

# COVID-19 on Mind: Daily Worry About the Coronavirus Is Linked to Negative Affect Experienced During Mind-Wandering and Dreaming

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Despite a surge of studies on the effects of COVID-19 on our well-being, we know little about how the pandemic is reflected in people's spontaneous thoughts and experiences, such as mind-wandering (or daydreaming) during wakefulness and dreaming during sleep. We investigated whether and how COVID-19-related general concern, anxiety, and daily worry are associated with the daily fluctuation of the affective quality of mind-wandering and dreaming, and to what extent these associations can be explained by poor sleep quality. We used ecological momentary assessment by asking participants to rate the affect they experienced during mind-wandering and dreaming in daily logs over a 2-week period. Our preregistered analyses based on 1,755 dream logs from 172 individuals and 1,496 mind-wandering logs from 152 individuals showed that, on days when people reported higher levels of negative affect and lower levels of positive affect during mind-wandering, they experienced more worry. Only daily sleep quality was associated with affect experienced during dreaming at the within-person level: on nights with poorer sleep quality people reported experiencing more negative and less positive affect in dreams and were more likely to experience nightmares. However, at the between-person level, individuals who experienced more daily COVID-19 worry during the study period also reported experiencing more negative affect during mind-wandering and during dreaming. As such, the continuity between daily and nightly experiences seems to rely more on stable trait-like individual differences in affective processing.

**Keywords:** COVID-19, emotion, spontaneous thought, mind-wandering, dreaming

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Online instructions, measures, preregistered hypotheses, analysis plan, deidentified data, and analysis scripts can be found at the project's Open Science Framework page: <https://osf.io/su7mn/>.

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The ongoing coronavirus (COVID-19, SARS-Cov-2) pandemic poses a major threat to public health and continues to have a large impact on the daily experiences and mental well-being of individuals across the world. Surveys show that many people are concerned about themselves or their family members contracting the virus (Lieberoth et al., 2021; Rossell et al., 2021). These concerns, together with social isolation, are associated with increased mental health issues, such as stress, anxiety, and depression (Aknin et al., 2022; Jia et al., 2020; Okruszek et al., 2020). Because most COVID-19-related studies have been cross-sectional surveys focusing on people's general evaluations of their well-being, we know little about how the pandemic has shaped our inner thoughts and experiences.

When humans encounter a threatening event or a natural catastrophe, they continue to ponder over it for many days to follow (Iyadurai et al., 2019). The mind provides a virtual space to reexperience such encounters in a safe environment, where we can model environmental risks and our own optimal responses (Foulkes, 1985; Hobson, 2009; Nielsen, 2010; Revonsuo, 2006; Windt, 2015). Such virtual rehearsal is arguably especially helpful for an ongoing prolonged threat because our behavior needs to be continuously adjusted to the changing nature of the threat. Interestingly, threatening and novel events occupy our minds not only during wakefulness, when we drift between mind-wandering (or daydreaming) and more attentive states, but also during sleep and dreaming (Fox & Christoff, 2018; Nielsen & Stenstrom, 2005; Revonsuo, 2000; Smallwood & Schooler, 2015; Valli et al., 2006). In fact, we spend a large part of our lives mind-wandering (Kane et al., 2017; Killingsworth & Gilbert, 2010) and dreaming (Siclari et al., 2017, 2018; Sikka et al., 2014). The affective quality of these experiences is tightly linked to well-being (DuPre & Spreng, 2018; Fox et al., 2018; Levin & Nielsen, 2007; Nolen-Hoeksema et al., 2008). Here, we investigated how a prolonged exposure to threat in the form of the COVID-19 pandemic—simultaneously experienced by virtually all humans—is reflected in the daily fluctuation of the affective quality of mind-wandering and dreaming.

According to recent theoretical frameworks, mind-wandering and dreaming are both spontaneous experiences that unfold largely independently of one's actual environment and ongoing tasks or activities (Christoff et al., 2016; Windt, 2021). Despite occurring in different behavioral and neurophysiological states—mind-wandering during wakefulness and dreaming during sleep—they are assumed to be generated by the same mechanisms (Domhoff, 2018; Fox et al., 2013; Seli et al., 2018; Sikka, Valli, et al., 2021). The difference is that mind-wandering is more constrained by sensory input and cognitive control mechanisms than dreaming (Christoff et al., 2016): whereas during mind-wandering we know that we are mind-wandering and have at least some sense of awareness of our surrounding environment, during dreaming we are typically fully immersed in an internally generated hallucinatory world unaware of the fact that we are dreaming. Also, whereas mind-wandering can be intentional or deliberate (Seli et al., 2016, 2018), dreaming is fully spontaneous (except for lucid dreaming which is more controlled). Despite these differences, mind-wandering is considered continuous with dreaming (Domhoff, 2018; Fox et al., 2013; Klinger, 2013; Schredl, 2003; Sikka, Valli, et al., 2021; Wamsley, 2013; Windt, 2021). In fact, some describe dreaming as an intensified form of mind-wandering (Domhoff, 2018; Domhoff & Fox, 2015). Both mind-wandering and dreaming

have been proposed to reflect an individual's current concerns (Domhoff, 2018; Klinger, 1971, 2009). Current concerns may even trigger spontaneous experiences, especially when they are pressing and significant (Klinger, 1971, 2009). These spontaneous experiences in the form of mind-wandering and dreaming are, in turn, involved in the processing of past memories and in the simulation of possible future events so as to better prepare for and cope with those (Fox et al., 2013; Revonsuo et al., 2015; Smallwood & Andrews-Hanna, 2013; Smallwood & Schooler, 2015; Wamsley, 2013). As such, given the proposed continuity between our daytime and nighttime experiences, and the putative function of spontaneous experiences, we can expect the COVID-19 pandemic to crop up in our spontaneous experiences during wakefulness and sleep.

As the pandemic took hold, the media was suddenly populated with news and anecdotal accounts of vivid, bizarre, and anxiety-ridden pandemic dreams and nightmares (Nielsen, 2020). Several websites (e.g., <https://www.idreamofcovid.com/>) and Twitter handles (e.g., @IDreamofCovid) were created for people to report their pandemic dreams. Providing scientific support for popular claims, research studies started to explore how the COVID-19 pandemic has changed sleep quality and dreaming. Studies comparing the pandemic versus the prepandemic periods, or the lockdown versus the pre- or postlockdown periods, report enhanced sleep difficulties (Kennedy et al., 2022; Pesonen et al., 2020), increased dream recall frequency (Alfonsi et al., 2022; Fränkl et al., 2021), increased negative and decreased positive affectivity of dreams (Barrett, 2020; Gorgoni et al., 2021; Schredl & Bulkeley, 2020), and increased frequency of nightmares (Fränkl et al., 2021; Musse et al., 2020; Scarpelli et al., 2021). Several studies have reported explicit references to coronavirus appearing in dreams (Kennedy et al., 2022; Kilius et al., 2021; Pesonen et al., 2020; Šćepanović et al., 2022). It has also been shown that these changes are specifically characteristic to those who experience higher levels of stress, depression, or anxiety (Dal Santo et al., 2022; Kennedy et al., 2022; Pesonen et al., 2020; Solomonova et al., 2021; Wu et al., 2020) and to those who are more affected by COVID-19 (Iorio et al., 2020; Scarpelli et al., 2021; Schredl & Bulkeley, 2020).

