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When Is a Wandering Mind Unhappy? The Role of Thought Valence

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The current research represents one of the first attempts to investigate how various thought qualities that naturally fluctuate across attention states (i.e., mind wandering vs. present-focused attention) impact mood. Of specific interest was whether thought valence may account for previously reported effects of attention state on mood. To examine this, an experience sampling methodology was used to capture participants' ($N =$ 337) attention state (present or mind wandering), thought valence, and mood 6 times per day for 7 days during daily life (all data collected in 2022–2023). Participants further indicated the form of their thoughts (e.g., inner speech), as well as their clarity and interestingness. This design allowed for a conceptual replication and expansion of Killingsworth and Gilbert (2010) in which it was observed that mind wandering leads to relatively poorer mood compared to present-focused attentional states, with the poorest mood for negatively valenced wandering thoughts. Unlike their study, however, we inquired about thought valence for both mind-wandering and present moments. Our findings revealed that the relationship between attention state and mood is substantially accounted for by thought valence, while interestingness and clarity further provided significant, albeit much weaker, indirect effects on mood. Exploratory analyses suggested that the effect of attention state on mood is greatest for older people. Overall, these findings suggest that the commonly reported detrimental impact of mind wandering on mood may largely be accounted for by certain confounding variables.

Keywords: mind wandering, thought valence, experience sampling methodology, multilevel modeling, mood

Supplemental materials: https://doi.org/10.1037/emo0001434.supp

Throughout the day, thoughts naturally ebb and flow from the present moment. Even when attempting to engage in a given task (such as reading this article), unrelated thoughts will spontaneously arise and interrupt our focus. Commonly referred to as *mind wandering*,[1] such thoughts are characterized as being internally generated and decoupled from the current situation (e.g., Antrobus, 1968; Giambra, 1989; Mooneyham & Schooler, 2013). The types of thoughts one has while mind wandering can vary widely—from pleasant musings to uncomfortable or intrusive ruminations. Despite such variety in thought content, there is a prevalent view that, on average, one's mood is more negative when mind wandering as compared to a present-focused state (e.g., Franklin, Mrazek, et al., 2013; Killingsworth & Gilbert, 2010; Ruby et al., 2013; Wilson et al., 2014; see Kam et al., 2024, for meta-analysis).

This notion first gained widespread traction following a seminal study by Killingsworth and Gilbert (2010) in which the authors concluded that *a wandering mind is an unhappy mind.* Using an experience sampling methodology (ESM), the influence of attention state (i.e., mind wandering vs. not mind wandering) on mood was investigated in a large and diverse sample. In their study, participants

[1] Note, we opt for the term "mind wandering" to encompass the broad class of thought that includes off-task thinking, stimulus-unrelated thoughts, unprompted thoughts, etc.

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responded to prompts on their smartphone 1–3 times a day as they went about their daily lives. For each prompt, they reported their *mood* ("How are you feeling right now?" from a scale of 0 = *very bad* to 100 = *very good*) and their *attention state* ("Were you thinking about something other than what you were currently doing?") with four possible response options; "yes, about something pleasant"; "yes, about something neutral"; "yes, about something negative"; or "no." The results revealed that participants' mood was poorer when they were mind wandering (vs. not mind wandering, which we hitherto refer to as being "present"). In addition (and perhaps unsurprisingly), the results from this study revealed that when participants were mind wandering, their mood was associated with the *valence* of their thoughts; specifically, more negative (as compared to positive) thoughts were associated with poorer mood. In fact, when participants were mind wandering about something positive, their mood was on par with being present.

Critically, although Killingsworth and Gilbert asked participants to report thought valence when they were mind wandering, they did not ask about participants' thought valence when their attention was present. Because of this omission, their findings leave open an intriguing possibility; perhaps people's mood is more negative when they are mind wandering (vs. being present) *due to* their thought valence being more negative during mind-wandering (vs. present-focused) moments. Stated differently, the relationship between attention state and concurrent mood may be accounted for by thought valence; this is the main question of the present study.

The notion that thought valence may account for the relationship between attention state and concurrent mood is supported by initial evidence from previous studies showing relationships between pairs of these three variables: attention state, thought valence, and mood (although, to our knowledge, no study has reported on the relationship between all three variables at once). First, the relationship between attention state and concurrent mood originally reported by Killingsworth and Gilbert (2010) has been replicated in several studies, all of which show that, in naturalistic settings, the higher the degree of mind wandering, the poorer individuals' concurrent mood (Franklin, Mrazek, et al., 2013; Hobbiss et al., 2019; Mills et al., 2021; Thiemann et al., 2023). Second, the relationship between thought valence and mood reported by Killingsworth and Gilbert (2010; on prompts when participants were mind wandering) holds up in a recent meta-analytic review of mind-wandering research (Kam et al., 2024), with the consensus being that mind wandering about something negative is associated with poorer mood.

With regard to the third pairing, that is, the relationship between attention state and thought valence, much less is known. Although there is evidence that mind wandering tends to center around personal concerns (e.g., Baird et al., 2011; Klinger, 1977), which are presumably often negative, to our knowledge, only one study has reported on whether mind-wandering thoughts are more negative than present-focused thought. Using a laboratory-based paradigm, Marchetti et al. (2012) reported no association between mind wandering (defined as off-task, rather than on-task, thoughts) and thought valence (measured on a continuous scale). However, the lack of an association is not surprising given that such laboratory-based studies employ intentionally mundane tasks in order to induce mind wandering, and therefore off-task thoughts (i.e., mind-wandering thoughts) are unlikely to be more negative than on-task thoughts (see Mason et al., 2013, for further discussion). This is, in fact, a general drawback to studying the relationship between attention state and thought valence (or between any variables) in tightly controlled, laboratory-based studies; they lack the ecological validity necessary for examining the relationship between all three variables as they naturally occur in daily life. For this reason, whether there exists a relationship between attention state and thought valence in naturalistic settings is still an open research question.

