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Attentional Biases in Dispositional Mindfulness and Gratitude

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Supplementary Materials: Code, Data [see [Index of Supplementary Materials](#)]



Abstract

Dispositional mindfulness and gratitude are two individual differences suggested to be linked to attentional processes. The present study aimed to assess the presence of attentional biases associated with these two traits. Sixty-one participants completed an emotional dot-probe task while eye movements were recorded. Each of the 96 trials presented one emotional facial expression (fear, surprise, anger, sadness, disgust, or happiness) paired with a neutral face from the same encoder. Attentional biases were measured using dwell time and initial orienting, in addition to traditional probe response times. Results suggested that individuals high in mindfulness responded faster to probes than those low in mindfulness across all conditions, supporting the view that mindfulness enhances attentional control and cognitive flexibility. Moreover, the interaction between dispositional mindfulness and gratitude significantly predicted initial orienting toward sad stimuli, suggesting a moderation effect. Johnson–Neyman analyses suggested that the time taken to first fixate on sadness stimuli significantly increased as one's level of mindfulness increased, but only for individuals with high levels of gratitude. In light of these results, we propose the hypothesis that highly grateful individuals may avoid sad stimuli as a self-preservation strategy and that this tendency becomes more efficient as attentional control improves with mindfulness.

Keywords

gratitude, mindfulness, attentional bias, eye movement, emotional facial expressions



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Highlights

- Attentional underpinnings of mindfulness and gratitude remain unclear.
- This paper explores the effects of mindfulness and gratitude on attentional biases in an emotional dot-probe task.
- The measure of response time to the probe yielded no significant results.
- However, eye tracking data showed that the time of the first fixation on sadness stimuli significantly increased with mindfulness only in those with high gratitude scores.
- We suggest that avoidance of sad stimuli may be a positive mood preservation process of highly grateful individual, which become more effective as mindfulness increases.

Selective attention plays a vital role in filtering the constant stream of stimuli individuals encounter at every moment, and selecting which information to attend to (Broadbent, 1958). When attentional processes systematically favor the processing of certain stimuli to the detriment of other relevant information, researchers refer to an *attentional bias* (Mathews & MacLeod, 1985). Associations between individual differences and attentional biases have been widely studied in contexts such as anxiety (see Valadez et al., 2022 for a review) and depression (see Shamai-Leshem et al., 2022 for a review). With the rise of positive psychology in the early 2000s, research has expanded to positive traits such as optimism (e.g., Isaacowitz, 2005) and empathy (Liu et al., 2022). Two additional traits that have been suggested to influence selective attention, mindfulness and gratitude (e.g., Brown & Ryan, 2003; Wood et al., 2010), are the focus of the present study.

Mindfulness

Mindfulness refers to a way of paying undivided attention to, and being aware of, stimuli that constitute the present moment. Mindful individuals observe these stimuli with curiosity and acceptance, and without any judgment (Baer et al., 2006; Brown & Ryan, 2003; Kang et al., 2013; Langer, 1989). Individual differences exist in the level and frequency of mindfulness experiences; individuals who experience states of mindfulness more frequently in their daily lives are described as having a disposition to mindfulness (Brown & Ryan, 2003).

All models of mindfulness posit an important attentional component to the concept. Langer's (1989) model suggests that mindful individuals have better attentional flexibility, allowing them to shift between different perspectives. Kang et al.'s (2013) model suggests the implication of sustained attention and attentional control, for individuals to maintain and constantly redirect attention to the present moment. Furthermore, it is suggested that the benefits that arise from mindfulness are due, in part, to reduced

automatic processing and behaviours, directly linked to the aforementioned attentional mechanisms (Kang et al., 2013).

However, findings on mindfulness and attention are inconsistent, likely due to methodological differences and varying conceptualizations (Kraines et al., 2021). Two recent studies have found seemingly opposite results regarding the presence of attentional biases related to the mindful disposition (Raila et al., 2024; Williams et al., 2024).

In the first study, Raila et al. (2024) examined the presence of sustained attention biases to emotional scenes as a function of dispositional mindfulness, while participants attempted to maintain a positive mood. Pairs of positive, negative, and neutral images were presented (positive-neutral, negative-neutral, and positive-negative) while eye movements were recorded. Participants completed the modified Discrete Emotion Scale (Fredrickson et al., 2003) before and after the task to assess the emotion regulation component (i.e., staying in a positive mood) and the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) after the task to assess dispositional mindfulness. Their results showed that dispositional mindfulness contributed to a gaze bias towards positive images when paired with a neutral or negative image and higher post-task positive affect. Furthermore, two interactions indicated that, among participants showing a gaze bias toward negative images (i.e., longer viewing time of the negative image of a pair), mindfulness supported the maintenance of positive mood, suggesting a role in emotion regulation. However, Raila et al. (2024) found no evidence that selective attention mediated the relation between dispositional mindfulness and positive mood.

In the second study, Williams et al. (2024) studied predictors of attentional bias to threat beyond trait anxiety. Attentional bias to threat is commonly found in highly anxious individuals (Bar-Haim et al., 2007), and consist of an attentional preference for stimuli that signals a potential danger (i.e., threatening stimuli) over neutral ones (Cisler & Koster, 2010). Participants of this study completed a dot-probe task with emotional faces (i.e., angry, happy and neutral) and a flanker task with threatening and neutral images. Predictors of attentional bias to threat included self-reported attentional control, state and dispositional mindfulness, worry, psychological distress, emotion regulation difficulties, personality traits, and aspects of reward and punishment sensitivity. State mindfulness was assessed with the MAAS (Brown & Ryan, 2003) and dispositional mindfulness with the Five-Facet Mindfulness Questionnaire (Baer et al., 2006). Results showed that the awareness facet of dispositional mindfulness, reward sensitivity and openness to experience explained about 8.6% of variance in attentional bias to threat in the dot-probe task, but none of these variables contributed significant unique variance in the model. Unexpectedly, the relation between these variables and attentional bias to threat was in the opposite direction to that expected: individuals with higher awareness, reward sensitivity and openness to experience scores had greater attentional biases to threat.

Despite their contributions to the question of attentional biases and mindfulness, these two studies have limitations that need to be addressed. First, the inclusion of an

emotion regulation goal without a control group in [Raila et al. \(2024\)](#) makes it hard to disentangle the effects of dispositional mindfulness from the effects of the emotion regulation goal. Secondly, [Williams et al. \(2024\)](#) only included angry, happy and neutral emotional expressions in the dot-probe task, making it impossible to differentiate the presence of attentional bias to threat from a general attentional bias to negative stimuli. Another noteworthy element is that both [Raila et al. \(2024\)](#) and [Williams et al. \(2024\)](#) used the MAAS ([Brown & Ryan, 2003](#)) as a measure of mindfulness, however the former used it as a dispositional measure while the latter used it as a state measure. This further highlights the current inconsistencies within the mindfulness literature.