However, the majority of these studies have used retrospective questionnaires to measure general changes in sleep quality and dream content or asked people to provide examples of COVID-19 dreams or the most recent dreams they remember. This is problematic because such questionnaires rely on people's general evaluations or beliefs about their dream experiences, rather than (memories of) systematically recorded dream experiences as such (Sikka, 2019, 2020; Windt, 2015). Memories of dream experiences are fleeting (Koulack & Goodenough, 1976; Parke & Horton, 2009) so it is questionable whether people can accurately remember the frequency and content of dreams they had weeks or months ago before the pandemic or lockdown. For example, it has been shown that questionnaires versus daily measures of dream recall frequency (Aspy, 2016), nightmare frequency (Robert & Zadra, 2008; Zadra & Donderi, 2000), and dream affect (Schredl, 2002) yield different results. Similarly, asking people to provide examples of specific (such as COVID-19-related), or the most recent, dreams constitute a very selective and biased sample of the most memorable or emotional dream experiences (Sikka, 2019). Thus, using such retrospective questionnaires, it is not surprising to observe a rise in pandemic-related negative dreams and nightmares since this corresponds to our beliefs and expectations.

Very few studies of pandemic dreaming have used ecological momentary assessment (Shiffman et al., 2008)—a method that more likely captures momentary experiences and is less susceptible to memory and reporting biases. Using this method, participants have been asked to keep a dream log (or diary) over a longer period of time and to report dreams immediately upon awakening (Alfonsi et al., 2022; MacKay & DeCicco, 2020; Mota et al., 2020; Scarpelli et al., 2022). These studies have painted a more ambiguous picture. On the one hand, pandemic dream reports, compared to prepandemic reports, have been found to contain a higher proportion of words related to anger and sadness (with no differences in anxiety, or other positive and negative emotion, words; Mota et al., 2020) and more virus-related content (MacKay & DeCicco, 2020). On the other hand, a study comparing lockdown and postlockdown periods in Italy reported increased dream recall frequency during lockdown, but no differences in dream features, including dream affect (Scarpelli et al., 2022). One explanation for the mixed findings may be that these studies did not investigate how daily fluctuation of worry about COVID-19 is associated with dream features or to what extent sleep quality can explain this relationship. Arguably, changes in dream experiences are more likely on days when people are more concerned and worried about, or affected by, COVID-19 in their daily life. In fact, according to the continuity hypotheses (Domhoff, 1996, 2017; Schredl & Hofmann, 2003) and the threat simulation theory (Revonsuo, 2000) of dreaming, the more concern and threat people have on particular days, the more negative their dreams should be on subsequent nights.

In addition to a direct link between daytime and nighttime subjective experiences, another possible explanation is that COVID-19-related changes in daytime behavior and psychological well-being, in particular COVID-19 anxiety and worry, may disrupt sleep quality, leading to more frequent awakenings. This may, in turn, increase the recall of predominantly negative dreams (Bottary et al., 2020; Conte et al., 2022). Thus, it would be important to control for sleep quality when investigating dream affect.

Surprisingly, very few studies have investigated mind-wandering during COVID-19. In one recent experience sampling study (McKeown et al., 2021), prelockdown and lockdown periods in the United Kingdom were compared with respect to features of (task-related and spontaneous) thought patterns and related affect. Whereas there were no differences in negative affect, lockdown was characterized by a smaller increase in positive affect evoked by social interactions. However, in this study, mind-wandering was not investigated separately but combined with task-related thoughts. In other survey studies, individuals with maladaptive daydreaming—a condition characterized by excessive and disruptive daydreaming—who followed lockdown restrictions reported spending more time daydreaming, having more intense and vivid daydreams (Somer et al., 2020) and experienced higher levels of anxiety and depression during the COVID-19 lockdown (Musetti et al., 2021). Moreover, those who were required to self-quarantine were more likely to engage in maladaptive daydreaming (Metin et al., 2021). The drawback of these studies is that they only focused on a maladaptive form of mind-wandering and did not assess the daily fluctuation of the affective dimension of mind-wandering.

Given the scarcity of studies following people's subjective experiences during the COVID-19 pandemic, it remains to be determined whether those who are more worried about COVID-19 indeed experience more negative, and less positive, spontaneous experiences and to what extent this association can be explained by poor sleep quality.

## The Present Study

Here, we investigated whether and how COVID-19-related concern, anxiety, and worry are associated with affect experienced during waking mind-wandering and nighttime dreaming, while controlling for sleep quality. We preregistered the following hypotheses (<https://osf.io/ncwf6/>; Sikka, Bekinschtein, et al., 2021).

Individuals with higher levels of general COVID-19-related concern and anxiety report more negative and less positive affect during mind-wandering (H1a, H1b), dreaming (H2a, H3a), and are more likely to have nightmares (H4a). The relationships regarding dreaming and nightmares remain even when controlling for daily sleep quality (H2b, H3b, H4b).

On days with more COVID-19-related worry, people report more negative and less positive affect during mind-wandering (H5a, H5b), dreaming (H6a, H7a), and are more likely to have nightmares (H8a). The relationships regarding dreaming and nightmares remain even when controlling for daily sleep quality (H6b, H7b, H8b).

Individuals who themselves belong to a risk group, or whose close ones belong to a risk group, report more negative and less positive affects during mind-wandering (H9a, H9b), dreaming (H10a, H11a), and more frequent nightmares (H12a). The relationships regarding dreaming and mind-wandering remain even when controlling for daily sleep quality (H10b, H11b, H12b). All hypotheses, together with the study variables, can be seen in detail in Table 1.

## Method

### Transparency and Openness

Below, we report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study. Upon data collection, but before testing hypotheses, we preregistered our hypotheses and analysis plan on the Open Science Framework. The instructions, measures, preregistered hypotheses, analysis plan, deidentified data, and analysis scripts can be found at <https://osf.io/su7mn/>.

### Participants

We collected data in the United Kingdom and Australia during a 4-month period (July–November 2020; see Figure 1a) via press releases and online social media advertisements. Altogether, 294 participants provided 2,604 daily dream logs, and 261 participants provided 1,767 daily mind-wandering logs.

According to Arend and Schäfer (2019), for two-level models that would yield sufficient power ( $\geq .80$ ) to detect at least medium level-1 effect sizes, the sample size at level 1 should be at least three and at level 2 at least 40. Thus, in the analyses, we included only those participants who provided at least three dream and/or mind-wandering logs.

Of the original 2,604 daily dream logs, after excluding the logs not fulfilling the criteria (see Data Preprocessing), 1,832 logs from 230 participants remained. Of those, 172 participants provided at least three dream reports. Thus, 172 participants (25 men, 139 women, eight “other”; mean age  $46.99 \pm 14.80$  years, range 19–78) and 1,755 dream logs ( $M = 10.20$ ,  $SD = 6.04$ ) remained for the main analyses. Of those participants, 64 were from Australia and 108 from the United Kingdom.