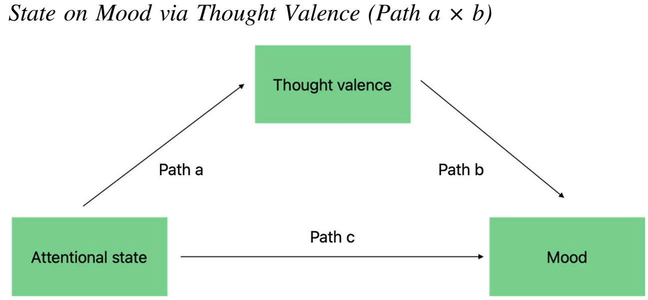
The main goal of the present study was therefore to investigate, in a naturalistic setting, whether thought valence is more negative when people are mind wandering versus present. To address this, we conducted a conceptual replication of Killingsworth and Gilbert (2010) with the main modification being that participants were asked to report their thought valence for *both* mind-wandering and present moments. If there is a relationship between attention state and thought valence (path *a* in Figure 1), we can ask whether the relationship between attention state and concurrent mood (path *c* in Figure 1) is accounted for by thought valence (path $a \times b$ in Figure 1). A positive result sets up the possibility that mind wandering leads to more negative thoughts, which, in turn, leads to poorer mood (as depicted in Figure 1), although future studies would be required to confirm the direction of causality, an issue we return to in the Discussion.

Another modification from the Killingworth and Gilbert study is that our participants were asked to report on the *nature* of their thought, specifically, whether it contained speech (which we refer to as "Inner Speech") or not (which we refer to as "Inner Experience"; the nature of which was explored with further questions). For the purpose of the present study, and as outlined in our preregistration, we focused our analyses on prompts that contained inner speech, as we reasoned that asking participants to report thought valence is more straightforward in moments that do (vs. do not) contain inner speech. Still, for the sake of comprehensiveness, in supplementary analyses, we also analyzed the data for prompts that did not contain inner speech.

A secondary goal of the present study was to explore various variables that might influence the relationship between attention state and mood (current activity and the clarity and interestingness of the thought) and potential moderating variables (demographics and trait measures). We included these variables not only because they showed up as relevant in our pilot data (Gross et al., 2023) but also based on previous literature from the mind-wandering field; for example, greater interestingness of a mind-wandering thought has been shown to be associated with more positive mood (Franklin,

Figure 1

Proposed Model Describing the Association Between Attention State on Mood via Thought Valence (Path a × b)



Note. See the online article for the color version of this figure.

Mrazek, et al., 2013), and age is correlated with both the degree of mind wandering (i.e., it is higher in older people: Maillet et al., 2018; McVay et al., 2013; Moran et al., 2021) and with thought valence (i.e., it is more negative in older people: Welhaf et al., 2024).

Method

Participants

Participants were recruited for this online study through University of California, San Diego's research subject pool run by the Department of Psychology from 2022 to 2023. Participants consisted of undergraduate students who were compensated with course credit. We aimed, and were successful, at reaching a total number that was at least as large as the sample size used in our pilot studies (n = 389), as our pilot group was large enough to yield significant effects for our main hypotheses.[2] After data cleaning (described below), 337 participants, ages 18–44 years (M = 20.82, SD = 3.24), were retained for analysis. Most participants were female (74.78%), followed by male (24.33%) and other (0.89%). The ethnoracial makeup was predominantly Asian (48.40%), followed by Hispanic/Latino (19.00%); White or Caucasian (18.70%); Mixed (7.72%); Black or African American (1.78%); Middle Eastern or North African (1.78%); First Nation, Indigenous American, Native Hawaiian, or other Pacific Islander (1.18%); and prefer not to say (1.48%). This study was approved by the Institutional Review Board committee at University of California, San Diego, and all participants gave their informed consent before participating.

Procedure and Measures

There were three parts to the study. Part 1 consisted of sending a Qualtrics link to participants, asking them to answer demographic questions (described above), validity questions (see Data Cleaning, below), a trait mindfulness questionnaire, and a personality questionnaire. For trait mindfulness, we used the 15-item Five Facet Mindfulness Questionnaire (Baer et al., 2012), which captures the following dimensions of mindfulness: Observing, Describing, Acting with Awareness, Nonjudging, and Nonreactivity. Each facet has been shown to have adequate to good internal consistency, with α scores ranging from .75 to .91. To measure core dimensions of personality, we used the 60-item NEO Five-Factor Inventory (Costa & McCrae, 1992), which measures personality across five domains: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. Each of these five dimensions has adequate internal consistency, with α scores ranging from .68 to .86 (Costa & McCrae, 1992). These two measures were used to determine whether the relationship between attention state and mood was moderated by these trait variables. At the end of Part 1, participants received detailed instructions on how to download and use the ExpiWell app (downloaded on a mobile device) for the ESM portion of the study.

Part 2 began the following day. First, participants received an instructional message from ExpiWell. The instructional message asked them not to respond to prompts if they were driving (for safety reasons), or if they were in class (so as to not disrupt their class time). It also introduced them to what to expect in the prompts by showing them a flowchart of the questions indicating how some questions depend on the participant's previous response.

Six ESM prompts were sent each day for the following 7 days. The prompts were distributed at semirandom times from 9 a.m. to 9 p.m., with one prompt randomly presented within each 2 hr block, that is, the first daily prompt in the morning (9 a.m.–10:59 a.m.), the next at 11 a.m.–12:59 p.m., and so on. If a participant did not initially respond to a prompt, the Expiwell app sent a notification every 15 min for 1 hr (or until the participant responded). Answering the items for each prompt (described below) took approximately 2 min.

Each prompt began with the following honesty prime, "Please be honest about your experience, it's really important to us. Thanks!" Participants were then asked to report the experience they were having immediately before the prompt with text that read as follows: "In the moment right before you responded to this prompt …"). Provided below, in the order they were presented to the participant, are the internal labels (*italicized*) we give to each variable (which was not seen by the participant) and the related questions they responded to.

1. *Attention State.* "In the moment right before the prompt … ." (1) *PRESENT*: "My attention was related to my current activity, immediate surroundings, or inner experience" or (2) *MIND WANDERING*: "My attention was NOT related to my current activity, or immediate surroundings."

