slides, each with a different pair of shapes on it.

Next, during the image viewing, participants were shown a series of image slides lasting about nine minutes total. Each slide included a pair of affective images (e.g., Positive-Neutral) or phase-scrambled control images, each shown for 6 seconds. Between each image slide, a slide containing only a fixation cross at the center of the gray background was shown for 1 second. Slide order was randomized for each participant. Once finished with the viewing task, participants completed the second round of self-report measures: the mDES (post-viewing) and MAAS.

Data Reduction and Analyses

For eye-tracking analysis, the two areas of interest (AOIs) on each trial were defined by the boundaries of the two images. Dwell Time was defined as the total time spent fixating and making saccades within a given AOI.

To capture Gaze Biases for one emotional image type relative to the other, the outcome measure of Dwell Time was calculated based on a “difference score” between the two images. For more details on data reduction and analysis, see supplemental material. To illustrate in plain terms, a Positivity bias of +13 on the Positive-Neutral slides would indicate that the participant spent, on average across the Positive-Neutral slides, 13% more of the trial time gazing at Positive images than at Neutral images. Each of these three Gaze Bias Scores (Positive on Positive-Neutral, Positive on Positive-Negative, and Negative on Negative-Neutral) was computed in the same manner for the matched, phase-scrambled control images, for a total of three matched pairs of bias scores, or six total scores – computed for each participant. Reliability of these eye tracking measures was generally good; for details, see supplemental material.

Results

Overall Gaze Preferences

Our first step was to calculate the overall Gaze Biases across our sample. We were interested in attention bias driven by the semantic content of the images, rather than by their low-level visual properties (e.g., luminance), so we removed the variance associated with the scrambled images by computing difference scores between the intact and phase-scrambled images for each participant (see Raila et al., 2015). For example, the Positive-Neutral Bias for a participant is computed by subtracting their Positive-Neutral Bias for phase-scrambled images (itself a difference score, explained above) from their Positive-Neutral Bias for intact images. This directly subtracts out effects of the low-level visual properties of the images and determines the amount of baseline Gaze Bias driven by semantic content.

These difference-of-differences measures – shown in supplementary Table S1 – summarize the looking behavior for the sample as a whole. One-sample t-tests were conducted to determine whether the biases were significantly different from zero. The sample overall showed a Positive Bias on both Positive-Neutral Trials and Positive-Negative Trials, and a Neutral Bias on Negative-Neutral Trials. In other words, participants spent much more time viewing Positive images and far less time viewing Negative images across our sample.

To ensure that the groups who had read three different kinds of passages did not differ in our key measures of interest, we conducted one-way, between subjects ANOVAs to compare the groups. There were no significant differences between the groups on either self-report measures of interest or gaze variables, *F*s < 2.11, *p*s > .127. For details and exact statistics, see supplemental material.

Trait Mindfulness Is Associated with a Gaze Bias for Positive Images

Primary analyses below employ the difference scores described in Method, then statistically control for gaze contributed by the low-level visual features in order to isolate the effects of the semantic content per se.

To determine the relationship between trait mindfulness and selective attention to emotional images during instructed emotion regulation, we conducted three multiple linear regressions predicting each of the three Gaze Biases as dependent variables. We tested whether MAAS score was a predictor, as well as baseline mDES PA and NA (controlling for baseline mood aligns with previous studies that aim to isolate the influence of affect-related traits; Raila et al., 2015) and the corresponding Scrambled Image Bias.

In predicting the Positive-Negative Bias, the contribution of MAAS while controlling for all other factors was significant, $\beta = .22$, $p = .044$. The results of this regression are summarized in Table 1. The zero-order correlation between MAAS and Positive-Negative Bias is also significant without including covariates, $r = .22$, $p = .035$. In predicting the Positive-Neutral Bias, the contribution of MAAS while controlling for all other factors was also significant, $\beta = .26$, $p = .012$. The results of this regression are summarized in supplementary Table S3. The zero-order correlation between MAAS and Positive-Neutral Bias is also significant without including covariates, $r = .25$, $p = .016$. The strength of the partial correlations between MAAS and these Gaze Biases is captured in supplementary Figures S2 and S3. In predicting the

Negative-Neutral Bias, however, the contribution of MAAS was not significant, $\beta = -.19$ $p = .071$, although this result was in a direction that would indicate higher trait mindfulness predicting gaze preference for neutral scenes over negative scenes. Taken together, these results demonstrate that trait mindful people – at least during instructed emotion regulation – gaze longer at positive scenes (over neutral or negative scenes).

