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To Be Attentive, Do Not React: Linking Dispositional Mindfulness to Attentional Networks and Vigilance Performance

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Abstract

Objectives: Research addressing the relationship between dispositional mindfulness and objective attention performance remains inconclusive, partly because previous studies used sample sizes possibly leading to underpowered designs. Here, we examined this relationship in a large sample using the ANTI-Vea: a novel cognitive-behavioral task that simultaneously assesses the classical attentional networks—phasic alertness, orienting, executive control—and both the executive and arousal components of vigilance.

Methods: Two hundred nineteen meditation-naïve participants completed the study. Correlational analyses using Kendall’s Tau were performed between FFMQ scores and ANTI-Vea outcomes. Additional subsidiary correlations were performed between the FFMQ and two self-report measures assessing subjective attentional control and mind-wandering. Benjamini-Hochberg was applied to control the Type I error rate. The hypotheses and plan of analyses were preregistered at the Open Science Framework.

Results: Higher *non-reactivity* predicted overall faster reaction times and higher accuracy in attentional networks trials. Higher *non-reactivity*, as well as higher FFMQ total score, predicted faster reaction time and fewer lapses in arousal vigilance trials, the latter also being negatively associated with *describe* scores. The magnitude of the correlations ranged from $\tau_b = .103$ to $\tau_b = .119$. We found no association between FFMQ scores and executive control or executive vigilance.

Conclusions: Our results indicate that dispositional mindfulness is linked to improved global attentional and arousal vigilance performance, being non-reactivity to internal experience the key facet driving the association. The absence of association to executive processes is discussed based on the high cognitive demands of the ANTI-Vea task.

Attention is one of the core components of the construct of mindfulness in virtually all theoretical and psychometric models proposed to date (Baer 2019; Brown and Ryan 2003; Bishop et al. 2004; Hölzel et al. 2011; Lutz et al. 2008; Malinowski 2013). Although different conceptualizations of dispositional mindfulness emphasize different particular aspects, most of them generally conceive it as a trait-like (yet modifiable) tendency to (1) attend to present moment experience while (2) having an attitude of acceptance towards it. These two aspects have been termed as the ‘*what*’ (attentional monitoring) and ‘*how*’ (accepting attitude) of mindfulness (Baer 2019). Apart from some exceptions (see, e.g., Levinson et al. 2014), dispositional mindfulness is most commonly assessed through self-report measures, such as the Mindfulness Attention Awareness Scale (MAAS; Brown and Ryan 2003) and the Five Facets Mindfulness Questionnaire (FFMQ; Baer et al. 2006).

While essential to mindfulness, attention is not a simple nor a single neurocognitive process—but rather a complex collection of them (Hommel et al. 2019). In fact, a host of theoretical proposals within Cognitive Psychology and Neuroscience has been advanced in trying to explain such complexity. Among them, one widely renowned proposal is the *attentional networks* model, an integrative framework for human attention initially developed by Michael Posner and collaborators now some 30 years ago (Petersen and Posner 2012; Posner and Petersen 1990).

The attentional networks model divides human attention into three differentiable yet interdependent neurocognitive systems: *alertness*, *orienting*, and *executive control*. The alertness network is composed of the locus coeruleus and the right frontoparietal cortex, and underpins the functions of *phasic alertness* (i.e., the capacity to increase arousal momentarily in response to a sudden event) and *tonic alertness* or *vigilance* (i.e., the capacity to sustain attention for a prolonged period). In turn, the orienting subsystem is implemented in the pulvinar nuclei of the thalamus, the superior colliculus, the frontal eye fields, and the

posterior parietal cortex, and is responsible for the allocation of attention towards potentially relevant locations or sensory modalities. Finally, the executive control network extends mainly over the dorsolateral prefrontal and anterior cingulate cortices, and enables flexible monitoring and control of attention in the adaptation of behavior to long-term goals (Petersen and Posner 2012; Posner and Petersen 1990).

Various cognitive-behavioral tasks have been devised to assess the efficiency of the attentional networks. These include the pioneer and widely used *Attentional Networks Test* (*ANT*; Fan et al. 2002), as well as posterior modifications of this task such as the *ANT for Interactions* (*ANTI*; Callejas et al. 2004). Using an arrows flanker paradigm (Eriksen and Eriksen 1974) that incorporates spatial cues and warning signals, these tasks are well suited to simultaneously evaluate executive control, orienting, and phasic alertness (i.e., the classical attentional networks). However, they are not suitable to evaluate tonic alertness (i.e., vigilance). To assess vigilance, other specific tasks have been developed, in which participants are classically required to remain attentive to detect critical events during extended periods. These assessments include, among others, the *Sustained Attention to Response Task* (*SART*; Robertson et al. 1997), the *Continuous Performance Test* (*CPT*; Conners 2000), or the *Psychomotor Vigilance Task* (*PVT*; Lim and Dinges 2008).

Excitingly, a novel experimental task has been developed in recent years to evaluate both the attentional networks and vigilance, simultaneously: the *ANT for Interactions and Vigilance—executive and arousal components* (*ANTI-Vea*; Luna et al. 2018). This comprehensive experimental assessment, moreover, is built upon the theoretical assumption that vigilance itself may not be a unitary function, but could be comprised of two distinct processes (Oken et al. 2006). While the first process would involve the capacity to maintain an executive control set for target selection of critical events over time (as assessed, e.g., in the *ANTI-V*, *SART*, or *CPT*), the second process would entail the maintenance of a level of

arousal that allows quick response to the environment without exerting much control (as assessed in the PVT). In considering this distinction, the ANTI-Vea thus assesses phasic alertness, orienting, and executive control, while simultaneously tapping into both *executive vigilance* (*EV*) and *arousal vigilance* (*AV*). Furthermore, the task provides two additional measures indexing global attentional performance (i.e., average processing speed and accuracy across all attentional networks conditions). Successfully validated for both laboratory and online testing (Luna et al. 2020), the ANTI-Vea is arguably one of the most comprehensive assessments of the human attention system to date.

Notwithstanding the fundamental role that attentional processes may play in the psychological construct of mindfulness, little research has examined the relationship between objective (sustained) attentional performance (as measured using ANT-related or vigilance tasks) and dispositional mindfulness (as measured by self-report, most commonly the MAAS or FFMQ). To our knowledge, there are ten published studies attempting to do so; and their results show little consistency. This is especially noticeable regarding the classic attentional networks, for which higher self-report dispositional mindfulness has been linked to improved executive control (Ainsworth et al. 2013); to enhanced phasic alertness and reduced orienting (Di Francesco et al. 2017); and to none of the attentional networks or only interactions among them (Jaiswal et al 2018; Sørensen et al. 2018). Regarding vigilance, previous research has found several positive associations between task performance and dispositional mindfulness (Cheyne et al. 2006; Josefsson and Broberg 2011; Lara et al. 2014; Rice and Liu 2017; Schmertz et al. 2009). However, effect sizes differed substantially among studies (from Pearson's $r = .13$ to $r = .51$) and null findings were also reported in nearly all of them (Josefsson et al. 2011; Lara et al. 2014; Rice and Liu 2017; Schmertz et al. 2009). Moreover, one study did not find any association at all (Rahl et al. 2016).