2. *Mood*. "How are you feeling?" on a 7-point scale with three anchor points: −3 = very bad, 0 = neutral, +3 = very good.

3. *Thought Nature.* "Which best describes what you were experiencing?" (1) *INNER SPEECH*: "I was experiencing inner speech (talking to myself internally)," or (2) *INNER EXPERIENCE*: "I was NOT experiencing inner speech (NOT talking to myself internally)."

   If *inner experience* was selected, participants were further asked "Which of these were you primarily experiencing?" (1) BODY: "I was experiencing body sensations, e.g., hunger," (2) EMOTION: "I was experiencing emotions, e.g., sadness," (3) ENVIRONMENT: "I was noticing the environment, e.g., looking at the trees," (4) MUSIC/SOUNDS: "I was listening to music/podcast, e.g., with my earphones in, or imagining music/sounds," (5) VISUAL IMAGERY: "I was experiencing visual imagery, e.g., imagining my dog," (6) ANOTHER PERSON: "I was experiencing another person, e.g., holding hands," (7) BLANK MIND: "I was not thinking about anything at all—my mind was completely blank," (8) OTHER: "Please type in." *Note that data from these prompts are not analyzed in the current article.*

The items below were asked to all participants, with the only difference being whether *inner speech* or *inner experience* was inserted in the prompt, which was dependent on the response to this *Thought Nature* question.

4. *Clarity*. "What was the clarity of your inner speech/inner experience?" on a 7-point scale with three anchor points:

[2] Data from the pilot group are not presented here as the present study made some significant changes in how the prompts were delivered.

1 = not at all clear, 3 = moderately clear, 7 = extremely clear.

5. *Thought Valence.* "What was the valence of your inner speech/inner experience? If a stranger saw the content of your inner speech/inner experience (i.e., just the actual words or the actual experience), how would they rate it?" on a 7-point scale with three anchor points: −3 = very negative, 0 = neutral, +3 = very positive. *Note that this item was meant to get a more "objective" measure of the content of the inner speech, regardless of how the participant reacts to the thought (see next item).*
6. *Reactivity*. "How much did you feel reactive to your inner speech/inner experience?" on a 7-point scale with three anchor points: 1 = no reaction at all, 3 = moderate reaction, 7 = extreme reaction. *Note that data from this item are not analyzed in the current article.*
7. *Interestingness*. "How interesting was the inner speech/ inner experience?" on a 7-point scale with three anchor points: 1 = not at all interesting, 3 = moderately interesting, 7 = extremely interesting.
8. *Current Activity.* "Whether in-person or online, what type of activity were you primarily doing (select one)?" (1) "Social activity, but NOT engaged in conversation (e.g., being around family, friends, or peers but not speaking; listening to others at a party or group outing), (2) Physical activity (e.g., exercising, sports, walking, bicycling, hiking), (3) Restful activity (e.g., eating, resting, taking a nap, doing nothing, reading for fun, watching TV or videos, browsing the internet or social media), (4) Household activity (e.g., preparing meals, grocery shopping, household finances, cleaning or other chores), (5) Cognitive activity (e.g., studying, homework, attending lecture, learning something new, puzzle solving), (6) Other activity (text entry)." *Note that these six activities are adapted from* Oerlemans et al. (2011).

It is perhaps important to point out that, when designing these questions, we were careful to word the "Thought Valence" and "Mood" items in a way that differentiated them as separate constructs. Specifically, Thought Valence was meant to capture the positivity or negativity of one's inner speech or experience. To this end, we instructed participants to assess the valence of their inner speech or experience "objectively," as if a third party were observing their thoughts. Our results indicated that while the two constructs are related, they do not overlap (see Table 1). By contrast, Mood was meant to capture an individual's emotional state at a specific moment, essentially asking, "How are you feeling?" This definition of mood aligns with one of the components of mood discussed in the emotion literature, which distinguishes the two main components of mood as "arousal" and "valence" (e.g., Kuppens et al., 2013; Posner et al., 2005). The present study's choice to focus on the valence component of mood is guided by previous research demonstrating inconsistent relationships between attention state and arousal (e.g., Franklin, Broadway, et al., 2013; Mills et al., 2021; Mittner et al., 2014; Unsworth & Robison, 2018).

Part 3 of this study involved sending a Qualtrics link to the participant after their last ESM day, in which they answered validity questions (see Data Cleaning, below).

Data Cleaning

A total of 284 participants were excluded from the study for the following reasons. *First*, 260 participants, the vast majority, were excluded for not completing the entirety of all three parts of the study or because they did not input the same unique ID needed to match their data across parts. *Second*, three participants were excluded because, in the validity question (in either Part 1 or 3), they revealed themselves to have not taken the study seriously. The validity question response options ranged from 1 = "I read all instructions and questions carefully, and answered honestly to the best of my ability" to 4 = "I tried to finish this as quickly as possible and did not read most of the questions or instructions, or I did not answer honestly," and participants were excluded if they selected options 3 or 4. *Third*, nine participants were excluded because they did not pass the two attention checks that were interspersed in the surveys of Part 1 and 2 (e.g., "If you are paying attention to this survey, please select [blank]"). *Fourth*, because our analyses were restricted to prompts for which participants indicated experiencing inner speech (see above), 12 participants were excluded because their data did not include a single ESM prompt of this nature. This resulted in a total of 337 participants left for analysis.