Gratitude

As with mindfulness, individual differences exist in the intensity and frequency of gratitude experiences; individuals who have a greater tendency to experience states of gratitude can be described as having a higher disposition to gratitude ([McCullough et al., 2002](#)). The disposition to gratitude is commonly defined as an orientation towards noticing and appreciating the positive in life ([Wood et al., 2010](#)), thus implying biases towards positive information.

The positive biases implied within this definition were further described by [Alkozei et al. \(2018\)](#) in the elaboration of their cognitive framework explaining how gratitude contributes to wellbeing. They suggest that individuals with a greater disposition to gratitude have a more positive cognitive style, which involves remembering past events more positively, interpreting negative and neutral stimuli more positively, and attending to positive information more readily. These positive biases are proposed to be responsible for increasing one's sense of wellbeing, and for producing neural and physiological changes that contribute to better physical health ([Alkozei et al., 2018](#)). Supporting this model, [Alkozei et al. \(2019\)](#) found that greater positive interpretation bias of neutral and negative stimuli partially explained the link between dispositional gratitude and lower depressive symptoms.

Aside from [Alkozei et al. \(2018, 2019\)](#), one relevant study that addressed the question of gratitude and attentional bias is the experiment by [Stone et al. \(2022\)](#). These authors studied the effects of a gratitude letter intervention and positive attention bias modification training on the deployment of attention. Participants were prompted to write either a gratitude letter or a letter about their morning routine (control condition) before or after a dot-probe task. During the dot-probe task, participants would see a pair of pictures (one positive and one neutral) before being replaced by a single arrow where one of the pictures previously was. Participants had to identify the direction in which the arrow was pointing regardless of which picture it appeared behind. In the training condition, the arrow would appear behind the positive picture 90% of the time, whereas in the control condition, the arrow would appear behind each picture evenly. To test for attentional biases following the interventions, all participants completed a two-choice

picture attention task comprising pairs of images of different valence (i.e., positive, neutral and negative), while their eye movements were recorded. [Stone et al.'s \(2022\)](#) results suggested that the two interventions increase positive affect, but had unique effects on attentional deployment. The gratitude letter intervention led to a strengthened initial viewing away from, and late viewing towards, emotional stimuli, suggesting attentional biases for emotional content. However, this bias was consistent for both positive and negative emotional stimuli. Furthermore, this effect occurred only when the emotional stimuli was presented in the right visual field.

Although [Stone et al. \(2022\)](#) focused on a gratitude intervention and not the dispositional aspect of gratitude, their results offer interesting insight into the attentional components that arise from gratitude. Nonetheless, more research is needed to replicate and deepen the understanding of the biases found.

Mindfulness and Gratitude

The relationship between mindfulness and gratitude remains unclear, though recent research suggests a positive, likely indirect association ([Sawyer et al., 2022](#); see [Schutte et al., 2021](#) for a meta-analytic review). One hypothesis proposes that higher levels of mindfulness may act as a foundation for individuals to experience more gratitude ([Sawyer et al., 2022](#); [Swickert et al., 2019](#)). As individuals develop mindfulness skills related to awareness and attention, it may become easier for them to start noticing and appreciating positive things that would have otherwise gone unnoticed (e.g., the feeling of the wind on your skin or the sounds of birds in the morning). This hypothesis has gained some preliminary empirical support (e.g., [Sawyer et al., 2022](#); [Schutte et al., 2021](#); [Swickert et al., 2019](#)). However, a gap remains in understanding the core mechanisms of mindfulness and gratitude (i.e., attention and awareness).

Current Study

The current study hopes to extend previous research by investigating the individual and joint effects of dispositional gratitude and dispositional mindfulness on attentional bias towards emotional stimuli. Attention plays a role in navigating between cognition and emotion ([Wilson & Gottman, 1996](#)). As mentioned previously, an attentional bias occurs when a stimulus captures more cognitive resources than expected (e.g., [Bruce & Jones, 2006](#)). To examine attentional biases, we used an emotional dot-probe paradigm ([MacLeod et al., 1986](#)) that included all six emotional facial expressions suggested by [Ekman \(1992\)](#). The dot probe task was developed by [MacLeod et al. \(1986\)](#) to measure attentional biases by dissociating target and distractor components that were typically confounded in other tasks (e.g., Stroop task). If attention is captured by an emotional stimulus, the response to a probe located at the same location would be faster than if it is located at a neutral area.

Gratitude and mindfulness literatures both suggest mechanisms that could be observed in terms of attentional biases; gratitude is said to arise from noticing and appreciating the positive in one's life (Alkozei et al., 2018; Wood et al., 2010), while mindfulness is said to be a way of paying attention to one's surroundings and to foster better attentional control and flexibility (Brown & Ryan, 2003; Kang et al., 2013; Langer, 1989). Given the inconsistencies in results from previous research and the lack of research examining both mindfulness and gratitude together in the context of attention bias, the current experiment is exploratory. As such, no specific hypotheses can be confidently advanced. Instead, the current research is guided by three main research questions:

1. Are there attentional bias differences in the processing of emotional facial expressions between highly and lowly grateful individuals?
2. Are there attentional bias differences in the processing of emotional facial expressions between highly and lowly mindful individuals?
3. How does the interaction between dispositional gratitude and dispositional mindfulness affect attentional bias towards emotional facial expressions?

Method

Participants

Sixty-one students from a French-Canadian university participated in the study (68.9% identified as women). Data was collected over the course of one academic year and represents a convenience sample. A post-hoc power analysis was conducted and suggested that the sample size was adequate to detect effects between .25 and .30 with a significance level of $\alpha = .05$ and a power of .80 for ANOVAs. For regression analyses, the power analysis suggested that the sample size was adequate to detect effects between .15 and .25 with a significance level of $\alpha = .05$ and a power of .80. Participants' ages ranged from 17 to 33 years old ($M = 20.80$, $SD = 3.09$). All participants reported having normal or corrected vision at the time of the experiment.

Materials

Questionnaires

Mindful Attention Awareness Scale — Trait mindfulness was assessed with the French version of the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003; Jermann et al., 2009). The 15-item questionnaire measures individuals' attention and awareness of the present moment on 6-point Likert scales ranging from 1 (Almost always) to 6 (Almost never). In the current sample, the scale's internal consistency was of $\alpha = 0.78$.

Gratitude Questionnaire – Short Form — Trait gratitude was assessed with the French version of the Gratitude Questionnaire – Short Form (GQ-6; McCullough et al., 2002; Shankland & Martin-Krumm, 2012). The six item self-report is designed to assess individual differences in terms of frequency and ways one experiences gratitude in daily life. The responses are assessed on a 7-point Likert-type scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). In the current sample, the scale's internal consistency was of $\alpha = 0.63$.

Eye Tracking Apparatus

Eye movements were recorded using the EyeLink II system. This apparatus consists of two small cameras set under the individuals' eyes and held by a headband. The headband is equipped with an infrared sensor that accounts for head movement. The EyeLink II system was used with default settings which includes a sampling rate of 500Hz and a precision below 0.5 visual angle degrees.