Trait Mindfulness Predicts Higher Positive Affect Post-viewing

To test the relationship between trait mindfulness and mood during instructed emotion regulation, we ran multiple linear regressions to predict post-viewing mDES scores (both positive affect [PA] and negative affect [NA]) as dependent variables. First, we looked at MAAS as a predictor of post-viewing mDES PA – with baseline mDES PA and NA also included as predictors – which revealed a significant independent contribution of MAAS, $\beta = .15$, $p = .050$. This regression model is summarized in supplementary Table S2, and the strength of the partial correlation between MAAS and post-viewing PA is captured in supplementary Figure S3. Second, we looked at MAAS as a predictor of post-viewing mDES NA – with the same set of predictors – which found that the independent contribution of MAAS was not significant, $\beta = -.05$, $p = .548$. Overall results indicate that, during instructed emotion regulation, higher trait mindfulness predicts a more positive mood after viewing emotional images.

No Relationship between Looking and Mood

To assess whether Gaze Biases predicted post-viewing mood, six total partial correlations were conducted between each of the three Gaze Biases (Positive-Neutral, Positive-Negative, and Negative-Neutral) and post-viewing mDES PA and NA, while controlling for baseline mDES PA and NA and the corresponding Scrambled Image Bias. No significant correlations were found, rs < |.18|, ps > .113 (for exact statistics, please see supplemental materials), such that unexpectedly, Gaze Biases did not predict post-viewing mood.

Although this result generally precludes a mediation analysis, to be thorough, we next investigated the possibility that Gaze Biases mediated the relationship between mindfulness and post-viewing PA. For details, see supplemental material. Overall, results indicate that Gaze Biases towards positive information did not mediate the relationship between mindfulness and post-viewing PA; that is, there was no indirect effect of mindfulness on mood by way of Gaze Bias. Rather, mindfulness separately predicts positive gaze biases and post-viewing PA.

Trait Mindfulness Interacts with Gaze Biases in Relationship with Post-viewing Mood

To test whether trait mindfulness interacted with the gaze biases in impacting post-viewing mood, we explored possible interactions between MAAS and each of the three Gaze Biases on the two dependent variables of post-viewing PA and NA. To do so, we conducted six multiple linear regression models. Each model had one of the interaction terms that would be relevant to our theory (e.g., MAAS x Positive-Negative gaze), as well as each of these as separate predictors, the corresponding Scrambled Gaze Bias, and baseline PA and NA.

Of these, there were two significant interactions on the dependent variable of post-viewing PA: between mindfulness and Negative-Neutral Gaze, $\beta = 0.91$, $t = 2.12$, $p = .022$, and between mindfulness and Positive-Negative Gaze, $\beta = -1.13$, $t = -2.16$, $p = .034$. No other interactions were significant, $\beta s > 0.44$, $ts < 1.51$, $ps > .134$. That is, for participants who gazed longer at the relatively negative image in a pair, their mindfulness mattered more for predicting their good mood. Put conversely, for those who are more mindful, their viewing bias mattered less for predicting good mood after viewing.

Discussion

Results indicate that trait mindful people – at least during instructed emotion regulation –

attend more to positive (vs. neutral and negative) images and are in a happier mood following image viewing. There was no evidence, however, that their selective attention mediated this relationship between trait mindfulness and happier mood. The lack of a mediation suggests mindful people may maintain their positive mood through another emotion regulation strategy outside of selective visual attention.

Our sample's overall gaze preferences under instructed emotion regulation – a bias toward positive images (vs. neutral and negative) and away from negative images (vs. neutral) – support previous findings. Experimental manipulations have shown that instructed emotion regulation, compared to passive viewing, decreases attention to negative images (Xing & Isaacowitz, 2006). Here, when all participants were under instructed emotion regulation, they demonstrated an attention bias for positive stimuli (though they were not compared to a control). This makes sense, and it suggests people may accurately intuit selective attention as an effective means of emotion regulation, since increasing attention to positive information does boost positive affect (Grafton et al., 2012; Wadlinger & Isaacowitz, 2011). Those who regularly consume a more positive "diet" of visual information may indeed be happier people (Raila et al., 2015).