Table 1
Associations Across Key Variables

Key variable	Thought valence	Clarity	Interestingness	Mood
Attention state	.14 [.09, .18], $p < .001$	.12 [.07, .18], $p < .001$	.09 [.04, .14], $p = .001$	.21 [0.16, 0.26], $p < .001$
Thought valence		.21 [.18, .24], $p < .001$	.27 [.24, .30], $p < .001$	.66 [.63, .68], $p < .001$
Clarity			.31 [.28, .34], $p < .001$	.16 [.13, .19], $p < .001$
Interestingness				.22 [.19, .25], $p < .001$

Note. Betas (unstandardized coefficients), 95% confidence intervals, and p values are shown for predicting one variable against another in a multilevel model. The row names represent the predictor variable, and the column names represent the dependent variable in each model. For continuous variables, positive effect sizes (listed in-text above) represent that an increase in one variable was associated with an increase in the other variable (and vice versa for negative effect sizes). For Attention State, a positive effect size means that the continuous variable it is paired with is higher for Present versus Mind-Wandering moments (and vice versa for negative effect sizes). Results for Current Activity had to be analyzed differently (see Method) and show that Current Activity was a significant predictor for each continuous variable in this table (all ps < .001). The associations between different Current Activities and Attention State are presented in Table 2.

Data Analysis

The main analyses in this study employed multilevel models (MLM) since the data have a natural two-level structure, where prompts collected over time are nested within individuals. All analyses were computed using R (Version 3.6.2; R Core Team, 2019) and the R-package lme4 (v1.1–27.1; Bates et al., 2015) with a maximum likelihood method of estimation. Using Type III, sum of squares MLMs, the dependent variable was *Mood*, and the main predictor variable was *Attention State* (entered as a fixed effect, contrast coded as Mind Wandering = −1 and Present = +1), with participant ID entered as a random intercept and prompt as the unit of analysis. Stated differently, the within- and between-subject variance of the dependent variable was partitioned by fitting random intercept terms for each participant and forcing a fixed slope. Prior to analysis, all continuous Level 1 variables were person-mean centered, sometimes referred to as "centering-within-clustering," which reveals within-person effects while eliminating Level 2 (i.e., between-person) effects in a multilevel model (Enders & Tofighi, 2007; Nezlek, 2011). As a precondition to using multilevel models, the intraclass correlation coefficient of the null model was calculated to determine the amount of variance within and between persons in Mood scores. The intraclass correlation coefficient was relatively low (0.28), indicating that most of the variance in Mood was due to within-person variation. Following the methodology used by Blanke et al. (2018), effect sizes were calculated via likelihood ratio-based pseudo-R^2 estimates, which approximate the unique variance accounted for by each predictor variable in the MLM. No model presented major violations of the following three MLM assumptions: linearity, homoscedasticity, and normality of residuals, predictor variables, and the dependent variable.

Transparency and Openness

The study design, hypotheses, and analysis plan were prospectively preregistered (prior to data collection) including sample size calculations, all data exclusions, all manipulations, and all measures in the study. The preregistration, materials, data, and code are publicly available here on the Open Science Framework at https://osf.io/fk6yu. Journal Article Reporting Standards recommendations were followed in the reporting of our findings (Appelbaum et al., 2018).

Results

Descriptive Data

Of the 42 total ESM prompts sent to each participant, an average of 29.70 (70.71%) were completed (SD = 10.44, range = 5–42). The final sample consisted of 10,009 total prompts. Of these 10,009 total prompts, 76.40% were reported as a "Present" Attention State. This differs a bit from Killingsworth and Gilbert (2010), who reported a much lower percentage of present experiences, which we address in the Discussion. Within this "Present" Attention State, Inner Speech was experienced for 47.10% of the prompts. For the 23.60% of 10,009 total prompts that were reported as a "Mind-Wandering" Attention State, Inner Speech was experienced for 36.10% of the prompts. As explained in the Introduction, we chose to restrict our analyses to prompts where a participant indicated experiencing Inner Speech (44.50% of the total 10,009 prompts when collapsed across Attention State, i.e., 4,454 prompts); however, in the Supplemental Materials, we present the results, which were nearly identical, when assessing prompts where a participant indicated *not* experiencing Inner Speech.

Bivariate Associations

As a first step, we examined bivariate associations among all variables collected in the ESM portion of the study (with the exception of "Current Activity," which had to be analyzed separately; see *below*). Due to the repeated testing nature of the study, we could not rely on zero-order correlations. Instead, we used MLMs that included one predictor variable and one dependent variable (see Table 1). Though we were forced to choose which variable in each pairing was considered the predictor (rows, Table 1) versus the dependent variable (columns, Table 1), the results were nearly identical if the predictor and dependent variables were swapped. Each model used a fixed slope, with participant ID entered as a random intercept effect. Note that although the reported beta coefficients are unstandardized, no data transformations were needed because all variables used the same 7-point scale, with the exception of Attention State, which was contrast coded as Present = +1, Mind Wandering = −1.

Because Current Activity was a factor with six levels, associations between this and other variables were analyzed in a different manner. *First*, to investigate the association between Current Activity and *continuous* variables, Current Activity was inputted as a fixed effect in a MLM predicting each continuous variable. A global factor-level result of Current Activity was then computed with Satterthwaite's approximation in a Type III analysis of variance table. *Second*, to investigate associations between Current Activity and the only other *categorical* variable (Attention State), we simply looked at whether the distribution of Activities differed substantially across the two Attention States (Table 2), noting that a simple statistical test (e.g., chi-square) could not be performed given the repeated data nature of the data.

The results of the associations in Table 1 reveal that all variables were significantly associated. With regard to hypothesis testing, we focus on three specific associations. *First*, in line with the hypothesis that people experience better, that is, more positive, mood when their inner speech is present-focused, we found a significant association between Attention State and Mood, with Attention State accounting for 1.20% of the variance. *Second*, lending support for the hypothesis that the relationship between Attention State and Mood could potentially be accounted for by thought valence, we found (a) a significant association between Thought Valence and Mood, with more positive inner speech being associated with better mood (Thought Valence accounting for 29.26% of the variance), and (b) a significant association between Attention State and Thought Valence, with inner speech being more positive for present-focused versus mind-wandering moments (Attention State accounting for 0.65% of the variance).