Stimuli

Images used in the current study were taken from the Japanese and Caucasian Facial Expressions of Emotion (JACFEE; Matsumoto & Ekman, 1988). Twenty-four images of emotional facial expressions were selected. The images depict six basic emotions (joy, disgust, fear, surprise, sadness, and anger), each produced by four Caucasian encoders (two males and two females). The 24 emotional stimuli were each paired with a neutral stimulus: an image of the same encoder showing a neutral face. For each of the 24 pairs, the location of the emotional stimulus was counterbalanced so that it would be presented once on the left and once on the right, creating a set of 48 pairs of stimuli. Participants saw the 48 pairs twice, once with the probe replacing the left-side image and once with the probe replacing the right-side image for a total of 96 trials, randomized between participants.

Procedure

General Procedure

All participants began by reading and signing a consent form. After consent was obtained, a research assistant informed the participant that they would be completing one attentional task while we recorded their eye movements, and they would finish participation by filling in two short questionnaires. All participants were debriefed after their participation.

Emotional Dot-Probe Procedure

Participants sat 60 cm away from a 24.5" monitor. Stimuli were presented at a resolution of 600 pixels/inch. After a research assistant installed the eye tracking apparatus, they

proceeded with a 9-point calibration of the system. Then the research assistant would reiterate the following instructions:

“You will be seeing pairs of faces on the screen. The pairs will be presented for 1500ms each. Then, the pair will disappear and be replaced by a single dot on either side of the screen. Your task is to indicate as quickly and as accurately as possible on which side of the screen the dot appears. You can record your answer with the keyboard by pressing either “D” with your left index finger (when the dot appears on the left), or “K” with your right index finger (when the dot appears on the right). This will be repeated 96 times. If you don’t have any questions before we start, you can place your index fingers on the “D” and “K” keys and tell me when you are ready.”

The participants then viewed the 96 pairs of stimuli, while their eye movements were recorded. Pairs were presented one at a time for 1500ms before being replaced by the probe. The probe would appear at the center of where the right or the left image previously was. The probe was displayed until participants provided an answer. Each trial started with the presentation of a fixation cross at the center of the screen to recalibrate the eye tracking apparatus between trials.

Data Analysis

Transparency Statement

The authors wish to be transparent in stating that no components of the current study were pre-registered. All anonymized data files that were used for analyses have been made publicly available through OSF (see [Guitard, 2024](#)).

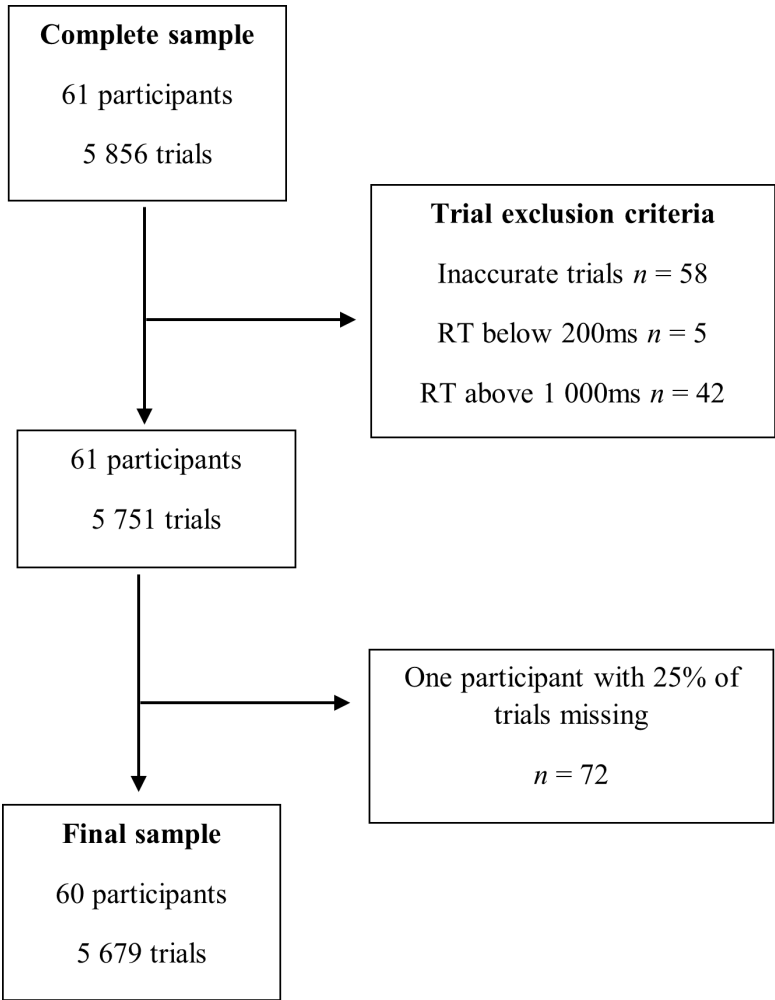
Data Exclusion Procedure

Before proceeding with the analyses, trials were removed according to three exclusion criteria. We first removed inaccurate trials, that is, trials for which the participant gave the wrong answer to the probe. We also removed trials for which the response time was below 200ms, as these likely represented anticipation errors ([Caudek et al., 2017](#)). Trials for which the response time was above 1000ms were also removed based on the threshold chosen by [Kappenman et al. \(2014\)](#). This choice was further verified by examining the data distribution of response times. Finally, we verified that each participant still had enough trials in each condition to be reliably analysed. Upon examination, we noticed that one participant had had 25% of their trials removed from the above-mentioned exclusion criteria (for certain conditions, only 62.5% of the participant’s trials were

usable for analysis). Because of the extent of missing data, the remaining trials from this participant were removed from the dataset. The data exclusion procedure is summarized in Figure 1 below.

Figure 1

Flow Chart Summarizing the Data Exclusion Procedure



Note. *n* = Number of trials removed at each step.

In the end, a grand total of 172 trials (3.02%) were excluded from the analyses, which is comparable to previous studies (e.g., Hilt et al., 2017). The final sample comprised a total

of 5679 trials dispersed across 60 participants (68.3% identifying as women; mean age = 20.82 years old; $SD = 3.11$). In the final sample, internal consistency was of $\alpha = .67$ for the French version of the GQ-6 (Shankland & Martin-Krumm, 2012) and $\alpha = .79$ for the French version of the MAAS (Jermann et al., 2009). Mean gratitude score was 35.98 ($SD = 4.22$) and mean mindfulness score was 3.84 ($SD = 0.64$) for the final sample.

Operationalization of Dependent Variables

Response Time (RT)

RT was measured as the time elapsed (in ms) from the onset of the probe until the participant's key press, indicating their answer. Given that our research objective was to study attentional processes more broadly than through attentional biases only, we chose not to compute attentional bias scores. Instead, we computed participants' mean RT for congruent and incongruent probes, for each of the six studied emotions.