Also of note, most previous studies were relatively small. Excluding one unusually large study ($N = 504$; Cheyne et al. 2006), the average sample size throughout them is 92 participants. While this is already a meritorious sample that may lead to reasonable statistical power in other types of study designs, it may arguably not be sufficient for individual differences (i.e., correlational) research (Schönbrodt and Perugini 2013). This holds especially true considering that most statistically significant findings were found within the small-to-medium size range, i.e., around $r = .20$ (Ainsworth et al. 2013; Cheyne et al. 2006; Di Francesco et al. 2017; Josefsson and Broberg 2011; Rice and Liu 2017). In fact, assuming a correlation of .02 (and setting alpha at .05) the statistical power achieved with a sample of 86 participants is .48 (Faul et al. 2009). Given that low power renders both low probability of observing effects that do exist (i.e., high probability of Type II errors) *and* high probability for observed significant effects to be false positives (Forstmeier et al. 2017), this may be one critical factor explaining the aforementioned pattern of mixed results.

The Present Study

Based on the above considerations, we conducted the present preregistered study (<https://osf.io/gb6c7>) aiming to examine the existence and strength of the relationship between dispositional mindfulness and objective attentional (i.e., phasic alertness, orienting, and executive control) and vigilance performance, while testing a well-powered sample of participants. Particularly, we set out to correlate scores on FFMQ (Baer et al. 2006) with objective performance in the ANTI-Vea (Luna et al. 2018). As compared to other single-scale instruments (such as the MAAS), the FFMQ comprises five sub-scales, thus offering a highly comprehensive assessment of the construct of mindfulness. In turn, the use of the ANTI-Vea allowed us—for the first time in the context of mindfulness research—to assess EV and AV simultaneously and probe a distinction between them. As we expected to

observe effect sizes of around $r = .20$, we aimed to test a sample of at least 200 participants (see *Methods* for details on sample size calculation). As a side goal, we sought to further address the subject by exploring the relationship between dispositional mindfulness and two subjective measures of attention, namely the Attentional Control Scale (ACS; Derryberry and Reed 2002) and the Mind-Wandering Deliberate and Spontaneous scales (MW-D and MW-S; Carriere et al. 2013).

We additionally implemented two features in our study not included in the preregistration. First, given the large number of correlations imposed by the multiplicity of our measures, we corrected for multiple comparisons to reduce the Type I error rate (Benjamini and Hochberg 1995). Second, we took into consideration recent discussions highlighting the criticality of assessing measurement reliability, especially when conducting correlational research (e.g., Dang et al. 2020; Hedge et al. 2018; Parsons et al. 2019). In short, as any observed correlation is constrained by the reliability of the measures used to obtain it (so that *Sample correlation* = '*True*' *correlation* $\times \sqrt{\text{Reliability}(x) \times \text{Reliability}(y)}$; Dang et al. 2020), without reliability estimates it is not possible to ascertain whether the size of a given correlation reflects the actual shared variance or is rather a byproduct of measurement error. Consequently, we computed internal consistency reliability indices for all used measures and factored them into the interpretation of our correlational results.

Concerning the study hypotheses, despite the paucity and relatively low consistency of studies on dispositional mindfulness and the attentional networks, related mindfulness training research appears more abundant and cohesive and may serve as a guide. In this regard, two independent reviews conclude that mindfulness meditation training likely improves the executive control network (while evidence for alerting and orienting networks remains less conclusive; Prakash et al. 2020; Tang et al. 2015). Accordingly, we

hypothesized a positive association between FFMQ scores and executive control network efficiency. Regarding vigilance, as discussed, most previous studies found at least one positive association with dispositional mindfulness. Of note, however, all such studies used SART or CPT tasks, thus addressing EV (one of them also included an AV measure, the PVT, but it was not reported to correlate to dispositional mindfulness; Lara et al. 2014). Therefore, we hypothesized higher FFMQ scores to predict improved EV performance. Finally, classic theoretical accounts on mindfulness and cognition posit a general improvement of the attentional regulatory capacity (apart from that of specific sub-functions) as related to mindfulness and meditation practice (e.g., Lutz et al 2008; Malinowski et al. 2013). Accordingly, we hypothesized higher FFMQ scores to be associated with better global attentional performance (i.e., with overall faster processing speed and lower error rate) in the ANTI-Vea.

Methods

Participants

As detailed in our preregistered study protocol (<https://osf.io/gb6c7>), G*Power 3.1 (Faul et al. 2009) was used to estimate the sample size needed given our study design. We expected some of the effects under investigation to be around $r = .20$, as found in several previous studies correlating self-report dispositional mindfulness and cognitive-behavioral tasks assessing attentional networks or vigilance (e.g., Ainsworth et al. 2013; Cheyne et al. 2006; Di Francesco et al. 2017; Josefsson and Broberg 2011; Rice and Liu 2017). In order to detect a two-tailed Pearson correlation of .20, setting the significance level at .05 and the statistical power at .80, the estimated sample size needed in our study was 193 participants. Based on this *a priori* calculation, we aimed at recruiting a sample of at least 200 participants (after exclusions).

Three hundred ninety-eight volunteers were initially recruited and took part in the data collection phase of this study. They were invited using the institutional e-mail distribution lists of the University of Granada and participated in exchange of course credit (in case they were undergraduate Psychology students) or monetary compensation (in case they were students from other programs or university staff). Of them, we selected those who met a prespecified, exhaustive set of inclusion criteria aimed to standardize the sample and to remove confounding variables that could potentially affect our data. In particular, it was required that participants: (1) were aged between 18 and 35 years; (2) had normal or corrected-to-normal vision and hearing; (3) had not suffered any psychiatric or neurologic disorders (anxiety and depression were only excluded when under pharmacological treatment), stroke, or diabetes; and (4) had no history of chronic use of psychoactive medication, drugs abuse, or alcoholism. Moreover, aiming to control for artifacts derived from a biased interpretation of self-report items, participants (5) had to be naïve to mindfulness-related meditation practices, and (6) their native language had to be Spanish. Lastly, (7) they had to meet the standard criteria of performance on the ANTI-Vea task (details below). A total of 219 participants (aged between 18 and 34 years; mean age = 23.37; $SD = 3.64$; 68.49% female) met these seven criteria and were included in the study.

All participants gave informant consent prior to data collection. This study was part of a larger research project (PSI2017-84926-P) that received approval from the University of Granada Ethical Committee (536/CEIH/2018) and was conducted according to the ethical principles established by the 1964 Declaration of Helsinki.

Procedure

Participants were reached through e-mail. By following a link, they could access the first part of the study that consisted of an online survey hosted on LimeSurvey (<http://www.limesurvey.org>). Once accessed, and prior to starting the experimental

procedure, participants received basic information about the study and gave informed consent. Next, they were presented with an eligibility battery comprised of sociodemographic, health-related, and lifestyle questions. Next, participants completed the FFMQ (Cebolla et al. 2012), the ACS (Derryberry and Reed 2002), as well as the MW-S and MW-D (Carriere et al. 2013) scales. By the end of the survey, participants were invited to follow another link to the webpage hosting the ANTI-Vea (<https://www.ugr.es/~neurocog/ANTI/>).