Of the original 1,767 daily mind-wandering logs, after excluding the logs not fulfilling the criteria (see Data Preprocessing), 1,579

**Table 1***Hypotheses of the Study and the Dependent and Independent Variables Used to Test These*

	Hypothesis	Dependent variable	Independent variables (predictors)	Hypothesis confirmed
1a	Individuals with higher levels of general COVID-19-related concern and anxiety report more negative emotions during mind-wandering	Mind-wandering NA	General COVID-19 concern self/others General COVID-19 concern countries General COVID-19 anxiety Age Gender Country	No
1b	Individuals with higher levels of general COVID-19-related concern and anxiety report less positive emotions during mind-wandering	Mind-wandering PA	General COVID-19 concern self/others General COVID-19 concern countries General COVID-19 anxiety Age Gender Country	No
2a	Individuals with higher levels of general COVID-19-related concern and anxiety report more negative emotions during dreaming	Dreaming NA	General COVID-19 concern self/others General COVID-19 concern countries General COVID-19 anxiety Age Gender Country	No
2b	Individuals with higher levels of general COVID-19-related concern and anxiety report more negative emotions during dreaming, even when controlling for daily sleep quality	Dreaming NA	General COVID-19 concern self/others General COVID-19 concern countries General COVID-19 anxiety Daily sleep quality Age Gender Country	No
3a	Individuals with higher levels of general COVID-19-related concern and anxiety report less positive emotions during dreaming	Dreaming PA	General COVID-19 concern self/others General COVID-19 concern countries General COVID-19 anxiety Age Gender Country	No
3b	Individuals with higher levels of general COVID-19-related concern and anxiety report less positive emotions during dreaming, even when controlling for daily sleep quality	Dreaming PA	General COVID-19 concern self/others General COVID-19 concern countries General COVID-19 anxiety Daily sleep quality Age Gender Country	No
4a	Individuals with higher levels of general COVID-19-related concern and anxiety are more likely to experience nightmares	Presence of nightmare	General COVID-19 concern self/others General COVID-19 concern countries General COVID-19 anxiety Age Gender Country	No
4b	Individuals with higher levels of general COVID-19-related concern and anxiety are more likely to experience nightmare, even when controlling for daily sleep quality	Presence of nightmare	General COVID-19 concern self/others General COVID-19 concern countries General COVID-19 anxiety Daily sleep quality Age Gender Country	No
5a	On days with more COVID-19-related worry, people report more negative emotions during mind-wandering	Mind-wandering NA	Daily COVID-19 worry Age Gender Country	Yes
5b	On days with more COVID-19-related worry, people report less positive emotions during mind-wandering	Mind-wandering PA	Daily COVID-19 worry Age Gender Country	Yes
6a	On days with more COVID-19-related worry, people report more negative emotions during dreaming	Dreaming NA	Daily COVID-19 worry Age Gender Country	No <sup>a</sup>
6b	On days with more COVID-19-related worry, people report more negative emotions during	Dreaming NA	Daily COVID-19 worry Daily sleep quality Age	No <sup>a</sup>

*(table continues)*

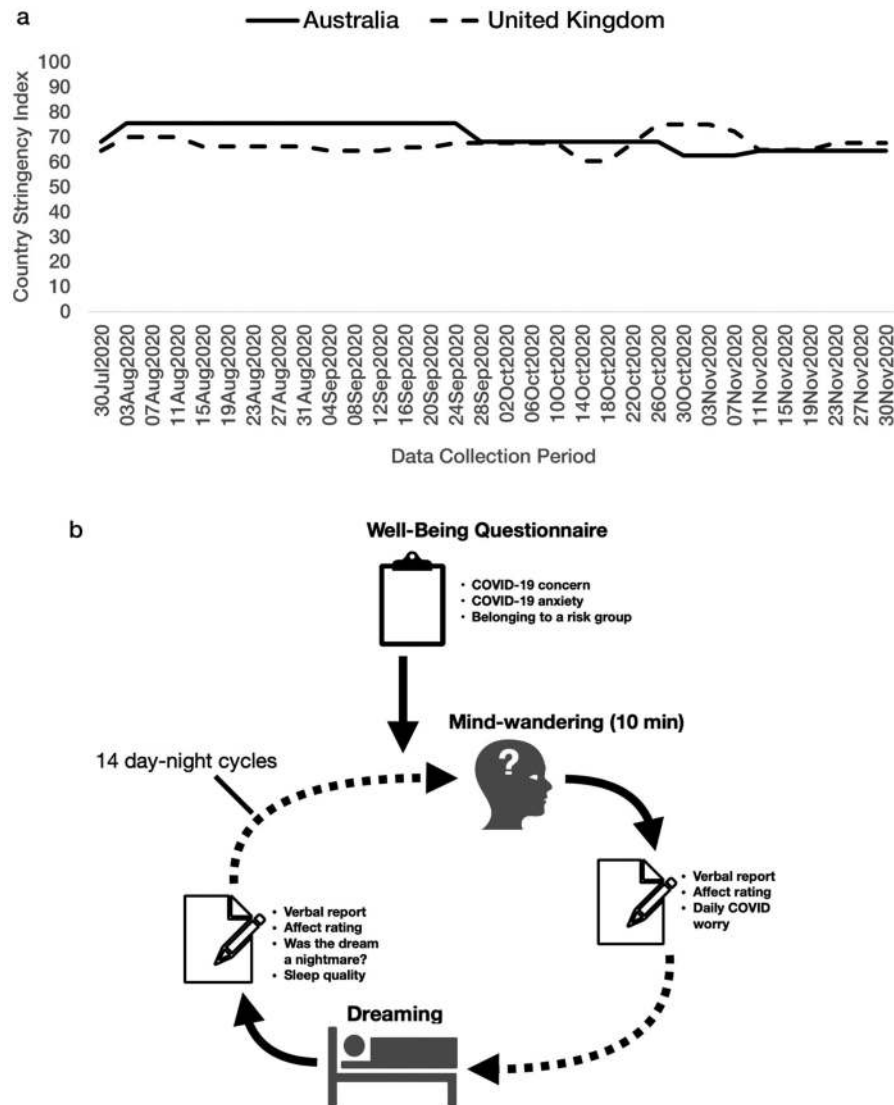
**Table 1** (continued)

	Hypothesis	Dependent variable	Independent variables (predictors)	Hypothesis confirmed
7a	On days with more COVID-19-related worry, people report less positive emotions during dreaming	Dreaming PA	Gender Country Daily COVID-19 worry Age	No
7b	On days with more COVID-19-related worry, people report less positive emotions during dreaming, even when controlling for daily sleep quality	Dreaming PA	Gender Country Daily COVID-19 worry Daily sleep quality Age	No
8a	On days with more COVID-19-related worry, people are more likely to have nightmares	Presence of nightmare	Gender Country Daily COVID-19 worry Age	No
8b	On days with more COVID-19-related worry, people are more likely to have nightmares, even when controlling for daily sleep quality	Presence of nightmare	Gender Country Daily COVID-19 worry Daily sleep quality Age	No
9a	Individuals who themselves belong to a risk group, or whose close ones belong to a risk group, report more negative emotions during mind-wandering	Mind-wandering NA	Country Self in risk group % Close ones in risk group % Age	No
9b	Individuals who themselves belong to a risk group, or whose close ones belong to a risk group, report less positive emotions during mind-wandering	Mind-wandering PA	Country Self in risk group % Close ones in risk group % Age	No
10a	Individuals who themselves belong to a risk group, or whose close ones belong to a risk group, report more negative emotions during dreaming	Dreaming NA	Country Self in risk group % Close ones in risk group % Age	No
10b	Individuals who themselves belong to a risk group, or whose close ones belong to a risk group, report more negative emotions during dreaming, even when controlling for daily sleep quality	Dreaming NA	Country Self in risk group % Close ones in risk group % Daily sleep quality Age	No
11a	Individuals who themselves belong to a risk group, or whose close ones belong to a risk group, report less positive emotions during dreaming	Dreaming PA	Country Self in risk group % Close ones in risk group % Age	No
11b	Individuals who themselves belong to a risk group, or whose close ones belong to a risk group, report less positive emotions during dreaming, even when controlling for daily sleep quality	Dreaming PA	Country Self in risk group % Close ones in risk group % Daily sleep quality Age	No
12a	Individuals who themselves belong to a risk group, or whose close ones belong to a risk group, are more likely to have nightmares	Presence of nightmare	Country Self in risk group % Close ones in risk group % Age	No
12b	Individuals who themselves belong to a risk group, or whose close ones belong to a risk group, are more likely to have nightmares, even when controlling for daily sleep quality	Presence of nightmare	Country Self in risk group % Close ones in risk group % Daily sleep quality Age	No

Note. NA = negative affect. PA = positive affect.