Dwell Time

Dwell time was calculated as the sum of the duration of all fixations on a target area. Each trial comprised two target areas, one being the emotional stimulus and the second, the neutral stimulus. As the stimuli were presented for a predetermined amount of time (1500ms), dwell times were directly comparable between trials and participants. Mean dwell times were computed for both target areas for each of the six studied emotions.

Initial Orienting

Initial orienting was measured as the time elapsed from the beginning of a trial until the first fixation is made onto a target area. Again, the two target areas within each trial were the emotional stimulus and the neutral stimulus. Mean initial orienting was computed for both target areas, for each of the six studied emotions.

Results

The results of the current study are presented by dependent variable in the following order: RT, dwell time, and initial orienting. For ANOVAs pertaining to gratitude, participants' gratitude scores were organized in ascending order and used to split the sample at the median, creating two even dispositional gratitude groups of 30 participants each: a high dispositional gratitude group and a low dispositional gratitude group. The same procedure was used with participants' mindfulness scores to create the high and low mindfulness groups of 30 participants each. Descriptive statistics of questionnaire scores for each group are presented at Table 1.

Table 1
Descriptive Statistics of High and Low Gratitude and Mindfulness Groups

	Group demographics		Questionnaire descriptives			
	Mean age (SD)	Gender (% women)	M	SD	Min	Max
Gratitude						
Low	20.23 (2.46)	63.3%	32.67	3.21	24	36
High	21.40 (3.60)	73.3%	39.30	1.76	36	42
Mindfulness						
Low	21.13 (3.53)	63.3%	3.31	0.33	2.60	3.87
High	20.50 (2.65)	73.3%	4.37	0.39	3.87	5.20

Note. N = 60, n = 30 for each group. Possible gratitude scores range from 6 to 42. Possible mindfulness scores range from 1 to 6.

RT

Descriptive statistics of RT are presented at Table 2 for each group, emotion and probe congruency.

Table 2
Mean RT for High and Low Gratitude Groups and High and Low Mindfulness Groups for Each Studied Emotion and Probe Congruency

	Low gratitude		High gratitude		Low mindfulness		High mindfulness	
	M	SD	M	SD	M	SD	M	SD
Anger								
Cong.	384.97	80.77	395.47	81.15	411.29	73.70	369.16	82.56
Incong.	387.84	62.61	408.73	84.33	415.39	69.57	381.18	76.24
Disgust								
Cong.	379.10	66.94	390.35	77.21	405.78	74.35	363.67	63.73
Incong.	388.40	86.07	398.52	87.39	411.03	85.69	375.89	84.36
Happiness								
Cong.	394.25	68.98	405.14	84.82	421.79	71.76	377.60	76.51
Incong.	396.22	76.31	394.68	90.33	421.67	84.56	369.23	73.56
Fear								
Cong.	396.45	83.33	392.76	87.50	418.12	80.90	371.09	83.17
Incong.	393.42	73.27	390.50	74.37	416.99	68.39	366.94	70.21
Surprise								
Cong.	383.82	73.54	387.12	79.46	409.31	71.13	361.63	74.11
Incong.	390.52	81.51	399.53	81.50	417.58	83.77	372.47	72.50

	Low gratitude		High gratitude		Low mindfulness		High mindfulness	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Sadness								
Cong.	384.68	71.49	391.57	82.91	410.86	78.93	365.40	68.64
Incong.	391.60	68.84	396.99	75.17	414.39	63.30	374.19	74.57

Note. *n* = 30 for each group. Cong. = the probe was congruent to the emotional stimulus. Incong. = the probe was incongruent to the emotional stimulus. All times are in ms.

A 2x2x6 mixed-design analysis of variance (ANOVA) with probe congruency and the emotion present in the trial as within-subject factors, and dispositional gratitude groups as the between-subject factor was computed for RT. The results suggested no significant main effect of dispositional gratitude, $F(1, 58) = .124, p = .726$, of the probe congruency, $F(1, 58) = 3.553, p = .064$, nor of the emotion present, $F(5, 290) = 1.348, p = .244$. All interactions were non-significant (all $F < 1.424, p > .216$).

A second 2x2x6 mixed-design ANOVA with probe congruency and the emotion present in the trial as within-subject factors was computed for RT, this time with dispositional mindfulness groups as the between-subject factor. Results revealed a significant main effect of dispositional mindfulness, $F(1, 58) = 5.852, \eta^2_p = .092, p = .019$, such that participants with high dispositional mindfulness scores were faster to respond to the probe ($M = 370,704$ ms) than participants with lower dispositional mindfulness scores ($M = 414,516$ ms). Main effects of probe congruency and of the emotion present were found to be non-significant, $F(1, 58) = 3.564, p = .064$ and $F(5, 290) = 1.333, p = .250$ respectively. All interactions were found to be non-significant as well (all $F < 1.327, p > .253$).

Next, a series of 12 multiple regressions were conducted to test for the effect of the interaction term between dispositional gratitude and dispositional mindfulness on RT. The interaction term was computed by multiplying participants' gratitude score and mindfulness score together. Regressions were computed for each presented emotion and both probe congruency. As shown in Table 3, the interaction term between dispositional gratitude and dispositional mindfulness did not significantly predict RT in any condition.

Table 3
Standardized Regression Coefficients of the Interaction Term Between Dispositional Gratitude and Dispositional Mindfulness in Predicting Mean RT for Each of the Studied Emotions and Both Probe Congruencies

Emotion	Probe congruency	β	Lower CI	Upper CI	t	p
Anger	Congruent	-1.758	-9.64	6.13	-0.447	0.657
	Incongruent	-5.583	-12.74	1.57	-1.564	0.123
Disgust	Congruent	-2.214	-9.21	4.78	-0.634	0.529
	Incongruent	-2.343	-10.89	6.20	-0.549	0.585
Happiness	Congruent	-4.337	-11.73	3.06	-1.175	0.245
	Incongruent	-5.760	-13.53	2.01	-1.486	0.143
Fear	Congruent	-6.819	-14.87	3.06	-1.696	0.100
	Incongruent	-4.515	-11.30	2.27	-1.332	0.188
Surprise	Congruent	-4.792	-11.99	2.40	-1.334	0.187
	Incongruent	-4.470	-12.25	3.31	-1.150	0.255
Sadness	Congruent	-2.920	-10.37	4.53	-0.785	0.436
	Incongruent	-2.423	-9.41	4.57	-0.694	0.490

Note. $N = 60$, confidence intervals at .95.

Dwell Time

Descriptive statistics of dwell times are presented at Table 4 for each group, emotion and both the emotional and neutral stimuli.