At the ANTI-Vea webpage, and before beginning with the task, participants were encouraged to reduce any possible distractions from then onwards. A message also warned them that the task would be displayed full-screen and that it was important to perform the entire procedure with no interruptions. Additionally, they were asked to configure the computer's sound level at 75%, use no headphones, and turn off the sound and vibration function on their mobile phone. They were also encouraged to keep the phone out of reach until the end of the task. Moreover, they were asked to turn off any entertainment device, such as television, radio, or music players. Immediately before starting the ANTI-Vea, participants were invited to take a break if it was needed for any particular reason and were encouraged to remain seated thereafter until completion of the task.

The ANTI-Vea comprises three types of trials: ANTI (measuring the attentional networks; 60%), EV (measuring executive vigilance; 20%), and AV (measuring arousal vigilance; 20%). In ANTI trials, participants performed a flanker task that was sometimes preceded by a warning tone and or a visual cue (or both), in order to assess phasic alertness (no tone minus tone condition), orienting (invalid minus valid cue condition), and executive control (incongruent minus congruent condition). In EV trials, the target (central arrow) was upwardly or downwardly displaced, and participants had to detect this minor change. In AV trials, a red millisecond countdown was presented, which participants were

instructed to stop as fast as possible. For a schematic representation of the ANTI-Vea task procedure in each trial type, see Fig. 1 (a detailed description of the procedure is provided in Supplementary Material S1). The ANTI-Vea started with a practice phase, in which instructions were given so that participants could gradually familiarize themselves with each type of trial. Next, six blocks of 80 randomized trials each (48 ANTI, 16 EV, and 16 AV) were presented, without any break, as the actual experimental task. Participants were encouraged to respond as quickly and accurately as possible while keeping their eyes on the fixation cross until the finalization of the task.

Fig 1. Visual representation of the ANTI-Vea task procedure. (a) Stimuli sequence for ANTI and EV trials, during which participants had either to respond to the direction pointed by the central arrow or to detect its vertical displacement, respectively. (b) Stimuli sequence for AV trials, during which participants had to stop the red countdown as fast as possible. (c) Examples of the three visual cue conditions for the assessment of the orienting network. (d) Correct responses for each type of trial.

Measures

Five Facets Mindfulness Questionnaire Our primary self-report measure was the Spanish version of the FFMQ (Cebolla et al. 2012), a 39-item scale assessing five component factors of mindfulness. (1) Observing (hereafter referred to as *Observe*) regards attending to and noticing internal and external experiences such as sensations, emotions, and thoughts. (2) Describing (*Describe*) refers to labeling internal experiences, especially emotions, with words. (3) Acting with awareness (*Actaware*) is defined as the capacity to being focused on present-moment activities as opposed to behaving reflexively or getting distracted. (4) Non-judging of inner experience (*Nonjudge*) refers to adopting a non-evaluative attitude toward thoughts and feelings. And (5) non-reactivity to inner experience (*Nonreact*) regards experiencing thoughts and feelings without reflexively responding nor being caught up by them. FFMQ items are rated on a 5-point Likert scale ranging from one (*never or very rarely true*) to five (*very often or always true*). The FFMQ has previously shown adequate reliability, with internal consistency indices ranging from $\alpha = .80$ to $\alpha = .91$ (Cebolla et al., 2012). The reliability of the instrument in our study was similar to that found on previous research, yielding estimates of internal consistency ranging from $\alpha = .75$ to $\alpha = .92$ (Observe: $\alpha = .75$; Describe: $\alpha = .92$; Actaware: $\alpha = .88$; Nonjudge: $\alpha = .91$; Nonreact: $\alpha = .75$; Total score: $\alpha = .87$). The items of the Spanish version of the FFMQ are provided as Supplementary Material S2.

Attentional Control Scale Participants additionally completed the Spanish translation of the ACS (Derryberry and Reed 2002). The ACS comprises 20 items assessing general everyday attentional control ability. Items are rated on a 4-point Likert scale from one (*almost never*) to four (*always*). The ACS has previously demonstrated adequate reliability ($\alpha = .88$; Derryberry and Reed 2002). In the present study, the internal consistency of the

instrument was $\alpha = .85$. The items of the Spanish translation of the ACS are provided as Supplementary Material S3.

Mind-Wandering Deliberate and Spontaneous Scales As the last self-report measure, participants completed the Spanish translation of the MW-D and MW-S (Carriere et al. 2013). The MW-D and MW-S comprise four items each and assess everyday tendencies to engage in task-unrelated thought or mind-wandering either voluntarily or involuntarily, respectively (Carriere et al. 2013). Items are scored on a 7-point Likert scale from one (*rarely*) to seven (*a lot*) except for the third item of the MW-S (1 = *almost never* to 7 = *almost always*) and the third item of the MW-D (1 = *not at all true* to 7 = *very true*). Both scales have previously shown adequate reliability (MW-D: $\alpha = .84$, MW-S: $\alpha = .83$; Carriere et al. 2013). In our study, the MW-D and MW-S showed similar internal consistency estimates of $\alpha = .86$ and $\alpha = .81$, respectively. The items of the Spanish translation of the MW-D and MW-S scales are provided as Supplementary Material S4.

ANTI-Vea Task Cognitive-behavioral attentional and vigilance data were collected using the online version of the ANTI-Vea (Luna et al. 2018), which is available for free use in multiple languages at <https://www.ugr.es/~neurocog/ANTI/>. The stimuli characteristics for each trial type are depicted in Fig. 1 (further technical specifications are provided in Supplementary Material S1). The ANTI-Vea has recently been validated for both in-lab and online testing (Luna et al. 2020). As demonstrated by Luna et al. (2020), there are no substantial differences between the data collected by each version of the task. Moreover, in both cases, the ANTI-Vea: (1) demonstrated to be at least as reliable as previous versions of the task such as the classic ANT for the assessment of the attentional networks; while (2) demonstrated high reliability for assessing the executive and arousal components of vigilance. In order to ascertain the reliability of the ANTI-Vea for this study, we computed split-half internal consistency estimates of the task based on our collected data. Given that

they entail a large number of indices and require a particular methodology to be obtained, we report them in the *Results* section. The statistical procedure followed to compute them is described in the *Data Analysis* section.

Data Analysis

ANTI-Vea Analysis Following standard analysis of the ANTI-Vea task (Luna et al. in press) and as indicated in our preregistered study protocol (<https://osf.io/gb6c7>), reaction time (RT) analysis in ANTI trials excluded incorrect responses or trials with RT below 200 ms or above 1500 ms. Data from participants with an error rate larger than 25% or with extreme average RT (± 2.5 standard deviations [SD] from the group mean) were also excluded. Additionally, we removed participants with extremely low hit rate or extremely high lapse rate (± 2.5 SD from the group mean), as such rates were interpreted not as just poor performance but as indicative of participants not being actually engaged in the task. Since it has been previously shown that four blocks are sufficient to reliably measure the attentional networks and to detect decrements changes in sustained attention (Román-Caballero et al. 2020), participants were included in the analysis if they had performed the task at least until the end of the fourth experimental block.

Once the data were preprocessed, separate analyses were conducted for ANTI, EV, and AV trials. For ANTI trials, we computed: (1) the mean RT and percentage of errors (as global indices of attentional performance); and the efficiency indices for (2) phasic alertness (no tone minus tone, in no cue trials), (3) orienting (invalid minus valid trials), and (4) executive control (incongruent minus congruent trials) using both RTs and percentage of errors. For EV trials, we computed the following measures: (1) hits (correctly identified vertically displaced target); (2) false alarms (non-displaced target assessed as being vertically displaced); (3) A' (sensitivity); and (4) B'' (response bias). For each of them, we obtained both *overall* indices (i.e., average measures throughout the task) and *decrement slope* indices

(i.e., measures of the extent of their change across blocks). Lastly, regarding AV trials, we computed both overall indices and decrement slopes for (1) mean RT, (2) SD of RTs, and (3) percentage of lapses (defined as the percentage of AV trials with responses >600 ms or with no response).