Although not part of our main hypothesis testing, we also found that Clarity and Interestingness were associated with Attention State (i.e., present-focused inner speech was clearer and more interesting). Both were also associated with Thought Valence (i.e., more positive

Table 2
Distributions of Activities Across Present Versus Mind-Wandering Attention States

Activity	Mind wandering (N = 852)	Present (N = 3,602)	Overall (N = 4,454)
Cognitive	157 (18.4%)	1,221 (33.9%)	1,378 (30.9%)
Household	79 (9.3%)	307 (8.5%)	386 (8.7%)
Other	43 (5.0%)	145 (4.0%)	188 (4.2%)
Physical	104 (12.2%)	315 (8.7%)	419 (9.4%)
Restful	337 (39.6%)	975 (27.1%)	1,312 (29.5%)
Social	132 (15.5%)	639 (17.7%)	771 (17.3%)
Total	100%	100%	100%

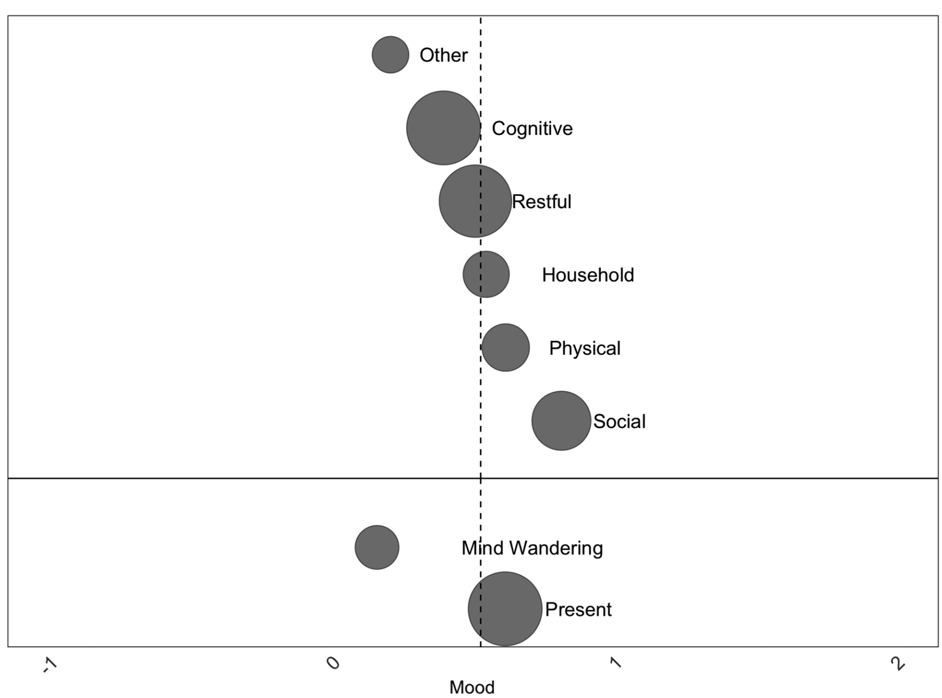
Note. Being Present had a higher proportion of Cognitive Activities, whereas Mind Wandering had a higher proportion of Restful Activities. Although we could not perform chi-square statistics on these data (see Method), this suggests an association between Current Activity and Attention State. Parenthetical values indicate the percentage of prompts in which each activity was selected.

inner speech was clearer and more interesting). Finally, Clarity and Interestingness were interrelated, that is, clearer inner speech was more interesting. The interplay of all these additional variables in our models is described under "*Covariates*," below.

Visual Depictions

In order to visualize our conceptual replication of Killingsworth and Gilbert (2010), in Figure 2, we plot mean Mood scores (averaged across prompts) for Present versus Mind-Wandering prompts and for each of the six activities. Overall, the mean Mood score across all 4,454 Inner Speech prompts was slightly greater than the midpoint of zero (M = 0.53, SD = 1.41), which is presented as a dashed vertical line. Collapsing across Current Activity, being Present, which accounted for 80.87% of the prompts, was associated with better mood (N = 3,602 prompts, M = 0.61, SD = 1.40) than Mind Wandering (N = 852 prompts, M = 0.16, SD = 1.40). Collapsing across Attention State, the most commonly reported activity was "Cognitive" (30.94% of the prompts), while "Other" was the least commonly reported activity (4.22% of the prompts). "Social" Activity displayed the highest mean mood (N = 771 prompts, M = 0.81, SD = 1.55), followed by "Physical" (N = 419 prompts, M = 0.62, SD = 1.44), "Household" (N = 386 prompts, M = 0.55, SD = 1.37), "Restful" (N = 1,312 prompts, M = 0.51, SD = 1.33),

Figure 2
Mean Mood for Each Activity and Each Attention State



Note. Activity is shown on top and Attention State on bottom. Dashed line indicates mean Mood across all prompts. Bubble size indicates the frequency of occurrence.

"Cognitive" (N = 1,378 prompts, M = 0.40, SD = 1.35), and Other (N = 188 prompts, M = 0.21, SD = 1.67). Note the range of Mood scores associated with Attention State (0.45) was very similar to that for Current Activity (0.41) if "Other" is not included in the latter.

Covariates

Before moving on with our main analyses, we asked whether Current Activity, Clarity, and Interestingness should be included as covariates in our multilevel models. Though we had no strong a priori hypotheses about these three variables, pilot data and the current data (see Tables 1 and 2) show that they are associated with both Attention State and Mood. Including them in our models therefore addresses their potential confounding effects when measuring the unique contribution of Attention State to Mood. We found that including these covariates improved all model fits compared to models without the covariates. Therefore, all reported MLM analyses include these covariates with the following notable exception that we return to in the Discussion: The effect of Attention State went from predicting 1.20% of the variance in Mood without including these three variables as covariates to predicting 1.07% of the variance when including them.

Does Attention State Predict Mood?

As a first step, we ran a MLM with Mood as the dependent variable, Attention State as a contrast-coded predictor variable (fixed effect), Current Activity, Clarity, and Interestingness as covariates (fixed effects), and Participant ID as a random intercept effect (Table 3, left panel). The results revealed a main effect of Attention State (β = .20, p < .001, 95% CI [0.15, 0.25]), which uniquely predicted 1.07% of the variance in Mood, with better Mood for Present versus Mind-Wandering prompts. This effect, which is quite small, is markedly lower than that observed in the original Killingsworth and Gilbert (2010) study, which we address in more detail in the Discussion. Notably, all three covariates also had a significant main effect on Mood in this model, uniquely accounting for 0.8% (Current Activity), 0.6% (Clarity), and 2.1% (Interestingness) of the variance in Mood.