<sup>a</sup>Daily COVID-19 worry at a between-person level was a significant predictor of negative affect experienced during dreaming. However, preregistered hypotheses focused on within-person relationships, which were not confirmed.

**Figure 1**  
 COVID-19 Government Response Country Stringency Index of Participating Countries (a) and Experimental Design of the Present Study (b)



*Note.* (a) The country stringency index is based on the data provided by the Oxford COVID-19 government response tracker (<https://covidtracker.bsg.ox.ac.uk/>) and it is calculated by averaging nine policy indicators (school closing, workplace closing, cancel public events, restrictions on gatherings, close public transport, stay at home requirements, restrictions on internal movement, international travel controls, and public information campaigns). The index can range from 0 to 100, with higher scores reflecting higher stringency. The figure shows that, during our data collection period, Australia and the United Kingdom had very similar (high) and largely stable level of restrictions. (b) Participants first filled in a Well-Being Questionnaire in which they reported their general COVID-19-related concern and anxiety, and whether they belonged to a COVID-19 risk group. They then engaged in a daily 10-min mind-wandering task. Immediately upon finishing the task, participants filled in a mind-wandering log, in which they provided a verbal report of their mind-wandering experiences, rated the extent to which they experienced negative affect and positive affect during mind-wandering (from 1—*not at all* to 5—*extremely*) and the extent to which they had worried about COVID-19 on that particular day (daily COVID-19 worry; from 1—*not at all* to 5—*very much*). Participants also filled in daily dream logs in which, every morning immediately upon awakening, they provided a verbal report of their dream experiences that night, rated the negative and positive affect they experienced in their dream (from 1—*not at all* to 5—*extremely*), reported whether the dream was a nightmare, and rated their sleep quality that night (daily sleep quality; from 1—*very good* to 4—*very bad*). Mind-wandering and dream logs were filled in daily over a 2-week (14-day) period. In this study, we focused on the affect ratings (not verbal reports) provided by the participants.

logs from 197 participants remained. Of those, 152 participants provided at least three mind-wandering reports. Thus, 152 participants (23 men, 123 women, six “other”; mean age  $48.42 \pm 14.71$  years, range 19–78) and 1,496 mind-wandering logs ( $M = 9.84$ ,  $SD = 5.28$ ) remained for the main analyses. Of those participants, 59 were from Australia and 93 from the United Kingdom.

## Procedure

Data collection took place online. Potential participants were directed to the study’s webpage (<https://sites.utu.fi/mind/en/>). They were asked to carefully read through the general description of the study and all the instructions and then to retrieve a participant ID (a randomly generated number), which they used throughout the study. Then, participants were asked to fill in the well-being questionnaire (WBQ; see Figure 1b), which contained scientifically validated scales measuring different aspects of well-being, sleep quality, dream experiences, and COVID-19-related experiences (see <https://osf.io/rydv3/>). Before answering the questions, participants were asked to (a) confirm whether they are at least 18 years old (in case of answering “no,” participants were directed to the end of the study page) and (b) provide informed consent (in case of answering “no,” participants were directed to the end of the study page). After the WBQ, participants were asked to fill in mind-wandering and dream logs daily over a 2-week period (14 days; see Measures). The mind-wandering and dream logs and related instructions were based on our previous studies in which they have worked well (e.g., Sikka, Revonsuo, et al., 2018; Sikka, Valli, et al., 2021). Participants received no reimbursement for their participation.

The study was carried out in accordance with the Declaration of Helsinki and approved by the Cambridge Psychology Research Ethics Committee and the Monash University Human Research Ethics Committee.

## Measures

### Dependent Variables

**Mind-Wandering.** Participants were asked to fill in a mind-wandering log every day for 2 weeks. First, they were to engage in a 10-min mind-wandering task in the evenings, at a time most convenient for them. For this, they were to find a quiet place free of interruptions and distractions and let their minds wander from thought to thought without any specific task or goal. Immediately after the 10-min period, participants were asked to write down everything that went through their minds (thoughts, feelings, images, and scenarios) as accurately and clearly as possible. They were also instructed to not change the original reports with later omissions, additions, conclusions, or embellishments (for specific instructions, see <https://osf.io/su7mn/>). After writing the report, participants rated the extent to which they experienced positive affect (Mind-wandering PA) and negative affect (Mind-wandering NA) during the 10-min period on a scale ranging from 1 (*not at all*) to 5 (*extremely*).

**Dreaming.** Participants were asked to fill in a dream log every morning immediately upon awakening for 2 weeks. First, participants were asked whether they remembered any dreams that night and to choose one of the three answer options: (a) “Yes, and I remember (at least some of) the contents,” (b) “Yes, I think I had a dream, but I cannot remember anything about it,” and (c) “No, I think I had no dreams tonight.” If participants chose answer options

(b) and (c), they were asked two additional questions (about their sleep quality last night and about the number of people they had social interaction with the day before). If participants chose the answer option (a), they were asked to report their dream(s) that night (in addition to the sleep quality and social interaction questions). Participants were given detailed instructions regarding how to remember and report their dreams (see <https://osf.io/su7mn/>). Briefly, participants were instructed to report their dreams in as much detail (what happened, where, when, who was present, and what they felt and thought) and as accurately as possible. Participants were also asked to not censor their dreams, or try to make them more logical, organized, and complete than they remembered them. After having reported the dream, participants were asked to rate the extent to which they experienced positive affect (Dreaming PA) and negative affect (Dreaming NA) in the preceding dream on a scale ranging from 1 (*not at all*) to 5 (*extremely*). In case participants remembered more than one dream from the night, they were asked to fill in separate dream logs for these.

**Nightmares.** In the daily dream log, after having reported and rated the affect experienced in dreams, participants were also asked to indicate whether the preceding dream was a nightmare (participants were provided with the following definition: “Nightmares are very disturbing and often elaborate dreams in which the unpleasant visual imagery and/or emotions wake you up, that is, the dream’s unpleasant content woke you up while the dream was still ongoing”). Participants answered either “yes” or “no” to this question.

### Independent Variables

**General COVID-19-Related Concern.** In the WBQ, participants answered five questions about how concerned they were about the consequences of the coronavirus for (a) themselves; (b) their family; (c) their close friends; (d) their country; and (e) other countries across the globe. Participants responded on a scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). These questions have been used previously in international studies on COVID-19 and well-being (Lieberoth et al., 2021; Yamada et al., 2021). The mean score of the first three statements (a, b, and c) was used to measure general COVID-19-related concern regarding self and others, whereas the mean score of the two last statements (d and f) was used to measure general COVID-19-related concern regarding countries. The reliability for both composites was good (COVID-19 concern self/others: Cronbach’s  $\alpha = 0.83$ ; COVID-19 concern countries: Cronbach’s  $\alpha = 0.81$ ).

**General COVID-19-Related Anxiety.** In the WBQ, participants also filled in the Coronavirus Anxiety Scale (Botes et al., 2020) in which they were asked how much they worry about (e.g., “I often worry about catching the Coronavirus”) and feel the emotional aspects of anxiety (e.g., “My heart beats faster when I think about catching the Coronavirus”) regarding coronavirus. Participants indicated to what extent they agree with 10 statements on a scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The mean score of the 10 items was used to measure general COVID-19-related anxiety. The scale had good reliability (Cronbach’s  $\alpha = 0.86$ ).

**Daily COVID-19-Related Worry.** In the mind-wandering log, after having provided mind-wandering reports and rated the affect experienced during mind-wandering, participants were also asked to rate to what extent they “have worried about the coronavirus situation today” on a scale ranging from 1 (*not at all*) to 5 (*very much*).