Correlational Analysis Correlational analyses were conducted (1) between FFMQ and the indices computed from ANTI, EV, and AV trials, and (2) between FFMQ and the ACS, MW-S, and MW-D scales. First, the assumption of normality was tested by using Shapiro-Wilk (Shapiro et al. 1968). Given that virtually none of the pairs of variables of interest were bivariate normally distributed, we used Kendall's Tau for analysis, as it is considered the most robust correlation coefficient in cases of non-parametric data (Croux and Dehon 2010). Note that the interpretation of Kendall's Tau magnitude differs from that of Pearson's r . While values of .10, .30, and .50 are commonly considered as small, medium, and large Pearson correlations, the equivalent values for Kendall correlation are .07, .20, and .35, respectively (for a table of conversion among correlation coefficients, see Gilpin 1993).

One-tailed correlations were applied to contrasts for which we had preregistered directional hypotheses (i.e., regarding executive control, executive vigilance, and global attentional performance). In particular, we applied one-tailed tests for positive correlations to variables indexing good performance (hits and A') or that decrease over time in task (hits slope, A' slope, FA slope); conversely, we applied one-tailed tests for negative correlations to variables indexing poor performance (interference control effect, FAs, overall RT, overall percentage of errors) or that increase over time in task (B'' slope). Two-tailed correlations were conducted for all remaining contrasts. Alpha (significance level) was set at .05. Finally, Benjamini-Hochberg correction for multiple comparisons was applied (Benjamini and Hochberg 1995) setting the FDR at .20 (McDonald 2014). We used JASP

0.13.1 (JASP Team 2020) to conduct the correlations and Jamovi 1.1.9 (Jamovi Project 2020) to generate the corresponding scatter plots.

Reliability Analyses As mentioned above, we set out to further inform our correlational results by computing internal consistency reliability estimates of the measures used for analysis. For self-report assessments, we obtained standard Cronbach's alpha coefficients (Tavakol and Dennick 2011). Regarding the ANTI-Vea, we computed 10,000-iterations permutation-based split-half reliability indices with Spearman-Brown correction, for both overall and decrement slope assessments. The rationale of the split-half reliability method has been described by Parsons et al. (2019), while its procedure as applied to the ANTI-Vea task has been detailed by Luna et al. (2020). The analysis was conducted in RStudio 1.1.463 (RStudio Team 2020). The script used was adapted from the original version by Luna et al. (2020) and is available at the Open Science Framework (<https://osf.io/374rs/>).

Results

Attentional Networks and Vigilance

Descriptive statistics and split-half reliability indices for ANTI, EV, and AV outcomes are provided in Table 1. As shown, the task yielded indices in line with those reported by Luna et al. (2020) regarding both the attentional and vigilance measurements and their reliability estimates. In turn, our main research outcomes are summarized in Table 2, where correlations between FFMQ scores and ANTI, EV, and AV outcomes are reported. For the sake of simplicity, herein we only report *p*-values of significant findings. *P*-values obtained for all significant and non-significant comparisons performed between FFMQ scores and ANTI, EV, and AV outcomes are provided as Supplementary Material S5.

Table 1 *Descriptive Statistics and Split-Half Reliability Indices (Spearman-Brown corrected) of ANTI-Vea Outcomes*

	<i>M</i>	<i>SD</i>	<i>r</i> _{SB}
Attentional Networks			
RT Overall	629	85	.99
% Errors Overall	6.01	4.51	.91
RT Alerting	43	41	.45
% Errors Alerting	1.30	4.56	.24
RT Orienting	45	27	.40
% Errors Orienting	0.14	3.71	.22
RT Control	38	28	.64
% Errors Control	0.01	3.71	.51
Executive Vigilance			
% Hits	80.40	12.83	.91
% Hits Slope	−1.79	3.22	.58
% FAs	6.84	6.04	.78
% FAs Slope	−0.37	2.16	.21
A'	.93	.04	.84
A' Slope	−.004	.01	.45
B''	.41	.43	.80
B'' Slope	.05	.16	.06
Arousal Vigilance			
RT Mean	490	55	.96
RT Mean Slope	5.44	10.74	.65
% Lapses	9.49	12.79	.96
% Lapses Slope	1.54	3.14	.81
SD of RT	78.27	26.71	.71
SD of RT Slope	4.03	9.59	.65

Note. M = Mean; SD = Standard deviation; *r*_{SB} = Split-half reliability (Spearman-Brown corrected); RT = Reaction time; FA = False alarm.

The reliability of the ANTI outcomes ranged from *r*_{SB} = .22 to *r*_{SB} = .99, with the global indices of attention demonstrating higher reliability (*r*_{SB} = .91 to *r*_{SB} = .99) than the efficiency scores (*r*_{SB} = .22 to *r*_{SB} = .64; see Table 1). We found seven correlations between

FFMQ and attentional networks outcomes, of which two remained significant after Benjamini-Hochberg correction for multiple comparisons (see Table 2). In particular, scores on Nonreact facet were negatively associated to overall RTs, $\tau_b = -.118, p = .006$, and percentage of errors, $\tau_b = -.118, p = .006$, in ANTI trials (see also Fig. 2). In line with our hypotheses, these results indicate that participants with higher self-report dispositional mindfulness—particularly those less predisposed to react reflexively to negative thoughts and emotions—showed better global attentional performance as indexed by faster and more accurate responses to the task.

Fig. 2 Main correlational results of the study. Scatter plot and correlation between Nonreact score and (a) mean RT across ANTI trials; (b) mean error rate across ANTI trials; (c) RT in AV trials; and (d) lapses rate in AV trials. Correlations estimated using Kendall's Tau coefficient. Reported p -values are after applying Benjamini-Hochberg procedure. Shading represents standard errors. $N = 219$.

Concerning EV outcomes, reliability estimates ranged from $r_{SB} = .06$ to $r_{SB} = .91$, with overall indices showing higher reliability ($r_{SB} = .78$ to $r_{SB} = .91$) than decrement slope scores ($r_{SB} = .06$ to $r_{SB} = .58$; see Table 1). Of the correlations performed, two of them were initially found to be significant. However, none of them were maintained as true positives after performing Benjamini-Hochberg correction for multiple comparisons (see Table 2).

In contrast, five correlations were found between AV and FFMQ scores, all of which remained significant after correcting for multiple comparisons (see Table 2). Split-half reliability ranged from $r_{SB} = .65$ to $r_{SB} = .96$ for AV outcomes. As for EV, overall indices demonstrated higher reliability ($r_{SB} = .71$ to $r_{SB} = .96$) than decrement slope scores ($r_{SB} = .65$ to $r_{SB} = .81$; see Table 1). Correlational results showed that scores on Describe facet were negatively associated with number of lapses, $r_b = -.111, p = .019$, while scores on Nonreact were negatively associated with both mean RT in AV trials, $r_b = -.119, p = .011$, and percentage of lapses, $r_b = -.107, p = .026$ (see also Fig. 2). Moreover, total FFMQ scores also correlated negatively with mean RT in AV trials, $r_b = -.103, p = .025$, and number of lapses, $r_b = -.103, p = .027$. These results indicate that participants with higher self-report dispositional mindfulness showed improved arousal vigilance as indexed by faster responses and fewer lapses (i.e., missed targets) in AV trials.