Trait Mindful People Attend to Positive Info During Instructed to Emotion Regulation

To our knowledge, this is the first study demonstrating a link between trait mindfulness and attention bias to positive stimuli during instructed emotion regulation. Importantly, this relationship was driven by the semantic content of the images rather than their low-level visual features and was independent of state affect.

Previous eye-tracking research has demonstrated links between a positivity bias during naturalistic picture viewing and trait constructs such as happiness, optimism, and old age (Raila et al., 2015; Isaacowitz, 2005; Isaacowitz et al., 2006). The present study adds to this literature by finding that positivity biases were also correlated with trait mindfulness. Studies with higher power may also find that biases in the direction away from negative stimuli (in our study, a trend) are significantly correlated with trait mindfulness, as found in a previous eye tracking study (Kraines et al., 2021).

Though correlational, this finding may reflect the greater capability of mindful people to control their attention to emotional stimuli. People in general alter what they look at when they are trying to feel happy (Xing & Isaacowitz, 2006), and more mindful people may be better equipped to sustain their attention towards certain information as a way to manage their emotions. The *when they are trying to feel happy* component is important, as people may alter their looking behavior differentially depending on their emotion regulation goal at the time; this was the primary study design motivation of instructing all of our participants to have the shared emotion regulation goal. The shared emotion regulation goal may partially explain some contradictory findings between our study and the two previous studies to look at trait mindfulness and eye tracking (i.e., Ford et al., 2021; Kraines et al., 2021), as the participants in those previous studies may have varied in their emotion goals in the lab at the time.

This study makes a methodological contribution by testing attentional biases that partial out the influence of images' low-level visual features to isolate influence due to the images' semantic content. Previous work (Raila et al., 2015) has highlighted that neglecting this type of methodological approach could result in misattributing effects to semantic categories that are really driven by confounded low-level visual features. For example, previous findings in the opposite direction – e.g., that trait mindfulness is connected to biases *towards* negative information (Ford et al., 2021) – may be driven by confounded low-level features.

Research has linked attentional control to both resilience to and treatment for a variety of internalizing disorders (e.g., anxiety: Shi et al., 2019) and to emotion regulation ability (Feng et al., 2018; Loeffler et al., 2019), and attentional control may be a key mechanism through which mindfulness-based treatments work (Chambers et al., 2008). Present results add to this literature by indicating that mindfulness predicts *what* we pay attention to during emotion regulation, which sheds light on the nature of mindfulness' known clinical benefits.

Do Trait Mindful People use Selective Attention to Maximize Positive Affect?

Trait mindfulness, in addition to predicting attention towards positive information, also predicted greater positive affect after image viewing. This suggests that mindful people are better at upregulating their mood when instructed to do so while viewing emotional scenes. Surprisingly, there was no relationship between the attention biases and post-viewing positive affect (which opposes previous findings wherein attention biases for positive stimuli have predicted increased positive affect; Sanchez et al., 2014).

This establishes an intriguing scenario: mindful people spent more time gazing at the positive images – which could indicate mindful people's ability to exert more purposeful attentional control (Garland et al., 2012) – and then were happier after viewing the images, *yet* the relationship between their mindfulness and their ability to stay in a good mood was not mediated by what they were attending to. These results were unexpected, and they provide initial evidence that the benefits to positive affect conferred by mindfulness may be less related to visual attention, and more to another strategy of emotion regulation, such as cognitive change (Gross, 2008), that then keeps them in a good mood throughout the task. In sum, the mechanism linking trait mindfulness to improved positive affect here likely involves the utilization of more than just attention to positive stimuli.

This lack of connection between what participants looked at and how they felt afterwards does align with previous findings that gaze biases are consistently linked with *trait* affect (Raila et al., 2015; Sanchez & Vazquez, 2014), while being indirectly linked with *state* affect. One study found that while both state affect and trait-level well-being predicted positive gaze bias, the effect of state affect in the model was fully mediated by trait-level well-being, reflecting that long-term affect had a more direct influence than state affect (Blanco & Vazquez, 2020). Accordingly, our failure to find gaze as a mediator influencing state affect – albeit unexpected – is perhaps not surprising. Future studies may test whether, instead, gaze biases mediate a relationship between trait mindfulness and trait happiness.

Interestingly, however, there was an interaction between mindfulness and what participants looked at to predict post-viewing mood. Interpreting these results, perhaps more mindful people - able to stay focused on the present moment - are better able to attend to negative information without impacting their mood (even though they overall spend more time gazing at positive information). Meanwhile, less mindful people, whose minds tend to drift away from the present, may be more in need of the comforting benefits of a positive viewing bias.