**Belonging to a Risk Group.** In the WBQ, participants were asked to indicate whether they themselves, or any of their close ones, belong to a risk group. Belonging to a risk group was defined as: (a) being over 70 years of age; (b) having preexisting conditions that significantly impair the functioning of the lungs, heart, or immune system; (c) morbid obesity (body mass index >40); and (d) daily smoking. Participants could answer either “Yes” or “No.”

**Daily Sleep Quality.** In the daily dream log, participants were asked to rate the quality of their sleep in the preceding night from 1 (*very good*) to 4 (*very bad*). This item derives from the Pittsburgh Sleep Quality Index (Buysse et al., 1989).

Table 1 provides an overview regarding which dependent and independent variables were used to test each hypothesis.

## Data Preprocessing

We excluded the following data: (a) Answers from participants who do not reside in the United Kingdom or Australia; (b) Answers from participants who did not confirm that they are at least 18 years old; (c) Answers from participants who did not give their consent to participate in the study (i.e., answered “No” to informed consent); (d) Answers provided before July 30, 2020 or after November 30, 2020; (e) Duplicate answers/reports; (f) Incorrect entries/answers/reports (e.g., no actual report provided); (g) If a participant provided several mind-wandering reports/ratings on the same day, then only the ones corresponding to the instructed time period (in the evening) were included; and (h) If a participant had filled in the WBQ more than 1 day after filling in the first daily mind-wandering/dream log.

## Statistical Analyses

Data were analyzed in the R statistical program (R Core Team, 2020) using two-level multilevel, or mixed-effects, regression models (also known as hierarchical models; Hox, 2010) to account for the nested and imbalanced nature of the data. Preregistered analyses are available at <https://osf.io/ncwf6/>

### Models With Ordinal Outcome Variables

Affect ratings for each mind-wandering (Mind-wandering NA, Mind-wandering PA) or dream (Dreaming NA, Dreaming PA) experience were treated as separate level-1 outcome variables. Because Mind-wandering NA, Mind-wandering PA, Dreaming NA, and Dreaming PA are ordinal variables (i.e., discrete responses measured on a 5-point ordinal scale ranging from 1 to 5), for these outcomes we fitted cumulative link mixed-effect models (CLMM) via Laplace approximation using the function *clmm* (with probit link function and equidistant threshold) from the R package *ordinal* (Christensen, 2019). We also carried out secondary non-preregistered analyses using the more traditional linear mixed models (LMM)—which assume that the outcome variable is a continuous variable—to compare with the CLMM results. These LMM analyses yielded very similar results to those obtained with the CLMMs, with the same inferential implications (see Tables S3–S5 in the online supplemental materials).

### Models With Binary Outcome Variables

Because the presence of nightmares is a binary variable (0 = no, 1 = yes), for this outcome we fitted generalized linear mixed models

(GLMM) with binomial error distribution (with logit link function) using the function *glmer* from the R package *lme4* (Bates et al., 2015). We used the *lmerTest* package (Kuznetsova et al., 2017) to obtain *p* values for the tests obtained with the *lme4* package.

## Predictors

Questionnaire scores for general COVID-19-related concern regarding self/others, general COVID-19-related concern regarding countries, COVID-19-related anxiety, oneself belonging to a risk group, and close others belonging to a risk group were treated as independent level-2 fixed-effect predictors. Scores for daily COVID-19-related worry and daily sleep quality (as a control variable) were treated as separate level-1 fixed-effect predictors.

In all models, to control for age and gender, these variables were added as level-2 fixed-effect predictors. Also, in all models, participant-specific random intercept was included (to account for the nested data). Although *country* is a level-3 unit, it has only two levels (i.e., two countries) and, therefore, country-specific random intercepts were not specified (i.e., three-level models are not warranted). To control for country, this variable was added as a fixed-effect predictor in all models.

All continuous level-2 predictors (general COVID-19-related concern, general COVID-19-related anxiety, age) were grand-mean centered. Categorical level-2 predictors were dummy-coded: self and close others belonging to a risk group (0 = yes, 1 = no), gender (0 = male, 1 = female, 2 = “other”), country (0 = Australia, 1 = United Kingdom). Level-1 predictors (daily sleep quality) were person-mean centered. Regarding daily COVID-19 worry, our main focus was on within-person relationships (as specified in pre-registration). However, to parse out the within- and between-person contributions (i.e., level-1 and level-2 effects), daily COVID-19 worry was entered as person-mean centered level-1 fixed-effect predictor together with the participants’ mean of daily COVID-19 worry as level-2 fixed-effect predictor that was grand-mean centered (Bell et al., 2018; Enders & Tofighi, 2007; Nezlek, 2012).

Before fitting the models, we tested for possible multicollinearity between noncentered independent variables (i.e., predictors). Since there was no evidence of multicollinearity, all predictors were entered simultaneously in all models.

## Alpha Level

Hypotheses were considered confirmed if  $p < .05\%$  and 95% confidence intervals did not include 0. To control for multiple analyses, all *p* values of the preregistered analyses were adjusted using the false detection rate.

## Exploratory Analyses

In addition to preregistered analyses, we conducted exploratory analyses examining the relationship between COVID-19-related concern, anxiety, and worry and daily sleep quality. We fitted CLMMs in which daily sleep quality was a level-1 outcome variable and (a) COVID-19-related concern regarding self/others, COVID-19-related concern regarding countries, and COVID-19-related anxiety as level-2 fixed-effect predictors, (b) daily COVID-19 worry as level-1 and as level-2 fixed-effect predictor, and (c) oneself belonging to a risk group and close ones belonging to risk group as level-2



fixed-effect predictors. Age, gender, and country were added as level-2 fixed-effect control variables (predictors).

**Results**

**Descriptive Statistics**

Table 2 displays descriptive statistics for all independent and dependent variables of the study (for correlations between the variables, see Table S1 in the online supplemental materials).

**Relationship Between General COVID-19-Related Concern, Anxiety, and Affect Experienced During Mind-Wandering and Dreaming (H1a–H4b)**

Results showed that general COVID-19-related concern (regarding self/others or countries) and anxiety were not significant predictors of either negative or positive affect experienced during mind-wandering (see Table 3). Only daily sleep quality was a significant predictor of negative and positive affect experienced during dreaming, and the presence of nightmares, with poorer sleep quality during the night associated with more negative and less positive affect experienced in dreams and with the increased likelihood of the dream being a nightmare. Younger age predicted more negative dream affect.

**Relationship Between Daily COVID-19 Worry and Affect Experienced During Mind-Wandering and Dreaming (H5a–H8b)**

To study the relationship between daily COVID-19 worry and affect experienced during mind-wandering, data regarding the 1,496 mind-wandering occasions of 152 participants were analyzed. Analyses regarding the relationship between daily COVID-19 worry and dream affect were based on only those measurement occasions for which there were ratings of daily worry (in the mind-wandering log) followed by ratings of affect experienced in dreams during the

subsequent night, that is, 1,199 measurement occasions of 133 participants.

Regarding within-person relationships, daily worry about COVID-19 predicted more negative, and less positive, affect during mind-wandering but not during dreaming (see Table 4 and Figure 2). Interestingly, however, different results were obtained at the between-person level: the mean level of daily COVID-19 worry across the days predicted more negative affect during both mind-wandering and dreaming. As reported above, daily sleep quality predicted dream affect: poorer sleep quality during the night was associated with more negative, and less positive, affect experienced in dreams as well as with the increased likelihood of the dream being a nightmare. Also, younger age was associated with more negative dream affect.