Table 2 *Kendall's Tau Correlations Between Five Facets Mindfulness Questionnaire and Attentional Networks, Executive Vigilance, and Arousal Vigilance Outcomes*

	Five Facets Mindfulness Questionnaire					
	Observe	Describe	Actaware	Nonjudge	Nonreact	Total
Attentional Networks						
RT Overall	-.055	-.014	-.016	-.029	-.118**	-.078#
% Errors Overall	.010	-.054	.005	-.012	-.118**	-.078#
RT Alerting	-.035	.025	.095#	-.014	-.020	.011
% Errors Alerting	-.031	-.026	.101#	.011	-.029	.017
RT Orienting	-.002	.012	-.035	-.040	.104#	-.008
% Errors Orienting	-.020	-.041	-.062	-.077	-.023	-.075
RT Control	-.014	-.024	.083	.006	-.025	.012
% Errors Control	-.001	-.009	.058	.031	.054	.044
Executive Vigilance						
% Hits	-.066	.049	.013	-.009	.010	.012
% Hits Slope	.008	-.013	-.026	.041	-.033	.006
% FAs	.011	.033	-.022	-.018	-.027	-.019
% FAs Slope	-.027	-.030	.046	.029	-.005	.020
A'	-.090	.025	-.007	-.008	.025	-.002
A' Slope	.007	.004	-.012	.027	.016	.002
B''	.045	-.032	.017	.013	.019	.026
B'' Slope	-.042	.023	-.058	-.078#	-.044	-.096#
Arousal Vigilance						
RT Mean	.052	-.091	-.033	-.060	-.119*	-.103*
RT Mean Slope	.043	.034	.015	-.010	-.059	.005
% Lapses	.034	-.111*	.010	-.059	-.107*	-.103*
% Lapses Slope	.026	-.042	-.008	-.082	-.058	-.070
SD of RT	.018	-.039	.034	-.022	-.079	-.043
SD of RT Slope	.001	-.031	-.004	-.046	-.062	-.049

Note. $N = 219$. RT = Reaction time. FA = False alarm. SD = Standard deviation. Number sign (#) indicates correlations declared significant ($p < .05$) prior to Benjamini-Hochberg procedure. Asterisks (*) indicate correlations held significant after Benjamini-Hochberg procedure.

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

Self-Report Attentional Control and Mind-Wandering

Secondary research outcomes are summarized in Table 3, where correlations between FFMQ and ACS, MW-S, and MW-D scores are reported. After correction for multiple

comparisons, we found that FFMQ total score correlated positively with ACS, $\tau_b = .336, p < .001$, and negatively with MW-S, $\tau_b = -.264, p < .001$ (while it was not related to MW-D, $\tau_b = -.013, p = .781$). These results indicate that participants with higher dispositional mindfulness reported having a greater everyday attentional control ability and a reduced inclination to engage spontaneously in mind-wandering (while showed no different propensity to mind-wander voluntarily). For correlations between specific FFMQ facets and self-report attentional control and mind-wandering see Table 3. *P*-values obtained for all comparisons performed between FFMQ scores, ACS, and MW questionnaires are provided as Supplementary Material S6.

Table 3 *Kendall's Tau Correlations Between Five Facets Mindfulness Questionnaire and ACS, MW-S, and MW-D.*

	Five Facets Mindfulness Questionnaire					
	Observe	Describe	Actaware	Nonjudge	Nonreact	Total
ACS	.004	.197***	.366***	.193***	.163***	.336***
MW-S	.184***	-.111*	-.434***	-.247***	-.091	-.264***
MW-D	.149**	-.013	-.137**	-.039	.075	-.013

Note. $N = 219$. ACS = Attentional Control Scale. MW-S = Mind-Wandering Spontaneous. MW-D = Mind-Wandering Deliberate. Asterisks (*) indicate correlations held significant after Benjamini-Hochberg procedure.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Discussion

The present study aimed to examine the existence and strength of the relationship between dispositional mindfulness and a variety of objective measures of attention and vigilance. To this end, FFMQ scores were correlated with attentional performance in a novel cognitive-behavioral assessment: the ANTI-Vea. As an additional aim, we also explored the relationships between dispositional mindfulness and two subjective attention-related measures (ACS and MW-S/MW-D). In order to buffer the influence of Type I and Type II

error rates, we tested a large sample of participants ($N = 219$) and corrected for multiple comparisons using the Benjamini-Hochberg procedure. For all measures, reliability coefficients were computed to aid in the interpretation of our results.

As expected, our analyses revealed an association between global attentional performance and dispositional mindfulness. Particularly, higher Nonreact scores predicted faster RT and reduced error rate in ANTI trials. Contrary to expectations, however, we did not find an association between dispositional mindfulness and executive vigilance. Instead, we found such a relationship with arousal vigilance, so that higher scores on Nonreact, as well as higher FFMQ total score, predicted faster RT and fewer lapses in AV trials. The number of lapses was also negatively correlated to Describe scores. Finally, we did not find the expected positive association between dispositional mindfulness and the efficiency of the executive control network (nor did we find any association with phasic alertness or orienting). Overall, this pattern of findings suggests that dispositional mindfulness is related to improved global attentional and arousal vigilance performance, with non-reactivity to internal experience as the main facet driving the association. The size of the effects was within the anticipated range, being on average of about Kendall's $\tau_b = .11$ (equivalent to Pearson's $r = .17$) for statistically significant correlations.

Non-reactivity was the facet most consistently and strongly associated with better objective attentional and vigilance performance. Interestingly, this indicates that a rather affective quality (i.e., not being emotionally reactive to the content of experience and, thus, not being carried away by it) is more closely related to improved cognition than other more attention-related qualities (such as acting with awareness). This may be explained by considering the characteristics of the ANTI-Vea, which requires to perform (and switch among) three simultaneous tasks (ANTI, EV, and AV) throughout approximately 50 minutes. Being highly demanding and lengthy, the ANTI-Vea is experienced by

participants as moderately aversive. As coping with stress requires cognitive resources (Muraven and Baumeister 2000), our results seem to suggest that less reactive participants may have needed to invest fewer resources to downregulate the mild negative affect linked to task performance, thus being less overloaded by its cognitive demands. In turn, freeing up cognitive load would have translated into an improved general state of preparation during the task. This interpretation is in line with the fact that participants with higher non-reactivity scores were faster in responding to both ANTI and AV trials, assessments that index overall and sustained preparation throughout the task, respectively. Importantly, this association is not the result of a speed/accuracy trade-off since higher non-reactivity scores were also associated with a reduced error rate in ANTI trials.