Limitations

There are several limitations to this study. First, we do not know the degree of effort each subject put in to regulate their emotions and stay in a positive mood. Participants who wanted to be “good subjects" may have been motivated by the instructions to look at certain stimuli, but not because they were trying to feel internally better. Similarly, we acknowledge that because participants’ emotional goals in this study originated from an external source (i.e., task instructions) rather than an internal source (i.e., intrinsically wanting to feel better), this could alter the use of cognitive resources to meet said goals. Future studies may wish to assess the degree of motivation, and self-perceived accomplishment in the attempt to regulate emotions, as other outcomes or covariates.

Second, the present study did not have a control condition to compare instructed emotion regulation vs. a no-instruction condition. Therefore, it remains unknown whether the observed viewing behaviors associated with trait mindfulness occur only under instructed emotion regulation. Future studies may wish to include such a control group.

Third, the MAAS captures one of the fundamental components of mindfulness, present focus, but researchers have argued that it does not capture the second one: nonjudgmental stance (Van Dam et al., 2010). Different kinds of attention biases may correlate with each of these two major components. For example, participants high on the nonjudgmental stance might equally attend to positive, negative, and neutral images, given their less valenced reaction to emotional stimuli. This could explain some differences from the two previous eye tracking studies, which used trait mindfulness questionnaires that also capture the nonjudgmental stance (Ford et al., 2021; Kraines et al., 2021). Future studies may wish to separately examine attention biases associated with present focus and nonjudgmental stance.

Fourth, we naturally cannot control for all potential confounding variables. These include depressive and anxiety symptoms, which may be connected to both mindfulness and mood regulation, and previous experience with mindfulness practice. Participants also likely vary in their use of higher-level emotional regulation strategies such as cognitive reappraisal, which could have been evoked by the instructed emotion goal of staying in a positive mood. As noted earlier, our measure of mindfulness (the MAAS) captures the present-focused attention of mindfulness, while we did not test the nonjudgmental open-minded component.

Future Directions

The results of the present study established that trait mindfulness is correlated with an attention bias for positive images, as well as with higher positive affect after viewing, during instructed emotion regulation. Attention biases did not mediate the relationship between mindfulness and mood, and future studies may wish to employ a larger sample size to detect subtler effects – or a clinical sample (e.g., depression) to examine this in people with a wider range in their emotions.

Naturally, this correlational study cannot determine causality. On the one hand, navigating the world focused on the present moment could encourage one to consume more positive information in any given moment. Conversely, attention to positive stimuli could help maintain trait mindfulness if this "diet" of positive information enables focus on the present. Experimental research using brief inductions of mindfulness could explore whether mindfulness *causes* changes in attention deployment during emotion regulation. Longitudinal data could also evaluate causal relationships between mindfulness and attention to emotional information.

This study is the first look at how trait mindful people allocate their attention during instructed emotion regulation. It contributes to deciphering the mechanisms through which mindful people maximize positive affect, and next steps include determining what other emotion regulatory processes beyond attention allocation may be at play in maintaining this connection.

References

Blanco, I., Roca, P., Duque, A., Pascual, T., & Vazquez, C. (2020). The effects of a 1-month meditation retreat on selective attention towards emotional faces: An eye-tracking study. *Mindfulness 11*(1), 219-229.

Blanco, I., & Vazquez, C. (2021). Integrative well-being leads our attentional system: An eye-tracking study. *Journal of Happiness Studies: An Interdisciplinary Forum on Subjective Well-being*, 22, 787-801.

Brown, K.W., & Ryan, R.M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*(4), 822.

Brown, K.W., Ryan, R.M., & Creswell, J.D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry*, *18*(4), 211-237.

Cash, M., & Whittingham, K. (2010). What facets of mindfulness contribute to psychological well-being and depression, anxious, and stress-related symptomatology? *Mindfulness, 1,* 177-182.

Chambers, R., Lo, B. C.Y., & Allen, N.B. (2008). The impact of intensive mindfulness training on attentional control, cognitive style, and affect. *Cognitive Therapy and Research*, *32*(3), 303-322.

de Bruin, E.I., van der Zwan, J.E., & Bogels, S.M. (2016). A RCT comparing daily mindfulness meditations, biofeedback exercises, and daily physical exercise on attention control, executive functioning, mindful awareness, self-compassion, and worrying in stressed young adults. *Mindfulness, 7*(5), 1182-1192.