**Relationship Between Belonging to a Risk Group and Affect Experienced During Mind-Wandering and Dreaming (H9a–H12b)**

Results showed that individuals who considered themselves to be in a risk group, compared to those who did not belong to a risk group, experienced more negative affect during mind-wandering. Surprisingly, those whose close ones belonged to a risk group, experienced less negative affect during mind-wandering (see Table 5). However, these relationships were not significant after correcting for multiple testing. As in the other analyses, only poorer sleep quality predicted more negative, and less positive, dream affect as well as the increased likelihood of the dream being a nightmare.

**Exploratory Analyses**

Given the relationship between daily sleep quality and dream affect, we explored whether COVID-19-related general concern, anxiety, and daily worry were related to daily sleep quality. None of the predictors in any of the models were significant ( $p > .05$ ; see Table S2 in the online supplemental materials).

**Table 2**  
*Descriptive Statistics of Independent and Dependent Variables*

Variable	United Kingdom <i>M (SD)</i>	Australia <i>M (SD)</i>	All <i>M (SD)</i>	Scale
General COVID-19 concern self/others ( $N = 176$ ) <sup>a</sup>	3.28 (0.93)	2.99 (0.99)	3.17 (0.96)	1— <i>very slightly or not at all</i> to 5— <i>extremely</i>
General COVID-19 concern countries ( $N = 176$ ) <sup>a</sup>	4.03 (0.89)	3.90 (0.76)	3.98 (0.84)	1— <i>very slightly or not at all</i> to 5— <i>extremely</i>
General COVID-19 anxiety ( $N = 176$ ) <sup>a</sup>	2.72 (0.73)	2.44 (0.69)	2.61 (0.73)	1— <i>strongly disagree</i> to 5— <i>strongly agree</i>
Self in risk group % ( $N = 176$ ) <sup>a</sup>	20.00%	12.12%	17.05%	
Close ones in risk group % ( $N = 176$ ) <sup>a</sup>	38.18%	50.00%	42.61%	
Daily COVID-19 worry <sup>b</sup> ( $N = 133$ ; $n = 1,199$ )	2.40 (0.97)	2.29 (1.04)	2.36 (1.00)	1— <i>not at all</i> to 5— <i>very much</i>
Daily sleep quality <sup>b</sup> ( $N = 172$ , $n = 1,755$ ) <sup>c</sup>	2.02 (0.78)	2.12 (0.80)	2.06 (0.79)	1— <i>very good</i> to 4— <i>very bad</i>
Daily sleep quality <sup>b</sup> ( $N = 133$ ; $n = 1,199$ ) <sup>d</sup>	1.98 (0.77)	2.08 (0.81)	2.02 (0.79)	1— <i>very good</i> to 4— <i>very bad</i>
Mind-wandering PA <sup>b</sup> ( $N = 152$ ; $n = 1,496$ )	2.47 (1.09)	2.59 (1.06)	2.52 (1.08)	1— <i>not at all</i> to 5— <i>extremely</i>
Mind-wandering NA <sup>b</sup> ( $N = 152$ ; $n = 1,496$ )	2.46 (1.15)	2.37 (1.06)	2.43 (1.12)	1— <i>not at all</i> to 5— <i>extremely</i>
Dreaming PA <sup>b</sup> ( $N = 172$ ; $n = 1,755$ )	2.24 (1.11)	2.19 (1.08)	2.22 (1.10)	1— <i>not at all</i> to 5— <i>extremely</i>
Dreaming NA <sup>b</sup> ( $N = 172$ ; $n = 1,755$ )	2.58 (1.20)	2.84 (1.23)	2.67 (1.22)	1— <i>not at all</i> to 5— <i>extremely</i>
Nightmares <sup>b</sup> ( $N = 172$ ; $n = 1,755$ )	1.10 (0.30)	1.09 (0.29)	1.10 (0.29)	
Nightmares <sup>b</sup> %	9.65%	9.27%	9.52%	

*Note.*  $N$  = number of participants;  $n$  = number of observations; NA = negative affect; PA = positive affect.  
<sup>a</sup> Includes 172 participants with dream logs (of whom 148 provided mind-wandering logs) plus four participants who provided mind-wandering logs but not dream logs (152 participants with mind-wandering logs in total). <sup>b</sup> (Unaggregated) mean and standard deviation scores across logs. <sup>c</sup> For testing hypotheses 2b, 3b, 4b, 10b, 11b, 1b. <sup>d</sup> For testing hypotheses 6b, 7b, 8b.

**Table 3**

*Results of Cumulative Link Mixed-Effect Models Predicting Affect Experienced During Mind-Wandering and Dreaming From COVID-19-Related Concern and Anxiety*