These findings are consistent with several pieces of previous evidence. For instance, non-reactivity has been identified as the mindfulness facet most strongly associated with attentional accuracy in a breath counting task (Tortella-Feliu et al. 2020), and has been shown to be sensitive to the length of focused attention meditation practice (Cebolla et al. 2017). Furthermore, evidence shows that non-reactivity appears to be the best proxy for the broader construct of acceptance (Soler et al. 2014), which has also been shown to be critical for cognitive performance. In a randomized controlled study, Rahl et al. (2017) evaluated vigilance performance in the SART after two different mindfulness interventions that incorporated either training in attention monitoring or training in both attention monitoring and acceptance. The study found that the attention monitoring and acceptance training group showed higher discriminability throughout the task, thus outperforming the one based on attention monitoring training alone. Altogether, these and our own findings suggest that the ‘how’ of mindfulness (acceptance attitude) is at least as relevant as the ‘what’ (attention monitoring) for cognitive performance.

Contrary to expectations, we did not find dispositional mindfulness to be associated with executive vigilance. Although speculative, differences in task demands between the ANTI-Vea and other assessments used in previous research may account for this null result. The high cognitive demand that characterizes the ANTI-Vea as a triple task sets it apart from other classic executive vigilance assessments, in which participants are required to perform a single task (e.g., CPT, SART). As simpler, less demanding tasks lead to less motivation and engagement, they are also more prone to mind-wandering, which is likely one important factor driving poor vigilance performance in this type of assessment. In turn, since dispositional mindfulness is known to be linked to diminished mind-wandering (Mrazek et al. 2012; see also our own secondary results), it may be argued that more mindful individuals perform better in simple vigilance tasks due to their reduced tendency to mind-wander. However, being the ANTI-Vea relatively more demanding, it may leave fewer cognitive resources available for participants to engage in mind-wandering. If this is true, the aforementioned advantage of more mindful individuals would be undermined in the context of our task, in which there is relatively little mind-wandering to be downregulated. As discussed below, future research manipulating task cognitive load while assessing the relationship between dispositional mindfulness and vigilance may prove useful in testing the validity of this explanation.

Also against our hypotheses, we did not find dispositional mindfulness to correlate with executive control. The above-mentioned explanation for the lack of correlation with executive vigilance is also applicable here. Assuming that improvements in executive attention related to high mindfulness are due to better control over mind-wandering—as suggested by our secondary results—we may not have observed the expected correlation with executive control because mind-wandering was already reduced for all participants. In line with this interpretation, it has been observed that the interference effect of the executive control network is smaller in the ANTI-Vea as compared to other simpler flanker

tasks (Luna et al. 2020), a reduction that is hypothesized to be a consequence of the relatively high demands and low mind-wandering that characterize our task. In fact, the interference effect in the classic ANT is approximately twice as large as it is in the ANTI-Vea (usually ~ 100 ms and ~ 45 ms, respectively).

A second plausible interpretation for the null result regarding executive control has to do with reliability and statistical power rather than with task characteristics. Note that while the ANTI-Vea measures for which we did observe statistically significant correlations demonstrated excellent reliability (ranging from $r_{SB} = .91$ to $r_{SB} = .99$), the internal consistency of the executive control indices was not as high (ranging from $r_{SB} = .51$ to $r_{SB} = .64$). This has two consequences. On the one hand, it lends confidence to our correlational results regarding global attentional and arousal vigilance performance, further suggesting that they are indeed true positives and that their observed magnitude is not strongly attenuated by suboptimal measurement reliability (Dang et al. 2020). On the other hand, it means that our *a priori* power calculation underestimated the sample needed to detect correlations involving the attentional networks, including executive control.

Consider as an example the FFMQ total score ($\alpha = .87$) and the executive control RT efficiency score ($r_{SB} = .64$). In order to detect a two-tailed correlation of $r = .20$ between them, the actual effect size one should aim for when estimating the sample size is $r = .20 * \sqrt{.87 * .64} = .15$. (see Dang et al. 2020). In this scenario, the sample needed to achieve the standard power of .80 would be of 346 participants, which stands in stark contrast to the 193 participants required in case of ideal reliability. By this logic, the observed null correlations involving the executive control indices might simply reflect Type II errors. In fact, the same holds true for all other attentional networks efficiency measures, which showed similar or lower reliability. In contrast, and importantly, this also implies that positive findings from previous (smaller) studies correlating dispositional mindfulness and

attentional networks tasks may indeed be Type I errors (note that phasic alertness, orienting, and executive control outcomes in the ANTI-Vea are at least as reliable as those from previous ANT-related tasks; Luna et al. 2020). Considering all this, it is possible that the existing body of research assessing this relationship—our own study included—has been unable to address the phenomenon reliably. Future studies must consider factoring measurement reliability into their power calculations, and thus testing larger samples, in order to better gain access to it.

A subsidiary aim of our study was to explore the relationships between FFMQ and two subjective attention-related measures: the ACS and the MW-D/MW-S scales. Our results showed that participants with higher dispositional mindfulness (as assessed by the total FFMQ score) also reported having better attentional control and less spontaneous (but not voluntary) mind-wandering during daily life. This result is consistent with what can be theoretically expected: the higher the level of dispositional mindfulness, the larger the metacognitive capacity to voluntarily regulate attention in the presence of both external and internal distraction (as assessed by the ACS and MW-S, respectively). In turn, dispositional mindfulness was not related to deliberate mind-wandering (MW-D), arguably because this process reflects aspects that are both correlated and anticorrelated to mindfulness. For instance, while it is voluntary (reflecting, therefore, a metacognitive regulatory capacity possibly linked to mindfulness), it also entails the detachment from immediate sensory experience (thus opposing the construct of mindfulness).

Discussing the associations between these constructs and specific mindfulness facets is beyond the scope of the present report. Nonetheless, there is a rather wider observation that may be worth calling attention to, namely that the size of the correlations between FFMQ and objective ANTI-Vea measures is on average about half the size of the correlations between FFMQ and subjective self-report scores. This seeming discrepancy is

not atypical when correlating measures addressing distinct levels of analysis of the same construct. For instance, Bernoster et al. (2019) addressed impulsivity (and other closely related constructs) simultaneously by using various self-report, behavioral, and electrophysiological measures. Similar to what we found, the authors observed that the measures were highly correlated within but not between each type of measurement (i.e., among self-report measures, but not between self-report and behavioral/electrophysiological measures), observation for which they could not find a convincing explanation. Although speculative, one possibility is that such discrepancy is reflecting systematic noise derived from the subjective nature of self-report assessments.

Consider as an example attentional control. If a participant believes she has high attentional control, she will likely score also relatively high in at least some aspects of mindfulness (e.g., acting with awareness subscale) and low in (spontaneous) mind-wandering, independently of whether her belief is true or not. In contrast, this participant would only score relatively high in the executive attention index of the ANTI-Vea if her belief is indeed true. In other words, self-report assessments may not only measure the actual capacities or tendencies of the participants but also their subjective beliefs about them (for a similar argument, see Quigley et al. 2017). If we assume that individuals will have similar beliefs about related constructs, a systematic bias may be introduced so that correlations between overlapping self-report measures are artificially enlarged—while the observed shared variance between cognitive-behavioral and self-report data will more closely reflect the underlying relationship of interest. Although this explanation remains speculative, it calls for caution when interpreting correlational results from self-report measures. Moreover, it further underscores the value of using objective experimental measures to assess attention when studying its relationship to mindfulness and meditation practice.