Does Thought Valence Account for the Relationship Between Attention State on Mood?

Even though the effect of Attention State on Mood was observed to be small, it was still significant, and so, we moved on to ask whether the effect might be accounted for by Thought Valence. To this end, in our next step, we added Thought Valence to the model as a fixed effect, and the results are shown in Table 3 (right panel). The model revealed a main effect of Thought Valence on Mood (β = .60, p < .001, 95% CI [0.57, 0.63]), which uniquely predicted 22.16% of the variance in Mood, with better mood for more positive inner speech content. With Thought Valence included in the model, the effect of Attention State on Mood was substantially reduced (β = .13, p < .001, 95% CI [0.09, 0.17]), uniquely predicting 0.46% of the variance. These results suggest that the relationship between Attention State and Mood is partially accounted for by Thought Valence and that once accounted for, the unique effect of Attention State is extremely small. Of note, the inclusion of Thought Valence also reduced the effect of the three covariates on Mood.

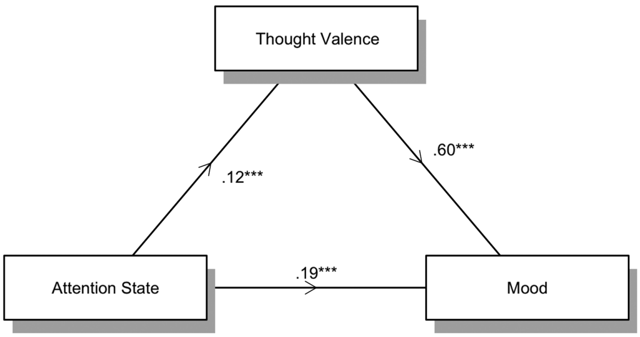
To further investigate the role of Thought Valence on the relationship between Attention State and Mood, we used the Mediation package in R (Tingley et al., 2014), including

Table 3
Variables Predicting Mood

	Attention state model				Mediation of valence model			
Predictor	Estimate	CI	p	Pseudo-R^2	Estimate	CI	p	Pseudo-R^2
Intercept	0.13	[0.02, 0.24]	**.017**		0.33	[0.23, 0.42]	**<.001**	
Activity				0.008				0.002
Household	0.14	[0.01, 0.28]	**.042**		0.06	[−0.05, 0.17]	.305	
Physical	0.25	[0.12, 0.38]	**<.001**		0.11	[0.00, 0.22]	**.046**	
Other	−0.09	[−0.28, 0.10]	.362		−0.02	[−0.18, 0.13]	.756	
Restful	0.19	[0.09, 0.28]	**<.001**		0.12	[0.04, 0.20]	**.003**	
Social	0.33	[0.22, 0.44]	**<.001**		0.19	[0.10, 0.28]	**<.001**	
Clarity	0.09	[0.06, 0.12]	**<.001**	0.006	0.03	[0.00, 0.05]	**.037**	0.001
Interestingness	0.17	[0.14, 0.20]	**<.001**	0.021	0.07	[0.05, 0.10]	**<.001**	0.004
Attention state	0.20	[0.15, 0.25]	**<.001**	0.011	0.13	[0.09, 0.17]	**<.001**	0.005
Thought valence					0.60	[0.57, 0.63]	**<.001**	0.222
Random effects								
σ^2	1.31				0.91			
τ_{00}	$0.52_{\text{Participant}}$				$0.48_{\text{Participant}}$			
ICC	0.29				0.35			
N	$337_{\text{Participant}}$				$337_{\text{Participant}}$			
Observations	4,454				4,454			
Marginal R^2/conditional R^2	0.059/0.328				0.274/0.525			

Note. *Left Panel*: Model asking if Attention State predicts Mood. *Right Panel*: Model asking if adding Thought Valence to the previous model lowers the effect of Attention State. Beta estimates are unstandardized. For continuous variables, positive effect sizes represent that an increase in the predictor variable is associated with an increase in Mood (and vice versa for negative effect sizes). For Attention State, a positive effect size means that Mood is higher for Present versus Mind-Wandering moments. For Activity, a positive effect size means that Activity led to better mood than did the referent level of Cognitive Activity (and vice versa for negative effect sizes). Current Activity and Clarity are included as covariates. Values in bold indicate statistical significance. CI = confidence interval; ICC = intraclass correlation coefficient.

Figure 3
Multilevel Mediation Model



Note. The model reveals that after accounting for the effects of Current Activity, Clarity, and Interestingness, the effect of Attention State on Mood is partially mediated by Thought Valence; being present is associated with more positive thought valence, which, in turn, is associated with better mood. *** $p < .001$.

the covariates (Current Activity, Clarity, and Interestingness) to quantify the indirect effect. As Figure 3 illustrates, the coefficient between Attention State and Thought Valence and the coefficient between Thought Valence and Mood were both significant. A 95% confidence interval of the indirect effect was computed by using a quasi-Bayesian approximation using 1,000 simulations. The indirect effect was (.12) × (.60) = .07, and the 95% confidence interval ranged from .05 to .11. Thus, the indirect effect was statistically significant ($p < .001$). That is, of the estimated 0.19 unit increase in Mood that appears to be due to Attention State, an estimated .07 of that is actually a result of Thought Valence changes generated by Attention State, while the remaining 0.12 is from Attention State itself. Put another way, the proportion of the effect of Attention State on Mood that was mediated by Thought Valence was 37.04%.