Variable	<i>B</i>	95% CI [ <i>LL</i> , <i>UL</i> ]	<i>SE</i>	<i>z</i>	<i>p</i>	Adjusted <i>p</i>
<b>H1a, Outcome: Mind-wandering NA (<i>N</i> = 152, <i>n</i> = 1,496)</b>						
General COVID-19 concern self/others	0.036	[-0.108, 0.180]	0.073	0.489	.625	.894
General COVID-19 concern countries	0.124	[-0.013, 0.261]	0.070	1.779	.075	.348
General COVID-19 anxiety	0.097	[-0.088, 0.282]	0.095	1.028	.304	.631
Age	-0.001	[-0.009, 0.007]	0.004	-0.277	.782	.915
Gender	-0.031	[-0.296, 0.234]	0.135	-0.230	.818	.928
Country	0.043	[-0.182, 0.268]	0.115	0.377	.706	.904
<b>H1b, Outcome: Mind-wandering PA (<i>N</i> = 152, <i>n</i> = 1,496)</b>						
General COVID-19 concern self/others	0.068	[-0.097, 0.233]	0.084	0.802	.422	.775
General COVID-19 concern countries	-0.006	[-0.163, 0.152]	0.080	-0.071	.944	.951
General COVID-19 anxiety	-0.045	[-0.258, 0.169]	0.109	-0.413	.680	.894
Age	0.002	[-0.007, 0.011]	0.005	0.419	.675	.894
Gender	-0.232	[-0.537, 0.073]	0.156	-1.488	.137	.410
Country	-0.198	[-0.456, 0.061]	0.132	-1.498	.134	.410
<b>H2a, Outcome: Dreaming NA (<i>N</i> = 172, <i>n</i> = 1,755)</b>						
General COVID-19 concern self/others	-0.028	[-0.160, 0.104]	0.067	-0.418	.676	.894
General COVID-19 concern countries	0.115	[-0.010, 0.239]	0.063	1.808	.071	.348
General COVID-19 anxiety	0.135	[-0.031, 0.301]	0.085	1.591	.111	.410
Age	-0.010	[-0.017, -0.003]	0.003	-2.792	<b>.005</b>	<b>.045</b>
Gender	-0.012	[-0.250, 0.223]	0.121	-0.101	.919	.951
Country	-0.191	[-0.394, 0.013]	0.104	-1.838	.066	.348
<b>H2b, Outcome: Dreaming PA (<i>N</i> = 172, <i>n</i> = 1,755)</b>						
General COVID-19 concern self/others	-0.028	[-0.162, 0.106]	0.068	-0.406	.685	.894
General COVID-19 concern countries	0.116	[-0.010, 0.242]	0.064	1.809	.071	.348
General COVID-19 anxiety	0.136	[-0.033, 0.305]	0.086	1.578	.115	.410
Daily sleep quality	0.233	[0.153, 0.312]	0.041	5.727	<b>&lt;.001</b>	<b>&lt;.001</b>
Age	-0.010	[-0.017, -0.003]	0.004	-2.780	<b>.005</b>	<b>.045</b>
Gender	-0.012	[-0.253, 0.229]	0.123	-0.097	.923	.951
Country	-0.192	[-0.398, 0.014]	0.105	-1.822	.068	.348
<b>H3a, Outcome: Dreaming PA (<i>N</i> = 172, <i>n</i> = 1,755)</b>						
General COVID-19 concern self/others	-0.033	[-0.707, 0.043]	0.071	-0.462	.644	.894
General COVID-19 concern countries	-0.093	[-0.078, 0.621]	0.067	-1.391	.164	.440
General COVID-19 anxiety	0.107	[-0.115, 0.824]	0.090	1.198	.231	.546
Age	-0.002	[-0.034, 0.005]	0.004	-0.413	.679	.894
Gender	-0.018	[-1.007, 0.314]	0.128	-0.140	.889	.951
Country	-0.034	[-0.251, 0.937]	0.109	-0.310	.756	.915
<b>H3b, Outcome: Dreaming PA (<i>N</i> = 172, <i>n</i> = 1,755)</b>						
General COVID-19 concern self/others	-0.333	[-0.174, 0.108]	0.072	-0.462	.644	.894
General COVID-19 concern countries	-0.094	[-0.227, 0.039]	0.068	-1.383	.167	.440
General COVID-19 anxiety	0.108	[-0.070, 0.286]	0.091	1.192	.233	.546
Daily sleep quality	-0.246	[-0.329, -0.164]	0.042	-5.840	<b>&lt;.001</b>	<b>&lt;.001</b>
Age	-0.002	[-0.009, 0.006]	0.004	-0.424	.671	.894
Gender	-0.020	[-0.273, 0.234]	0.129	-0.151	.880	.951
Country	-0.034	[-0.251, 0.183]	0.111	-0.309	.757	.915
<b>H4a, Outcome: Presence of nightmare (<i>N</i> = 172, <i>n</i> = 1,755)</b>						
General COVID-19 concern self/others	-0.332	[-0.707, 0.043]	0.191	-1.735	.083	.353
General COVID-19 concern countries	0.272	[-0.078, 0.621]	0.178	1.524	.128	.410
General COVID-19 anxiety	0.354	[-0.115, 0.824]	0.239	1.480	1.139	.410
Age	-0.015	[-0.033, 0.005]	0.010	-1.499	.134	.410
Gender	-0.346	[-1.007, 0.314]	0.337	-1.028	.304	.631
Country	0.343	[-0.251, 0.937]	0.303	1.133	.257	.559
<b>H4b, Outcome: Presence of nightmares (<i>N</i> = 172, <i>n</i> = 1,755)</b>						
General COVID-19 concern self/others	-0.336	[-0.722, 0.050]	0.197	-1.708	.088	.353
General COVID-19 concern countries	0.276	[-0.083, 0.634]	0.183	1.507	.132	.410
General COVID-19 anxiety	0.360	[-0.122, 0.843]	0.246	1.463	.144	.410
Daily sleep quality	0.749	[0.478, 1.019]	0.138	5.425	<b>&lt;.001</b>	<b>&lt;.001</b>
Age	-0.016	[-0.036, 0.004]	0.010	-1.552	.121	.410
Gender	-0.364	[-1.042, 0.315]	0.346	-1.051	.293	.628
Country	0.361	[-0.249, 0.971]	0.311	1.161	.246	.552

*Note.* Bold values denote significant findings (*p* value < .05). CI = confidence interval; *LL* = lower limit; *UL* = upper limit; *N* = number of participants; *n* = number of observations; NA = negative affect. PA = positive affect. Adjusted *p*-values refer to *p*-values corrected using the False Discovery Rate (FDR) method.

**Table 4**  
*Results of Cumulative Link Mixed-Effect Models Predicting Affect Experienced During Mind-Wandering and Dreaming From Daily COVID-19 Worry*

Variable	<i>B</i>	95% CI [ <i>LL</i> , <i>UL</i> ]	<i>SE</i>	<i>z</i>	<i>p</i>	Adjusted <i>p</i>
<b>H5a, Outcome: Mind-wandering NA (<i>N</i> = 152, <i>n</i> = 1,496)</b>						
Daily COVID-19 worry (within)	0.468	[0.384, 0.553]	0.043	10.834	<.001	<.001
Daily COVID-19 worry (between)	0.394	[0.254, 0.535]	0.072	5.514	<.001	<.001
Age	-0.001	[-0.008, 0.007]	0.004	-0.223	.823	.928
Gender	-0.044	[-0.300, 0.212]	0.131	-0.335	.738	.915
Country	0.038	[-0.180, 0.255]	0.111	0.340	.734	.915
<b>H5b, Outcome: Mind-wandering PA (<i>N</i> = 152, <i>n</i> = 1,496)</b>						
Daily COVID-19 worry (within)	-0.325	[-0.409, -0.240]	0.043	-7.543	<.001	<.001
Daily COVID-19 worry (between)	-0.054	[-0.222, 0.114]	0.086	-0.631	.528	.851
Age	0.002	[-0.007, 0.011]	0.005	0.522	.601	.894
Gender	-0.228	[-0.537, 0.081]	0.158	-1.446	.148	.414
Country	-0.197	[-0.459, 0.066]	0.134	-1.469	.142	.410
<b>H6a, Outcome: Dreaming NA (<i>N</i> = 133, <i>n</i> = 1,199)</b>						
Daily COVID-19 worry (within)	-0.020	[-0.116, 0.076]	0.049	-0.407	.684	.894
Daily COVID-19 worry (between)	0.206	[0.059, 0.352]	0.075	2.754	.006	.045
Age	-0.013	[-0.021, -0.004]	0.004	-3.041	.002	.024
Gender	-0.103	[-0.379, 0.174]	0.141	-0.726	.468	.801
Country	-0.214	[-0.448, 0.020]	0.119	-1.790	.074	.348
<b>H6b, Outcome: Dreaming NA (<i>N</i> = 133, <i>n</i> = 1,199)</b>						
Daily COVID-19 worry (within)	-0.026	[-0.122, 0.070]	0.049	-0.537	.592	.894
Daily COVID-19 worry (between)	0.211	[0.062, 0.361]	0.076	2.772	.006	.045
Daily sleep quality	0.289	[0.191, 0.387]	0.050	5.788	<.001	<.001
Age	-0.013	[-0.021, -0.005]	0.004	-3.031	.002	.024
Gender	-0.103	[-0.386, 0.179]	0.144	-0.717	.473	.801
Country	-0.214	[-0.453, 0.025]	0.122	-1.758	.079	.348
<b>H7a, Outcome: Dreaming PA (<i>N</i> = 133, <i>n</i> = 1,199)</b>						
Daily COVID-19 worry (within)	0.058	[-0.039, 0.156]	0.050	1.167	.243	.552
Daily COVID-19 worry (between)	-0.055	[-0.228, 0.119]	0.087	-0.619	.536	.854
Age	<0.001	[-0.010, 0.009]	0.005	-0.078	.938	.951
Gender	-0.016	[-0.347, 0.315]	0.169	-0.095	.924	.951
Country	-0.041	[-0.321, 0.239]	0.143	-0.288	.773	.915
<b>H7b, Outcome: Dreaming PA (<i>N</i> = 133, <i>n</i> = 1,199)</b>						
Daily COVID-19 worry (within)	0.062	[-0.035, 0.160]	0.050	1.252	.210	.544
Daily COVID-19 worry (between)	-0.056	[-0.179, 0.092]	0.089	-0.632	.527	.851
Daily sleep quality	-0.194	[-0.295, -0.093]	0.052	-3.769	<.001	.002
Age	<0.001	[-0.010, 0.009]	0.005	-0.084	.933	.951
Gender	-0.017	[-0.350, 0.316]	0.170	-0.100	.920	.951
Country	-0.040	[-0.322, 0.242]	0.144	-0.281	.778	.915
<b>H8a, Outcome: Presence of nightmare (<i>N</i> = 133, <i>n</i> = 1,199)</b>						
Daily COVID-19 worry (within)	-0.091	[-0.437, 0.255]	0.176	-0.518	.605	.894
Daily COVID-19 worry (between)	0.185	[-0.281, 0.651]	0.238	0.780	.436	.775
Age	-0.022	[-0.048, 0.003]	0.013	-1.713	.087	.353
Gender	-0.335	[-1.177, 0.506]	0.429	-0.780	.435	.775
Country	0.233	[-0.525, 0.991]	0.387	0.602	.547	.862
<b>H8b, Outcome: Presence of nightmare (<i>N</i> = 133, <i>n</i> = 1,199)</b>						
Daily COVID-19 worry (within)	-0.148	[-0.512, 0.217]	0.186	-0.793	.428	.775
Daily COVID-19 worry (between)	0.185	[-0.296, 0.665]	0.245	0.752	.452	.794
Daily sleep quality	0.809	[0.457, 1.162]	0.180	4.499	<.001	<.001
Age	-0.024	[-0.050, 0.003]	0.014	-1.769	.077	.348
Gender	-0.367	[-1.236, 0.503]	0.444	-0.826	.409	.775
Country	0.266	[-0.517, 1.050]	0.400	0.666	.505	.834