Table 4
Mean Dwell Time for High and Low Gratitude Groups and High and Low Mindfulness Groups for Each Studied Emotion and Both Target Areas

	Low gratitude		High gratitude		Low mindfulness		High mindfulness	
	M	SD	M	SD	M	SD	M	SD
Anger								
Emot.	472.60	136.48	515.61	121.01	501.57	132.01	486.64	129.18
Neut.	451.81	148.51	498.86	130.10	489.68	158.44	460.99	120.82
Disgust								
Emot.	504.63	139.23	540.26	144.65	532.03	147.33	512.87	138.10
Neut.	456.49	138.48	478.03	120.26	478.01	151.78	456.61	102.96
Happiness								
Emot.	511.99	144.08	542.60	138.91	530.42	157.51	524.17	125.34
Neut.	442.69	115.33	489.28	109.87	478.50	121.95	453.47	106.30

	Low gratitude		High gratitude		Low mindfulness		High mindfulness	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Fear								
Emot.	492.12	121.12	529.65	135.24	529.69	112.65	492.08	142.38
Neut.	469.67	126.46	471.05	125.79	490.47	126.48	450.25	122.41
Surprise								
Emot.	500.79	135.64	547.03	141.19	538.85	156.42	508.97	120.46
Neut.	457.51	123.65	475.97	131.97	480.28	127.45	453.20	127.51
Sadness								
Emot.	492.66	144.69	511.71	131.51	515.94	135.79	488.43	139.96
Neut.	459.97	115.84	510.14	122.92	490.33	125.90	479.78	118.00

Note. *N* = 30 for each group. Emot. = the emotional target area. Neut. = the neutral target area. All times are in ms.

A 2x2x6 mixed-design ANOVA with target area and the emotion present in the trial as within-subject factors, and dispositional gratitude groups as the between-subject factor was computed for dwell time. Results revealed a significant main effect of the target area, $F(1, 58) = 21.527, \eta_p^2 = .271, p < .01$, such that all participants spent more time viewing the emotional stimuli ($M = 513.471$ ms) than the neutral stimuli ($M = 471.796$ ms) in all trials. The main effect of dispositional gratitude was non-significant, $F(1, 58) = 1.269, p = .265$, as was the main effect of the emotion presented in the trial, $F(5, 290) = 1.268, p = .278$. Furthermore, none of the interactions were significant (all $F < 2.069, p > .069$).

A second mixed-design ANOVA with target area and the emotion present in the trial as within-subject factors was computed for dwell time using dispositional mindfulness groups as the between-subject factor. Results revealed once again a significant effect of the target area, $F(1, 58) = 21.514, \eta_p^2 = .271, p < .001$. This main effect will not be reinterpreted as it is the same effect found in the previous analysis. The main effect of mindfulness was non-significant, $F(1, 58) = .662, p = .419$, as was the main effect of the emotion presented in the trial, $F(5, 290) = 1.266, p = .279$. Results also suggested no significant interactions (all $F < 2.045, p > .072$).

Next, a series of 12 multiple regressions were conducted to test for the effect of the interaction term between dispositional gratitude and dispositional mindfulness on dwell time. Regressions were computed for each presented emotion and both target areas. As shown in Table 5, the interaction term between dispositional gratitude and dispositional mindfulness did not significantly predict dwell time in any condition.

Table 5

Standardized Regression Coefficients of the Interaction Term Between Dispositional Gratitude and Dispositional Mindfulness in Predicting Mean Dwell Time on the Emotional Target Area and on the Neutral Target Area, for Each of the Studied Emotions

Emotion	Stimulus	β	Lower CI	Upper CI	t	p
Anger	Emotion	-5.012	-17.79	7.76	-0.786	0.435
	Neutral	-9.842	-23.63	3.95	-1.430	0.158
Disgust	Emotion	-10.160	-24.28	3.97	-1.441	0.155
	Neutral	-1.945	-15.05	11.17	-0.297	0.768
Happiness	Emotion	-13.180	-26.90	0.54	-1.924	0.060
	Neutral	-6.644	-17.87	4.58	-1.185	0.241
Fear	Emotion	-3.330	-16.20	9.54	-0.518	0.606
	Neutral	-8.978	-21.41	3.45	-1.447	0.153
Surprise	Emotion	-5.664	-19.55	8.23	-0.817	0.417
	Neutral	-0.354	-13.30	12.59	-0.055	0.957
Sadness	Emotion	-6.736	-20.51	7.04	-0.979	0.332
	Neutral	-6.651	-18.62	5.31	-1.114	0.270

Note. $N = 60$, confidence intervals at .95.

Initial Orienting

Descriptive statistics of initial orienting are presented at Table 6 for each group, emotion and both the emotional and neutral stimuli.

Table 6

Mean Initial Orienting for High and Low Gratitude Groups and High and Low Mindfulness Groups for Each Studied Emotion and Both Target Areas

Emotion	Low gratitude		High gratitude		Low mindfulness		High mindfulness	
	M	SD	M	SD	M	SD	M	SD
Anger								
Emot.	522.22	79.53	533.12	78.51	520.85	69.05	534.49	87.68
Neut.	558.10	87.28	536.30	90.84	534.18	61.13	560.14	108.97
Disgust								
Emot.	516.74	98.06	503.61	93.19	516.34	98.19	504.02	93.12
Neut.	544.05	78.78	544.37	121.40	518.15	83.27	570.27	112.28
Happiness								
Emot.	508.55	89.36	492.30	89.45	499.22	96.24	501.63	82.80
Neut.	574.68	93.79	561.08	104.66	564.91	80.33	570.85	115.65

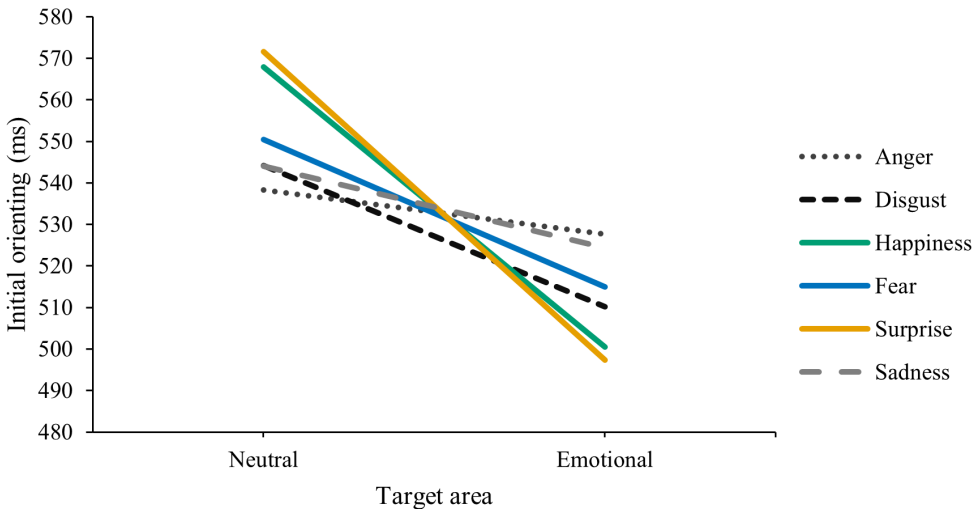
Emotion	Low gratitude		High gratitude		Low mindfulness		High mindfulness	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Fear								
Emot.	518.56	92.56	511.39	90.02	511.45	79.57	518.50	101.69
Neut.	561.50	103.06	557.87	98.48	538.90	76.71	579.84	116.01
Surprise								
Emot.	503.36	86.65	491.37	136.83	510.72	137.45	484.01	83.93
Neut.	574.86	104.80	568.26	103.96	559.39	104.04	583.73	103.36
Sadness								
Emot.	536.62	84.26	512.09	81.29	510.77	61.05	537.94	99.55
Neut.	533.07	114.81	554.83	153.98	555.70	160.39	532.20	105.48

Note. *n* = 30 for each group, except for the low mindfulness group on the neutral stimuli in trials of fear and the high gratitude group on the neutral stimuli in trials of anger where *n* = 29. Emot. = the emotional target area. Neut. = the neutral target area. All times are in ms.