Limitations and Future Research

Although the present study has various strengths—including the use of a large sample, the control of the false positive rate, the evaluation of the reliability of the measures used, or the simultaneous assessment of the classic attentional networks, executive vigilance, and arousal vigilance—it is not without limitations. First, our sample was composed of young, healthy participants with no meditation experience. This methodological feature precludes the generalization of our results beyond this population. Second, the relatively low reliability of some of our measures (especially those related to the attentional networks) hindered their capacity to detect small correlations, thus potentially increasing the probability of Type II errors. In light of this, future research should consider (1) extending our results both to the general population and to other specific populations—such as, and especially, experienced meditators—; and (2) when feasible, testing even larger samples to buffer the reduction in statistical power derived from suboptimal measurement reliability.

As mentioned above, future studies may also consider assessing the relationship between dispositional mindfulness and vigilance while manipulating cognitive load (i.e., the task demand). The online ANTI-Vea website (<https://www.ugr.es/~neurocog/ANTI/>) affords the configuration of task demand by choosing whether to present a single, double, or triple task, thus being an accessible and convenient tool for researchers aiming to further explore this topic. Finally, yet importantly, in light of our results, future studies may find it fruitful to deepen into the relationship between objective attentional performance and measures tapping into constructs related to non-reactivity. Examples of such related constructs may be non-attachment (Sahdra et al. 2010) or experiential avoidance (Bond et al. 2011). It is our hope that future research implementing these suggestions will extend the present findings, thereby continuing to enlarge scientific insight into the multifaceted relationship between dispositional mindfulness and attention.

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Ethical Approval: The study was performed according to the ethical standards of the 1964 Declaration of Helsinki and its later amendments, and was part of a larger research project approved by the Universidad de Granada Ethical Committee (516/CEIH/2018).

Informed Consent: All subjects provided informed consent.

Data, Materials, and Code Availability: The data and R scripts used for analysis are provided at the Open Science Framework (<https://osf.io/374rs/>). The online version of the ANTI-Vea task is available for free use and in multiple languages at <https://www.ugr.es/~neurocog/ANTI/>.

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Supplementary Material

**To Be Attentive, Do Not React: Linking Dispositional Mindfulness to
Attentional Networks and Vigilance Performance**

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SUPPLEMENTARY MATERIAL S1: Online ANTI-Vea – technical specifications

Detailed task procedure The ANTI-Vea is comprised by three types of trials: ANTI, EV, and AV. In ANTI trials, participants performed a flanker task: by pressing either “c” or “m”, they had to indicate the direction pointed by a central arrow (the target) while ignoring four distracting arrows appearing at its sides (the flankers). Stimuli was presented randomly either above or below the fixation point. To assess the control network, in half of the trials both the target and the flankers pointed to the same direction (congruent condition), whereas in the other half they pointed towards opposite directions (incongruent condition). To measure phasic alertness, in half of the trials a warning signal preceded the target (tone condition), whereas no warning signal was presented in the other half (no tone condition). Lastly, to assess the orienting network, participants were presented with a visual cue that could appear either at the same location than the arrows (valid condition, one third of trials), at the opposite location (invalid condition, one third of trials), or could not appear at all (no cue condition, one third of trials). In EV trials, the procedure was as for ANTI trials except for one difference: the target appeared upwardly or downwardly displaced from its usual position. Participants were instructed to remain vigilant to this vertical displacement, and to press the space bar when they detected it. Finally, in AV trials none of the above-mentioned stimuli was presented. Instead, the fixation point remained on the screen until a red millisecond countdown appeared. For these trials, participants were instructed to remain vigilant to the appearance of the counter, and to stop it as fast as possible by pressing any key.

The ANTI-Vea started with a practice phase, in which instructions were given so that participants could gradually familiarize with each type of trial. During this phase, participants were presented with four blocks comprised, respectively, of 16 ANTI trials (with visual feedback), 32 randomized trials (16 ANTI and 16 EV; with visual feedback), 48

randomized trials (24 ANTI, 8 EV and 8 AV; with visual feedback), and 40 randomized trials (24 ANTI, 8 EV and 8 AV; without visual feedback). Prior to begin with the experimental blocks, participants were invited to repeat the last practice block if needed. Lastly, six blocks of 80 randomized trials each (48 ANTI, 16 EV and 16 AV) were presented without visual feedback nor any break as the actual experimental task.

Stimuli characteristics The ANTI-Vea was designed and run with Javascript ES5, HTML5, CSS3, and Angular JS. In ANTI and EV trials, the stimuli were: a ~ 7 pixels (px) black cross as the fixation point; a ~ 13 px black asterisk as the visual cue; a 2000 Hz tone as the warning signal; and five black arrows of 50 px wide $\times$ 23 px high, separated horizontally from each other by ~ 63 px, as the target (central arrow) and the flankers (surrounding arrows). In EV trials, the target was vertically displaced by 8 px either upwards or downwards. Additionally, and to make more difficult the detection of displaced targets, a random variability of ± 2 px was further applied to the vertical and horizontal locations of each arrow, for both ANTI (for target and flankers) and EV (only for flankers) trials. Concerning AV trials, the stimuli consisted of a millisecond countdown timer comprised by four red numbers of ~ 110 px height each (see also Fig. 1 in main text).

SUPPLEMENTARY MATERIAL S2: Items of the Spanish version of the Five Facets Mindfulness Questionnaire (FFMQ)

We used the Spanish version of the FFMQ as validated by Cebolla et al. (2012). The items of the scale were as follows:

1. *Cuando camino, noto deliberadamente las sensaciones de mi cuerpo al moverse.*
2. *Se me da bien encontrar las palabras para describir mis sentimientos.*
3. *Me critico a mí mismo/a por tener emociones irracionales o inapropiadas.*
4. *Percibo mis sentimientos y emociones sin tener que reaccionar a ellos.*

5. *Cuando hago algo, mi mente divaga y me distraigo fácilmente.*
6. *Cuando me ducho o me baño, estoy atento a las sensaciones del agua en mi cuerpo.*
7. *Con facilidad puedo poner en palabras mis creencias, sentimientos y expectativas.*
8. *No presto atención a lo que hago porque sueño despierto, porque me preocupo o porque me distraigo.*
9. *Observo mis sentimientos sin perderme en ellos.*
10. *Me digo a mi mismo/a que no debería sentir lo que siento.*
11. *Noto cómo los alimentos y las bebidas afectan a mis pensamientos, sensaciones corporales y emociones.*
12. *Me es difícil encontrar palabras para describir lo que siento.*
13. *Me distraigo fácilmente.*
14. *Creo que algunos de mis pensamientos no son normales o son malos y que no debería pensar así.*
15. *Presto atención a las sensaciones que produce el viento en el pelo o el sol en la cara.*
16. *Tengo problemas para pensar en las palabras que expresan correctamente cómo me siento.*
17. *Hago juicios sobre si mis pensamientos son buenos o malos.*
18. *Me es difícil permanecer centrado/a en lo que está sucediendo en el presente.*
19. *Cuando tengo pensamientos o imágenes perturbadoras, soy capaz de dar un paso atrás, y me doy cuenta del pensamiento o la imagen sin que me atrape.*
20. *Presto atención a sonidos como el tic-tac del reloj, el gorjeo de los pájaros o los coches que pasan.*
21. *En situaciones difíciles, puedo parar sin reaccionar inmediatamente.*
22. *Cuando tengo sensaciones en el cuerpo es difícil para mí describirlas, porque no puedo encontrar las palabras adecuadas.*
23. *Conduzco en “piloto automático”, sin prestar atención a lo que hago.*
24. *Cuando tengo pensamientos o imágenes perturbadoras, me calmo en poco tiempo.*