Demeyer, I., Sanchez, A., & De Raedt, R. (2017). Older adults' attentional deployment: Differential gaze patterns for different negative mood states. *Journal of Behavior Therapy and Experimental Psychiatry, 55*, 49-56.

Eddy, M. D., Brunye, T.T., Tower-Richardi, S., Mahoney, C.R., & Taylor, H.A. (2015). The effect of a brief mindfulness induction on processing of emotional images: An ERP study. *Frontiers in Psychology, 6*.

Feng, C., Becker, B., Huang, W., Wu, X., Eickhoff, S. B., & Chen, T. (2018). Neural substrates of the emotion-word and emotional counting Stroop tasks in healthy and clinical populations: A meta-analysis of functional brain imaging studies. *NeuroImage, 173*, 258-274.

Ford, C. G., Haliwa, I., & Shook, N. J. (2021). Mind your gaze: Examining the relation between trait mindfulness and visual attention to valenced images. *Behavioural Brain Research*, *401*, 113063. https://doi.org/10.1016/j.bbr.2020.113063

Fredrickson, B.L., Tugade, M.M., Waugh, C.E., & Larkin, G.R. (2003). What good are positive emotions in crisis? A prospective study of resilience and emotions following the terrorist attacks on the United States on September 11th, 2001. *Journal of Personality and Social Psychology*, *84*(2), 365.

Garland, E.L., Farb, N. A.R., Goldin, P., & Fredrickson, B.L. (2015). Mindfulness broadens awareness and builds eudaimonic meaning: A process model of mindful positive emotion regulation. *Psychological Inquiry, 26*(4), 293-314.

Grafton, B., Ang, C., & MacLeod, C. (2012). Always look on the bright side of life: The attentional basis of positive affectivity. *European Journal of Personality, 26*(2), 133–144.

Gross, J. J. (2008). Emotion regulation. Handbook of emotions, 3(3), 497-513.

Isaacowitz, D.M. (2005). The gaze of the optimist. *Personality and Social Psychology Bulletin*, *31*(3), 407-415.

Isaacowitz, D.M. (2006). Motivated gaze: The view from the gazer. *Current Directions in Psychological Science*, *15*(2), 68-72.

Isaacowitz, D.M., Wadlinger, H.A., Goren, D., & Wilson, H.R. (2006). Is there an age-related positivity effect in visual attention? A comparison of two methodologies. *Emotion*, *6*(3), 511.

Jha, A.P., Krompinger, J., & Baime, M.J. (2007). Mindfulness training modifies subsystems of attention. *Cognitive, Affective, & Behavioral Neuroscience*, *7*(2), 109-119.

Kiken, L.G., Garland, E.L., Bluth, K., Palsson, O.S., Gaylord, S.A. (2015). From a state to a trait: Trajectories of state mindfulness in meditation during intervention predict changes in trait mindfulness. *Personality and Individual Differences*, *81*, 41-46.

Kraines, M. A., Kelberer, L. J. A., Krug Marks, C. P., & Wells, T. T. (2021). Trait mindfulness and attention to emotional information: An eye tracking study. *Consciousness and Cognition*, *95*, 103213. https://doi.org/10.1016/j.concog.2021.103213

Loeffler, L.A., Satterthwaite, T.D., Habel, U., Schneider, F., Radke, S., & Derntl, B. (2019). Attention control and its emotion-specific association with cognitive emotion regulation in depression. *Brain Imaging and Behavior, 13*(6), 1766-1779.

MacLeod, C., Rutherford, E., Campbell, L., Ebsworthy, G., & Holker, L. (2002). Selective attention and emotional vulnerability: assessing the causal basis of their association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology*, *111*(1), 107.

Malinowski, P. (2013). Neural mechanisms of attentional control in mindfulness meditation. *Frontiers in Neuroscience*, *7*, 8.

Millgram, Y., Sheppes, G., Kalokerinos, E.K., Kuppens, P., & Tamir, M. (2019). Do the ends dictate the means in emotion regulation? *Journal of Experimental Psychology: General, 148*(1), 80-96.

Pavlov S.V., Korenyok V.V., Reva N.V., Tumyalis A.V., Loktev K.V., & Aftanas L.I. (2015) Effects of long-term meditation practice on attentional biases towards emotional faces: An eye-tracking study. *Cognition and Emotion, 29*(5), 807-815.