A 2x2x6 mixed-design ANOVA with target area and the emotion presented in the trial as within-subject factors, and dispositional gratitude groups as the between-subject factor was computed for initial orienting. Results revealed no significant main effect of the gratitude group, $F(1, 58) = .416, p = .522$, nor of the emotion, $F(5, 290) = .152, p = .979$. However, results revealed a significant main effect of the target area, $F(1, 58) = 21.222, \eta_p^2 = .268, p < .001$, as well as a significant interaction between the target area and the emotion, $F(5, 290) = 2.401, \eta_p^2 = .040, p = .037$. All other interaction were non-significant (all $F < .946, p > .431$). To better understand the interaction between the target area and the emotion, simple main effect tests were computed. After applying Dunn’s correction to alpha levels, *p* values needed to be smaller than .019 to be considered significant. Simple main effect tests revealed no significant differences in initial orienting between the six studied emotions for the target area containing the neutral stimuli, $F(5, 290) = 2.110, p = .064$, nor for the target area containing the emotional stimuli, $F(5, 290) = 1.768, p = .119$. Furthermore, there were no significant differences in initial orienting between the two target areas in trials presenting the expression of anger, $F(1, 58) = 3.003, p = .088$, disgust, $F(1, 59) = 3.862, p = .054$, and sadness, $F(1, 59) = 1.083, p = .302$. However, significant differences in initial orienting came to light between the two target areas for trials presenting the expressions of happiness, $F(1, 59) = 22.410, \eta_p^2 = .275, p = .000$, fear, $F(1, 58) = 7.343, \eta_p^2 = .112, p = .009$, and surprise, $F(1, 59) = 23.052, \eta_p^2 = .281, p = .000$. For all three significant single main effects, participants were faster to make a first fixation on the emotional stimulus than on the neutral stimulus, as shown in Figure 2.

Figure 2

Simple Main Effects of the Interaction Between the Target Area and the Emotion on Initial Orienting



Note. Full lines represent a significant difference between the neutral and the emotional target area for the associated emotion. Dashed lines represent non significant difference between the two target areas for the associated emotion.

A second 2x2x6 mixed-design ANOVA with target area and the emotion present in the trial as within-subject factors was computed for initial orienting, this time with dispositional mindfulness groups as the between-subject factor. Results revealed a significant main effect of the target area, $F(1, 58) = 22.003$, $\eta_p^2 = .275$, $p < .001$ as well as a significant interaction between the target area and the emotion $F(5, 290) = 2.432$, $\eta_p^2 = .040$, $p = .035$. As these significant effects are the same as those found in the previous analysis, they will not be reinterpreted. No other main effects nor interactions were found to be significant (all $F < 2.135$, $p > .132$).

Next, a series of 12 multiple regressions were conducted to test for the effect of the interaction term between dispositional gratitude and dispositional mindfulness on initial orienting. Results suggested that the interaction term between dispositional gratitude and dispositional mindfulness significantly predicted initial orienting on the target area that contained the emotional stimulus in trials of sadness, indicating a moderation effect (Hayes & Matthes, 2009). All other regressions were non-significant as can be seen in Table 7.

Table 7

Standardized Regression Coefficients of the Interaction Term Between Dispositional Gratitude and Dispositional Mindfulness in Predicting Mean Initial Orienting on the Emotional Stimulus and the Neutral Stimulus, for Each of the Studied Emotions

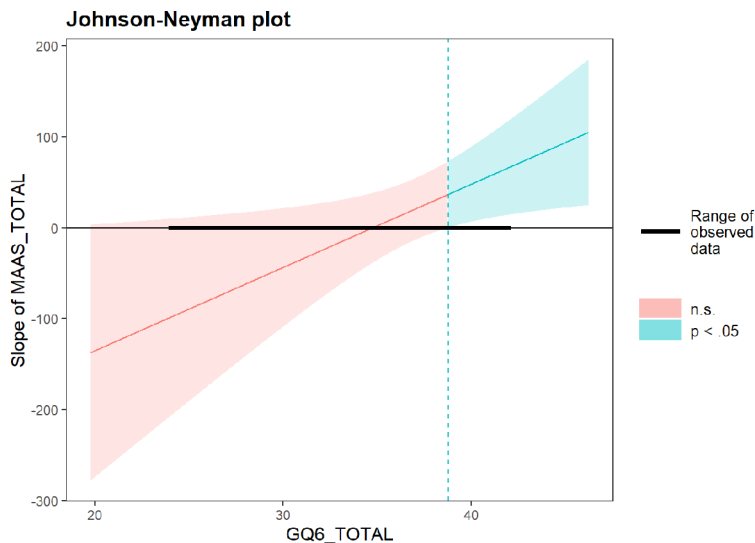
Emotion	Stimulus	β	Lower CI	Upper CI	t	p
Anger	Emotion	2.994	-4.92	10.91	0.758	0.452
	Neutral	4.318	-5.78	11.89	0.784	0.436
Disgust	Emotion	4.234	-5.39	13.85	0.882	0.382
	Neutral	5.673	-3.89	15.23	1.189	0.240
Happiness	Emotion	-1.376	-10.39	7.64	-0.306	0.761
	Neutral	3.475	-6.43	13.38	0.703	0.485
Fear	Emotion	7.194	-1.80	16.19	1.602	0.115
	Neutral	8.003	-2.98	16.40	1.357	0.180
Surprise	Emotion	1.088	-10.46	12.64	0.189	0.851
	Neutral	-1.819	-12.33	8.69	-0.347	0.730
Sadness	Emotion	9.157	1.25	17.06	2.320	0.024
	Neutral	6.438	-7.21	20.09	0.945	0.349

Note. N = 60, confidence intervals at .95. Significant p values are bolded.