25. *Me digo a mi mismo/a que no debería pensar como pienso.*
26. *Percibo el olor y el aroma de las cosas.*
27. *Incluso cuando estoy muy enfadado, encuentro una forma de expresarlo con palabras.*
28. *Hago actividades precipitadamente sin estar de verdad atento/a a ellas.*
29. *Cuando tengo pensamientos o imágenes perturbadoras soy capaz de notarlas sin reaccionar.*
30. *Creo que algunas de mis emociones son malas o inapropiadas y que no debería sentirlas.*
31. *Percibo elementos visuales en la naturaleza o en el arte, como colores, formas, texturas o patrones de luces y sombras.*
32. *Mi tendencia natural es poner mis experiencias en palabras.*
33. *Cuando tengo pensamientos o imágenes perturbadoras, las noto y las dejo marchar.*
34. *Hago tareas automáticamente, sin ser consciente de lo que hago.*
35. *Cuando tengo pensamientos o imágenes perturbadoras, me juzgo como bueno o malo, dependiendo del contenido.*
36. *Presto atención a cómo mis emociones afectan a mis pensamientos y a mi conducta.*
37. *Normalmente puedo describir como me siento con considerable detalle.*
38. *Me sorprendo haciendo cosas sin prestar atención.*
39. *Me critico cuando tengo ideas irracionales.*

SUPPLEMENTARY MATERIAL S3: Items of the Spanish translation of the Attentional Control Scale (ACS)

We used the Spanish translation of the Attentional Control Scale as it has been used in other previous publications (e.g., Pacheco-Unguetti et al. 2011). The items of the scale were as follows:

1. *Me cuesta mucho concentrarme en tareas difíciles cuando hay mucho ruido.*
2. *Cuando necesito concentrarme y resolver problemas, tengo muchas dificultades para centrar mi atención.*
3. *Me distraigo con sucesos que ocurren a mi alrededor aunque esté trabajando intensamente en algo.*
4. *Mi concentración es buena aunque haya música en la misma habitación.*
5. *Cuando me concentro, puedo llegar a mantener tanto mi atención que no me doy cuenta de lo que ocurre a mi alrededor.*
6. *Cuando estoy leyendo o estudiando, me distraigo fácilmente si hay gente hablando en la misma habitación.*
7. *Cuando intento centrar mi atención en algo, tengo dificultades para impedir que surjan pensamientos distractores.*
8. *Me cuesta mucho concentrarme cuando estoy nervioso/a por algo.*
9. *Cuando estoy concentrado/a, no hago caso de las sensaciones de hambre o sed.*
10. *Puedo pasar rápidamente de una tarea a otra.*
11. *Me lleva mucho tiempo involucrarme en tareas nuevas.*
12. *Cuando estoy tomando apuntes en clase tengo dificultades para escuchar y escribir al mismo tiempo.*
13. *Cuando me interesa algo novedoso me implico en ello rápidamente.*
14. *Para mí es fácil leer o escribir mientras hablo por teléfono.*
15. *Tengo problemas para llevar dos conversaciones a la vez.*
16. *Tengo dificultad para encontrar ideas nuevas rápidamente.*
17. *Después de ser interrumpido/a o distraído/a, puedo dirigir mi atención fácilmente hacia lo que estaba haciendo y reanudarlo.*

18. *Cuando un pensamiento distractor me viene a la cabeza, me resulta fácil alejar mi atención de él e ignorarlo.*
19. *Fácilmente puedo alternar entre dos tareas diferentes.*
20. *Para mí es difícil cambiar la forma de pensar sobre algo y considerarlo desde otro punto de vista.*

SUPPLEMENTARY MATERIAL S4: Items of the Spanish translation of the Mind-Wandering Deliberate and Spontaneous scales (MW-D/MW-S)

For the MW-D and MW-S scales, we translated the items from the original English version (Carriere et al. 2013), as there is currently no such translation of the instrument to Spanish. The items were translated and back-translated with the aid of a professional English translator who helped to resolve discrepancies between both translations. The items of the scales were as follows:

MW-D:

1. *Dejo a mis pensamientos divagar a propósito.*
2. *Disfruto dejando a mi mente divagar.*
3. *Dejar mi mente divagar me resulta una buena forma de lidiar con el aburrimiento.*
4. *Me permito ensimismarme en ensoñaciones agradables.*

MW-S:

1. *Me doy cuenta de que mis pensamientos divagan espontáneamente.*
2. *Cuando mi mente divaga, mis pensamientos tienden a saltar de una idea a otra.*
3. *Siento que no tuviera control sobre mi mente cuando divaga.*
4. *Mi mente divaga espontáneamente incluso cuando se supone que debería estar haciendo otra cosa.*

SUPPLEMENTARY MATERIAL S5: *P*-values for main correlations

P-Values for Kendall's Tau Correlations Between Five Facets Mindfulness Questionnaire and Attentional Networks, Executive Vigilance, and Arousal Vigilance Outcomes

	Five Facets Mindfulness Questionnaire					
	Observe	Describe	Actaware	Nonjudge	Nonreact	Total
Attentional Networks						
RT Overall	.118	.385	.367	.268	.006	.043
% Errors Overall	.581	.125	.458	.396	.006	.047
RT Alerting	.459	.593	.040	.756	.676	.804
% Errors Alerting	.517	.586	.033	.817	.545	.709
RT Orienting	.965	.794	.450	.385	.026	.861
% Errors Orienting	.674	.384	.187	.096	.629	.102
RT Control	.769	.605	.074	.899	.598	.788
% Errors Control	.991	.849	.210	.500	.253	.343
Executive Vigilance						
% Hits	.921	.146	.386	.579	.412	.394
% Hits Slope	.434	.612	.712	.190	.758	.448
% FAs	.406	.239	.682	.650	.718	.661
% FAs Slope	.714	.737	.162	.270	.544	.330
A'	.973	.297	.558	.570	.298	.513
A' Slope	.440	.468	.599	.277	.368	.332
B''	.338	.486	.709	.781	.684	.568
B'' Slope	.187	.687	.105	.047	.175	.019
Arousal Vigilance						
RT Mean	.266	.050	.473	.198	.011	.025
RT Mean Slope	.357	.458	.740	.822	.206	.907
% Lapses	.478	.019	.834	.214	.026	.027
% Lapses Slope	.585	.366	.869	.079	.224	.134
SD of RT	.692	.395	.459	.641	.092	.350
SD of RT Slope	.978	.500	.930	.322	.185	.285

Note. $N = 219$. RT = Reaction time. FA = False alarm. SD = Standard deviation.

SUPPLEMENTARY MATERIAL S6: *p*-values for secondary correlations

P-Values for Kendall's Tau Correlations Between Five Facets Mindfulness Questionnaire and ACS, MW-S, and MW-D.

	Five Facets Mindfulness Questionnaire					
	Observe	Describe	Actaware	Nonjudge	Nonreact	Total
ACS	.939	<.001	<.001	<.001	<.001	<.001
MWS	<.001	.019	<.001	<.001	.058	<.001
MWD	.002	.788	.004	.406	.116	.781

Note. $N = 219$. ACS = Attentional Control Scale. MW-S = Mind-Wandering Spontaneous. MW-D = Mind-Wandering Deliberate.

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