Age Moderates the Relationship Between Attention State and Mood

In exploratory analyses, we examined whether any trait-level variable (including all demographics, and the two trait measures—the Five Facet Mindfulness Questionnaire and the NEO Five-Factor Inventory) moderated the relationship between Attention State and Mood, with the idea that this relationship might be stronger for certain types of people. To test this, we added the trait-level variables and the cross-level interaction term for each variable with Attention State to the model in Table 3 (left panel) as fixed effects. The only interaction we found to be significant (with an α lowered to $p < .01$ given our multiple tests) was with Age ($\beta = .03$, $p < .001$, 95% CI [0.01, 0.04]), which uniquely predicted 0.20% of the variance in Mood. Post hoc analysis revealed two ways to describe the interaction (presented in Figure 4). The first way is to note that, for present-focused moments, older people are happier than younger people (and the reverse age trend is seen for mind-wandering moments). The more obvious way to explain the interaction is to note that the relationship between Attention State and Mood grows stronger with increasing age (this effect is seen despite the age range being relatively limited given the student sample used). This effect of age, together with the fact that our sample was much younger than that of Killingsworth and Gilbert (2010), might explain why they found that Attention State explained more variance in Mood than found in the present study, which we return to in the Discussion.

Discussion

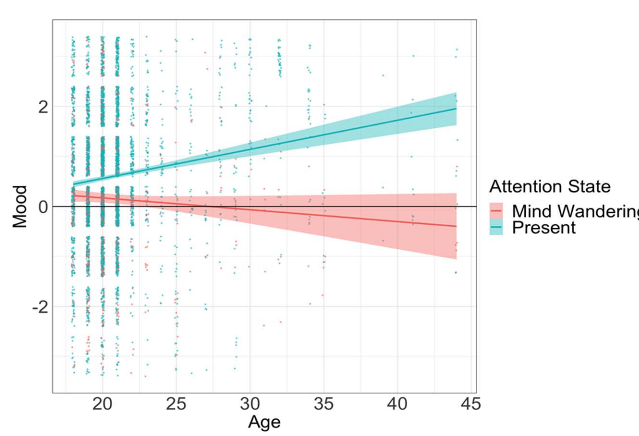
Although several studies have examined the effects of attention state on mood, the present study is one of the first attempts to investigate how various thought qualities that naturally occur across different attention states impact concurrent mood. Corroborating the results of Killingsworth and Gilbert (2010), we show that attention state does matter; an individual's mood is more negative when mind wandering than when present. Unlike their study, however, which asked participants about thought valence only for mind-wandering moments, we inquired about thought valence for *both* mind-wandering and present moments. This allowed us to reveal that the relationship between attention state and concurrent mood is partially accounted for by thought valence. More precisely, mind wandering appears to be associated with more negative thoughts, which helps explain its association with poorer mood.

While our findings demonstrate that the inclusion of thought valence substantially reduces the relationship between attention state and concurrent mood, it is important to point out that the present study was not designed to speak to the question of causality. One way to establish causality is through the use of *time-lagged* methodology (either within an ESM or laboratory-based design), showing that the state of one variable at time 0 predicts the state of another at time 1. Although no single study has used time-lagged methodology to investigate the causal relationship between all three variables of interest, that is, attention state, mood, and thought valence, the causal relationship between *pairs* of these variables has been investigated in previous studies.

Previous Literature Showing Evidence for Causality

First, with regard to the relationship between attention state and mood (path c in Figure 1), results from time-lagged ESM studies have been mixed. While some studies report that a mind-wandering

Figure 4
Age Moderates the Relationship Between Attention State and Mood



Note. The effect of Attention gets stronger with age. See the online article for the color version of this figure.

state precedes a subsequently negative mood (Killingsworth & Gilbert, 2010; Welz et al., 2018), others have failed to observe this relationship (Mills et al., 2021; Poerio et al., 2013). In fact, Poerio et al. (2013) observed the opposite causal direction, that is, a negative mood precedes a subsequently wandering mind, although this was not observed in Killingsworth and Gilbert (2010) nor Mills et al. (2021). These mixed results in ESM-based studies may be due to differences in the amount of time between prompts; if a study presents prompts too far apart, the causal relation between constructs would likely be missed (see Mason et al., 2013, for more discussion on this criticism). For example, the greater the time in between prompts, the greater the chance that intervening life events can muddle the relationship between constructs measured at those time points. Another reason for mixed results could be due to differences in the analytical approach (e.g., controlling vs. not controlling for *concurrent* mood in the statistical analysis).

In contrast to ESM designs, laboratory-based studies can offer better control for examining causal relationships between constructs. Here, participants are randomly prompted while they engage in a cognitive task that is minimally demanding, and thus likely to induce mind wandering. In these contexts, mind wandering is operationalized by the degree of task unrelatedness. The general consensus from these studies is that attention state predicts subsequent mood (Marchetti et al., 2012; Ruby et al., 2013; Wilson et al., 2014), specifically, greater task unrelatedness at time 0 predicts poorer mood at time 1 (noting that Ruby et al. observed a "two-way" street, in that poorer mood at time 0 also predicts greater task unrelatedness at time 1). However, several criticisms have arisen regarding the generalizability of findings regarding task-unrelated thoughts induced in a laboratory setting compared to other forms of naturally occurring mind wandering (e.g., see Murray et al., 2020). In sum, although more studies are needed, there is at least some evidence to suggest that attention state predicts mood.

Next, the relationship between thought valence and mood (path b in Figure 1) has also been investigated in some of the lab-based, time-lagged, studies mentioned above. Specifically, Marchetti et al. (2012) and Ruby et al. (2013) reported that more positive thoughts precede subsequently more positive mood (also see Welz et al., 2018). This causal relationship between thought valence and mood was also reported in the ESM, time-lagged, study of Poerio et al. (see above), although here it was found to be bidirectional, that is, thought valence predicted mood and vice versa.

Finally, with regard to the relationship between attention state and thought valence (path a in Figure 1), time-lagged studies are unfortunately lacking. In addition to there being no ESM studies that address this question, only the lab-based study of Marchetti et al. (mentioned above) investigated whether attention state at time 0 predicts thought valence at time 1. They found that while mind wandering did not increase negative thinking during the task, it increased *accessibility* to negative thought content after the task. Accessibility to negative cognitions was measured using a Scrambled Sentences Test in which participants rearrange scrambled words to form either positive or negative sentences. Following mind wandering, a greater ratio of negative interpretations was observed. Thus, there is at least some time-lagged evidence to suggest that attention state has a causal effect on thought valence, or more specifically, that mind wandering leads to more negative thoughts.