Quaglia, J.T., Brown, K.W., Lindsay, E.K., Creswell, J.D., & Goodman, R.J. (2015). From conceptualization to operationalization of mindfulness. *Handbook of Mindfulness*, 151-170.

Quigley, L., Nelson, A.L., Carriere, J., Smilek, D., & Purdon, C. (2012). The effects of trait and state anxiety on attention to emotional images: An eye-tracking study. *Cognition & Emotion, 26(8),* 1390-1411.

Raila, H., Scholl, B.J., & Gruber, J. (2015). Seeing the world through rose-colored glasses: People who are happy and satisfied with life preferentially attend to positive stimuli. *Emotion*, *15*(4), 449.

Roca, P., & Vazquez, C. (2020). Brief meditation trainings improve performance in the emotional attentional blink. *Mindfulness, 11,* 1613-1622.

Sanchez, A., & Vazquez, C. (2014). Looking at the eyes of happiness: Positive emotions mediate the influence of life satisfaction on attention to happy faces. *The Journal of Positive Psychology, 9*(5), 435-448.

Sanchez, A., Vazquez, C., Gomez, D., & Joormann, J. (2014). Gaze-fixation to happy faces predicts mood repair after a negative mood induction. *Emotion, 14*(1), 85-94.

Sheppes, G., Scheibe, S., Suri, G., & Gross, J.J. (2011). Emotion-regulation choice. *Psychological science*, *22*(11), 1391-1396.

Sheppes, G., Suri, G., & Gross, J.J. (2015). Emotion regulation and psychopathology. *Annual review of clinical psychology*, *11*, 379-405.

Shi, R., Sharpe, L., & Abbott, M. (2019). A meta-analysis of the relationship between anxiety and attentional control. *Clinical Psychology Review, 72*, 101754.

Van Dam, N.T., Earleywine, M., & Borders, A. (2010). Measuring mindfulness? An item response theory analysis of the Mindful Attention Awareness Scale. *Personality and Individual Differences, 49*(7), 805-810.

van Reekum, C.M., Johnstone, T., Urry, H.L., Thurow, M.E., Schaefer, H.S., Alexander, A.L., & Davidson, R.J. (2007). Gaze fixations predict brain activation during the voluntary regulation of picture-induced negative affect. *Neuroimage*, *36*, 1041-1055.

Wadlinger, H.A., & Isaacowitz, D.M. (2011). Fixing our focus: Training attention to regulate emotion. *Personality and Social Psychology Review, 15*(1), 75-102.

Walsh, J.J., Balint, M.G., SJ, D.R.S., Fredericksen, L.K., & Madsen, S. (2009). Predicting individual differences in mindfulness: The role of trait anxiety, attachment anxiety and attentional control. *Personality and Individual Differences*, *46*(2), 94-99.

Wenzel, M., von Versen, C., Hirschmuller, S., & Kubiak, T. (2015). Curb your neuroticism–Mindfulness mediates the link between neuroticism and subjective well-being. *Personality and Individual Differences*, *80*, 68-75.

Xing, C., & Isaacowitz, D.M. (2006). Aiming at happiness: How motivation affects attention to and memory for emotional images. *Motivation and Emotion*, *30*(3), 243-250.

Table 1.

Regression Coefficients for Predicting the Dependent Variable of Positive-Negative Gaze Bias

Independent Variable	*B*	95% CI		*SE*	*β*	*t*	*p*
		LL	*UL*				
(Constant)	-24.85	-65.37	15.66	20.38		-1.22	.226
MAAS	**6.68**	**0.17**	**13.18**	**3.27**	**.22**	**2.04**	**.044***
Bias for Scrambled Images	-0.22	-1.31	0.87	0.55	-.04	-0.40	.692
Baseline PA	5.54	-2.35	13.44	3.97	.15	1.39	.167
Baseline NA	-1.12	-8.18	5.95	3.56	-.03	-0.31	.754

Notes. N=90. R^2 *=.073, p* = .155. *B* = unstandardized regression coefficient; CI = confidence interval of *B*; SE = standard error of *B; β* = standardized regression coefficient. This model includes MAAS score, corresponding Scrambled Positive-Negative Image Bias Score, baseline mDES PA and NA, and Group.
* indicates p < .05

Figure 1

An Example of a Positive-Neutral Experimental Trial (i.e., with Intact Images).