The moderation effect was probed using a Johnson-Neyman (J-N) plot with 95% confidence intervals. Compared to the pick-a-point technique (Rogosa, 1980), which shows the variation of the main effect between a predictor and an outcome at a few values of the moderator (usually at the mean and at one standard deviation above and below the mean), the J-N technique has the advantage of showing the full range of the moderator variable for which the main effect between a predictor and an outcome is significant and not significant (Hayes & Matthes, 2009; Lin, 2020). Additionally, the 95% confidence interval around the regression line shows the range of values of the moderator for which the main effect between the predictor and the dependant variable is significant, which provides a more comprehensive picture of the moderation effect (Lin, 2020). As depicted by Figure 3, the J-N analysis suggested that dispositional mindfulness significantly predicted initial orienting on the emotional stimulus in trials of sadness when scores of dispositional gratitude were above 38.77. More precisely, this indicates that the time elapsed before making a first fixation on the emotional stimulus in trials of sadness increased significantly as a function of participants’ dispositional mindfulness score, only when their dispositional gratitude score was above 38.77.

Figure 3

Johnson-Neyman Plot Showing the Size and Significance of the Slope of Dispositional Mindfulness on Initial Orienting to Sad Facial Expressions for the Full Range of Dispositional Gratitude Scores



Note. $N = 60$. MAAS-TOTAL represent the mindfulness score as measured by the French version of the MAAS (Jermann et al., 2009). GQ-6_TOTAL represents the gratitude score as measured by the French version of the GQ-6 (Shankland & Martin-Krumm, 2012). Shaded areas indicate 95% confidence intervals.

Discussion

The current study explored the individual and joint effects of dispositional gratitude and mindfulness on attentional biases to emotional facial expressions during a dot-probe task. Our results suggest that, in general, all participants spent more time looking at the emotional than neutral stimuli, regardless of the emotion presented in the trial. This aligns with prior research showing that emotional content captures visual attention to a greater extent than neutral content (Becker et al., 2017; Calvo et al., 2007) but does not suggest the presence of attentional biases specific to the studied dispositions.

Furthermore, our results suggest that all participants were faster at making a first fixation on the emotional than on the neutral stimuli in trials presenting happy, fearful and surprised facial expressions. As happy, fearful and surprised expressions convey widely different emotional significance and valence (i.e., positive, negative, and undetermined), the emotional significance of these expressions is unlikely to be driving this effect. Instead, upon closer examination of the stimuli used in these three conditions, we believe that the presence of visually salient features could be driving this effect. Prior work shows that certain salient features of emotional facial expressions (i.e., exposure

of teeth, visibility of the eyes' sclera) can capture attention to a greater extent (e.g., Calvo & Nummenmaa, 2008; Leppänen et al., 2008). In our emotional stimuli, happy facial expressions featured smiles with visible teeth, fearful expressions showed widened eyes which exposed the sclera and surprised stimuli presented a large opening of the mouth, all increasing visual saliency relative to the neutral expression. In terms of attentional biases, this result suggests that all participants present attentional biases towards happy, fearful and surprised facial expressions. However, this attentional bias is not specific to grateful or mindful dispositions as it is observed for all participants.

Regarding the classic RT measure of attentional bias used in the dot-probe, we found no evidence that dispositional gratitude or dispositional mindfulness contributes to attentional biases. This is not completely surprising given that our stimuli were presented for 1500ms. According to Bar-Haim et al.'s (2007) meta-analysis, stimuli exposure times are important to consider when assessing attentional bias with RT in the dot-probe task. They found that stimuli presentation times above 1000ms yielded significant threat-related attentional biases in anxious individuals, but that the effect size was small in comparison to shorter presentation times (i.e., 500ms and shorter). Because this study used eye-tracking measures of attentional biases instead of relying solely on RTs, the authors chose the 1500ms presentation time to gather more eye movement information related to attentional biases while understanding that this reduced the likelihood of observing attentional biases with the RT measure.

However, we did find a general effect of the mindful disposition on reaction times to the probe. In the dot-probe paradigm, the response time to the probe is an indicator of attentional disengagement, with shorter response times reflecting a facility to disengage from the last stimulus attended prior to the apparition of the probe (MacLeod et al., 1986). In our study, participants who had a high level of dispositional mindfulness were faster to respond to the probe in all conditions (congruent and incongruent, for all emotional facial expressions) suggesting a generalized facility in disengaging attention, but not an attentional bias. Thus, our results align with empirical (Cásedas et al., 2022) and theoretical (Kang et al., 2013; Langer, 1989) accounts that mindfulness increases cognitive flexibility and attentional control, but do not suggest that mindfulness contributes to attentional biases to emotional facial expressions.

According to Kang et al. (2013), there are four components to mindfulness: awareness, attention, present moment, and acceptance. Each component uniquely contributes to the de-automatization of (usually) automatic processes. In line with our results, the component of attention seems to be of high importance. For Kang et al. (2013), the component of attention refers to the mindful individual's ability to voluntarily direct, and efficiently redirect, their attention onto the continuous stream of internal and external stimuli of the present moment. When an individual is in a state of mindfulness, their attention is usually directed towards goal-relevant stimuli while inhibiting competing stimuli (Kang et al., 2013). Individuals who have high levels of dispositional mindfulness are considered

to experience states of mindfulness more frequently (Brown & Ryan, 2003), meaning that they get more practice in inhibiting and allocating their attentional resources, increasing flexible and voluntary allocation of attention (Kang et al., 2013; Langer, 1989).

Finally, results suggested that the interaction between dispositional gratitude and dispositional mindfulness predicted initial orienting of attention to the facial expression of sadness. More precisely, the analysis showed that, as one's level of dispositional mindfulness increased, the time taken to first fixate on the expression of sadness increased, but only when one's level of dispositional gratitude was above 38.77. To add some context, McCullough et al. (2002) reported that in a sample of 1,224 adults, a score of 38 was at the 50th percentile. Thus, only when one's level of gratitude was high was the effect of mindfulness on initial orienting of attention to sad stimuli significant. Initial orienting mainly reflects vigilance, with faster orienting indicating greater sensitivity to a target stimulus (Posner & Petersen, 1990). In anxiety research, for example, individuals with low anxiety are less likely than highly anxious individuals to fixate first on threat-related facial expressions (angry or fearful faces; Mogg et al., 2007). From an evolutionary perspective, attentional orienting is driven by motivational systems that support protection and survival (Bradley, 2009). In the present study, individuals with higher gratitude may delay looking at sad faces to maintain a positive mood, a response linked to defensive motivational processes (Wegener et al., 1995). As mindfulness increases among highly grateful participants, so does their ability to regulate attention, leading to more effective avoidance of sad expressions, reflected in longer initial orienting times. This effect may not appear for other negative facial expressions because avoiding cues of immediate threat (e.g., fear, anger, disgust) carries greater evolutionary costs than avoiding sadness (Ekman, 1992). Since sad expressions signal less immediate danger, individuals have more flexibility to avoid them in ways that support and preserve positive traits such as gratitude and mindfulness (Isen, 2008).

Limitations and Future Directions

A first limitation to address is the exploratory nature of this research. Exploratory research is often criticized, but necessary when addressing a subject where little is known (Swedberg, 2020), as is the case for attentional biases underlying gratitude and mindfulness. The goal of exploratory research is to advance *a posteriori* hypothesis considering the gathered data rather than testing *a priori* hypothesis. Findings of the current study should therefore be considered paths for future hypotheses rather than definitive conclusions (Swedberg, 2020).