Outside the realm of time-lagged studies, however, there is an intuitive reason to believe that the opposite is true, that is, thought valence has a causal effect on attention state. For example, if one spontaneously experiences a troubling (negative) thought while attempting to complete a task, this may create a particularly compelling urge to prioritize thinking through the concern at the expense of paying attention to the task at hand. This direction of causality is supported by studies showing that *inducing* negative thought valence in people (e.g., by delivering distressing news, presumably resulting in negative thoughts) leads to greater mind wandering during task engagement (e.g., Antrobus et al., 1966; Smallwood et al., 2009). Future experimental or time-lagged studies are therefore required to clarify the direction of causality between attention state and thought valence.

Thought Valence Versus Attention State

Regardless of the direction of causality, the prominent role that thought valence plays in predicting mood suggests that rather than changing the frequency of a particular attention state (such as through mindfulness practices aimed at promoting increased frequency of present-focused attention), individuals may want to focus more on changing the valence and quality of one's thoughts—a notion that is in line with cognitive behavioral therapy (Beck, 1997; Hofmann et al., 2012). At first glance, this suggestion might seem contradictory to a large volume of research showing the benefits of mindful meditation on improving mood (Eberth & Sedlmeier, 2012; Pascoe et al., 2021; Rodrigues et al., 2017). However, mindfulness is multifaceted with the most common definitions consisting of at least two facets: present-focused attention *and* an attitude of acceptance/nonjudgment (Bishop et al., 2004). It is therefore unclear which facet underlies the improvements in mood. Future research that explores the effects of different components of mindfulness in naturalistic settings will be needed to answer this question (Raynes & Dobkins, 2024).

Is Mind Wandering Really Associated With Poor Mood?

The present study shows that the poorer mood associated with mind wandering is reduced when other qualities of thought are considered. Specifically, we find that thought valence substantially accounts for the relationship between attention state and concurrent mood. And we find similar (albeit smaller) roles of thought interestingness and clarity, as both of these constructs were found to be associated with attention state and with mood. The finding that thought interestingness is associated with mood corroborates a previous study by Franklin, Mrazek, et al. (2013) showing that off-task thoughts rated as more interesting during daily life are associated with a better mood (noting that this study only assessed the interestingness of the content of mind-wandering episodes, and not present-focused ones). Such findings further illustrate the importance of taking into consideration the quality of thought contents when investigating the relationship between mind wandering and mood.

In fact, despite the generally poor reputation surrounding mind wandering, there are several (perhaps underappreciated) studies indicating that mind wandering can offer benefits, such as entertainment (Franklin, Mrazek, et al., 2013), feelings of social bond and connection (Poerio et al., 2015), emotional respite from boring or stressful circumstances (e.g., Molstad, 1986), as well as being potentially important for creative thinking in both daily life (e.g., Gable et al., 2019) and in the laboratory (e.g., Baird et al., 2012; but see Murray et al., 2024, for null results). These findings are underscored by recent studies indicating that the beneficial side of mind wandering can even be enhanced. For instance, recent studies have shown that certain activities, such as listening to positive music, can promote more pleasant mind wandering (Koelsch et al., 2019; Taruffi, 2021; Taruffi et al., 2017).

The Small Yet Reliable Effect of Attention State on Mood

Despite the potential benefits of mind wandering in certain situations, the present study still found a significant (albeit small) effect of attention state when all potential confounding variables were considered. As such, we are in agreement with the conclusions of the original ESM study of Killingsworth and Gilbert (2010), but caution that the effect of attention state on mood might be greatly overstated in the literature. Interestingly, the present study finds smaller effects of attention state on mood (accounting for 1.2% of the variance, when not taking other variables into account) as compared to Killingsworth and Gilbert (2010). Although their 2010 article did not report on the pseudo-R^2, through personal communication, they reran these statistics using their original data and models and reported to us that attention state accounted for 4% of the variance in mood (and that thought valence in mind-wandering moments accounted for 13% of the variance in mood). One possibility for why the effect size of the Killingsworth and Gilbert study is roughly fourfold of the present study may be related to sample demographics, such as age; the mean age of our sample (21 years) was substantially lower than that of the Killingsworth and Gilbert study (34 years). This difference in age between studies, together with our finding that the effect of attention state on mood is larger for older people in our sample (see Figure 4), might partially explain why attention state explained more variance in mood in their study compared to the present study.

In addition to differences in effect sizes between Killingsworth and Gilbert (2010) and the present study, we also observed a lower frequency of mind-wandering prompts (23.6% of all prompts; 36.1% of Inner Speech prompts), which is on par with previous reports (e.g., Kane et al., 2007; Song & Wang, 2012), than they did (46.9% of prompts). While some of this difference might be explained by age differences (as mind wandering has been reported to be higher in older people: Maillet et al., 2018; McVay et al., 2013; Moran et al., 2021), there is also some evidence that this discrepancy may be due to the ethnoracial makeup of our sample, which was predominantly Asian. For example, in an ESM study with a similar demographic makeup to ours (undergraduate Chinese students, 70% female), an average of 24.4% of prompts involved mind wandering (Song & Wang, 2012), similar to us. Further studies are required to understand who, when, and why some people mind wander more frequently than others.

Constraints on Generality

The main limitations in the generality of our findings stem from the aforementioned demographics of our sample, that is, the relatively low average age and predominately Asian ethnoracial composition. Given that our study used student populations, future research could include targeted examinations of demographic factors to understand how they may influence the observed patterns.

Conclusion

In conclusion, the current findings suggest that an individual's mood is more negative when mind wandering than when present and that this may be due, in part, to a tendency for a wandering mind to think more negative thoughts, which then leads to poorer mood. These findings have real-world implications, suggesting that interventions that train people to be more present (through mindfulness practices) or to change their thought content (through cognitive behavioral therapy) are likely to benefit mood.

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