A second limitation concerns potential confounds. One potential confound is between the emotional content and the low-level visual properties of the stimuli. Numerous studies have underscored that emotional facial expressions are often associated with distinct low-level visual characteristics (e.g., contrast, spatial frequency, luminance), which can influence perceptual and neural responses independently of emotional meaning (e.g.,

Hedger et al., 2015; Webb & Hibbard, 2019). The use of naturalistic facial stimuli in the current study prevents full dissociation of these factors. Another potential confound is the higher repetition of neutral stimuli compared to emotional stimuli, which could have affected viewing times. The neutral stimuli may have become less novel due to this repetition, requiring less viewing time. This confound is partially mitigated by using different encoders for the neutral stimuli rather than repeating the same image at every trial. However, the current paradigm does not allow full exclusion of this possibility.

A third limitation concerns the use of a median split to divide the sample into groups based on their gratitude and mindfulness scores. As thoroughly explained by Iacobucci et al. (2015), one common concern of the use of the median split is the loss of variability in the data, which happens when participants who have similar scores (one above or below the median) are classified in different groups (high versus low groups). This type of categorization can thus reduce effect sizes and statistical power, inflating the probability of Type II errors (i.e., not finding an effect that exists). Another, more concerning claim suggested by some authors (e.g., Maxwell & Delaney, 1993) is that using a median split could inflate the probability of Type I errors (i.e., finding an effect that does not exist) therefore creating spurious results. However, Iacobucci et al. (2015) demonstrated, through a series of Monte Carlo simulations, that when only one measured variable is split into high and low groups (in this case gratitude *or* mindfulness) to test for differences across conditions (in this case, the type of emotion, the probe congruency and the target area), this represents a legitimate use of a median split that does not, in itself, create spurious results. Rather, it simply decreases the probability of finding an existing effect by reducing statistical power and effect sizes.

Finally, a fourth limitation regards the measures used in assessing the constructs of dispositional gratitude and mindfulness. There has been some legitimate concern around measurement tools in positive psychology, as noted by van Zyl et al. (2024). In the current study, both constructs were assessed by a single, unifactorial measure: the GQ-6 (McCullough et al., 2002; Shankland & Martin-Krumm, 2012) for gratitude and the MAAS (Brown & Ryan, 2003; Jermann et al., 2009) for mindfulness. A first concern is that both gratitude and mindfulness are likely to be complex multifactorial concepts (e.g., Kang et al., 2013; Morgan et al., 2017). Unifactorial measures might therefore oversimplify and reduce these concepts too much to capture the full extent of the phenomenon.

A second concern over the measurement tools regards the validity and internal consistency. The measures used in the present study were chosen mostly because of their availability in French, the first language of the study participants. For the current sample, the internal consistency of the French version of the GQ-6 (Shankland & Martin-Krumm, 2012) remains questionable with the Cronbach's alpha coefficient being below the typical .70 threshold. This issue was also observed in the original validation of the French translation (Shankland & Martin-Krumm, 2012). Low internal consistency refers to the idea that certain items of the scale do not highly correlate with each other. This can have

various implications, for example, it can lead to an underestimation of the relationship between the construct measured by the scale and other variables (Nunnally & Bernstein, 1994; Schmitt, 1996). Therefore, it is possible that relationships between gratitude and attentional biases towards emotional facial expressions exist in reality, but were not found in the current study due to the low internal consistency of the gratitude measure. Unfortunately, the GQ-6 (McCullough et al., 2002; Shankland & Martin-Krumm, 2012) is currently the only gratitude questionnaire validated in French language.

We strongly recommend that future studies use more than one measure when assessing complex constructs such as gratitude and mindfulness to obtain a more complete picture of individuals' experience and to be able to compare results obtained with different scales. For example, one could assess gratitude with the unidimensional GQ-6 (McCullough et al., 2002) along with a multidimensional measure such as the Multi-Component Gratitude Measure (MCGM; Morgan et al., 2017). As the GQ-6 (McCullough et al., 2002) is more commonly used, it is useful for comparison with previous studies, while the more recent MCGM (Morgan et al., 2017) captures a detailed picture of individuals' gratitude experiences. At the present moment, the MCGM (Morgan et al., 2017) is available in English, Spanish and German. As for mindfulness, researchers could add the multidimensional Five Facets Mindfulness Questionnaire (Baer et al., 2006) to the unidimensional MAAS (Brown & Ryan, 2003). Both of these scales are available in French amongst other languages. Furthermore, we highlight the need for more psychometric work to be done regarding positive psychology questionnaires and French language assessment tools.

It should also be mentioned that the sample was small and might have lacked power. Simulations were computed in the *Superpower* package in R with sample sizes between 10 and 100 participants with the effect sizes obtained within the current study. Simulations suggested that power would have been sufficient (.80) for the within-subject effects with a sample of 24 participants. In the current ANOVAs, within-subject factors were the emotion presented, the target area (the emotional facial expression or the neutral face) and the probe congruency. However, a sufficient power was not quite reached (~.72) for between-subject effects (i.e., the effect of the high/low gratitude groups and high/low mindfulness groups). Thus, either effects are too small or the sample was too small to detect them. While the current study was exploratory and eye movement studies require long individual testing and data extractions, future studies should use larger samples.

Conclusion

Based on the current study, we believe that more research is needed to better understand the impact of positive dispositions on attentional biases. While our results support the idea that mindfulness may increase attentional control and cognitive flexibility, we found no evidence that a mindful or a grateful disposition, on its own, contributes to attentional biases. Instead, we found that a high level of both dispositions, together, might contribute

to attentional biases away from sad facial expressions. As such, we propose the hypothesis that instead of biases towards positive information, gratitude might increase biases away from negative information only when said negative information is nonthreatening from a survival standpoint (i.e., facial expressions of sadness). Mindfulness would contribute to this bias by increasing one's attentional control and cognitive flexibility to better avoid the negative information.

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Author Contributions: *Joline Guitard*—Conceptualization | Methodology | Investigation | Data curation | Writing – original draft | Visualization | Project administration. *Annie Roy-Charland*—Methodology | Supervision | Writing – review & editing | Formal analysis.

Ethics Statement: Before proceeding with the current study, the authors obtained an ethical approval from the *Comité d'éthique de la recherche* of the *Université de Moncton* (project #1819-031). After the ethical approbation was obtained, each participant read and signed an approved informed consent form before their participation.

Use of AI Tools: Linguistic revision of this manuscript was done with the help of AI.

Data Availability: All data and analysis code are available on OSF (see [Guitard, 2024](#)).

Supplementary Materials

For this article, all data and analysis code are available (see [Guitard, 2024](#)).

Index of Supplementary Materials

Guitard, J. (2024). *Attentional biases in dispositional mindfulness and gratitude* [Data, code]. OSF.
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