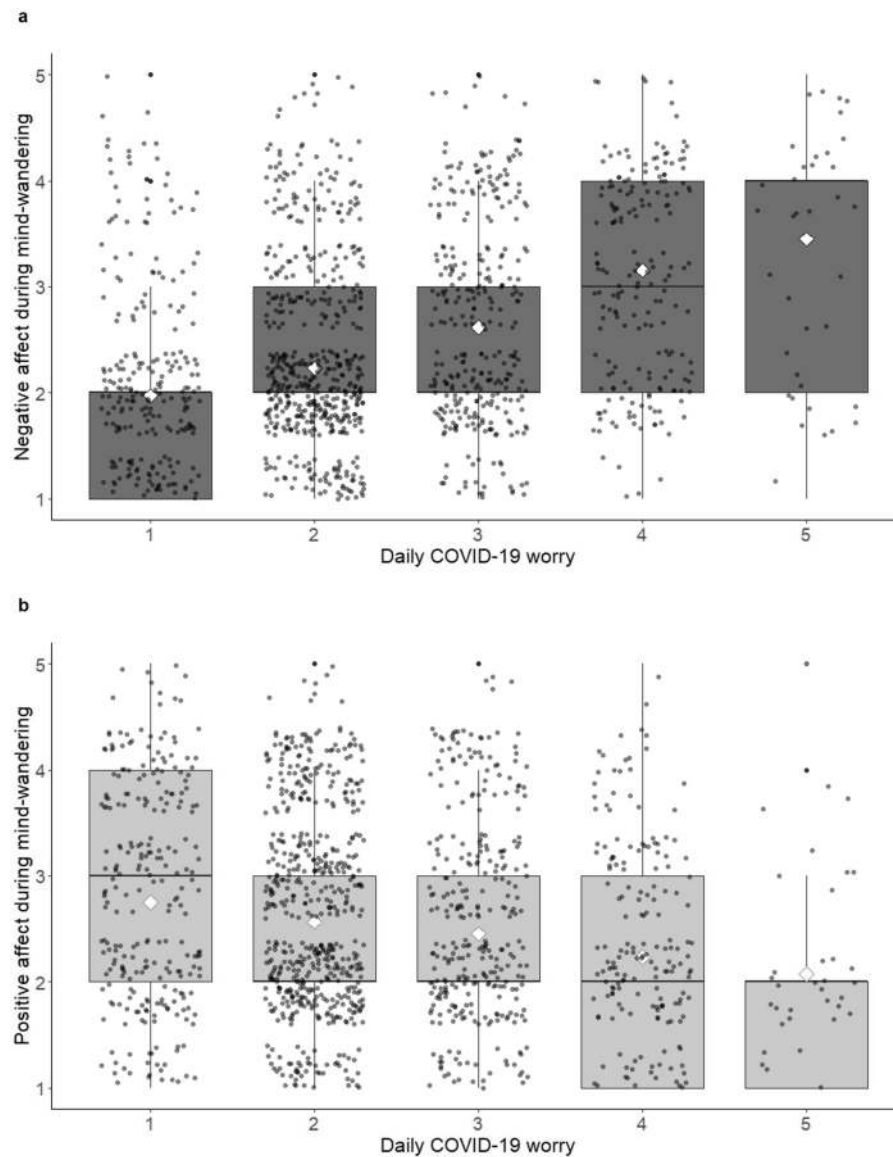
*Note.* Bold values denote significant findings (*p* value < .05). CI = confidence interval; *LL* = lower limit; *UL* = upper limit; *N* = number of participants; *n* = number of observations; NA = negative affect; PA = positive affect. Adjusted *p*-values refer to *p*-values corrected using the False Discovery Rate (FDR) method.

**Discussion**

By asking people to rate their daily experiences during the COVID-19 pandemic, we investigated whether and how COVID-19-related concern, anxiety, and worry are associated with the affective quality of spontaneous experiences—mind-wandering during wakefulness and dreaming during sleep.

Our results showed that daily COVID-19 worry (measured using daily logs) was associated with the affective quality of mind-wandering but not dreaming. On days when people reported experiencing more negative and less positive affect during mind-wandering, they also experienced more COVID-19-related worry. COVID-19-related concern and anxiety (measured using a general questionnaire) were not associated with affect experienced during mind-wandering, dreaming,

**Figure 2**  
*Daily COVID-19 Worry and Affect Experienced During Mind-Wandering and Dreaming*



*Note.* Cumulative link mixed-effect models showed that, on days when people were more worried about COVID-19, they experienced (a) more negative affect and (b) less positive affect during mind-wandering ( $N = 1,496$  mind-wandering logs). In the boxplots, diamond symbol = mean; horizontal line = median; box = 25th and 75th percentiles; whiskers = minimum and maximum values; darker points = outliers. See the online article for the color version of this figure.

or with nightmares, despite the average scores of participants' COVID-19-related concern being relatively high (above the mid-point on the scale ranging from 1—*not at all* to 5—*very much*). Similarly, although 17% of the participants considered themselves, and 42% considered their close ones, as belonging to a COVID-19 risk group, belonging to a risk group was not associated with affect experienced during mind-wandering, dreaming, or with nightmares. Different results obtained with daily logs and the retrospective questionnaire indicate the importance of using longitudinal measures that enable the day-to-day measurement of COVID-19 worry.

### **Daily COVID-19 Worry and Affect Experienced During Mind-Wandering and Dreaming**

The findings show that the more people are worried about COVID-19, the more likely their minds wander to negatively valenced thoughts, feelings, and imagery during wakefulness. One form of negatively valenced (or “sticky” form of) mind-wandering is rumination—repetitive thinking focused on self-relevant concerns (DuPre & Spreng, 2018). Given the dysfunctional nature of rumination and its widely documented negative

**Table 5**  
*Results of Cumulative Link Mixed-Effect Models Predicting Affect Experienced During Mind-Wandering and Dreaming From Participants Themselves, or Their Close Ones, Belonging to COVID-19 Risk Group*

Variable	<i>B</i>	95% CI [ <i>LL</i> , <i>UL</i> ]	<i>SE</i>	<i>z</i>	<i>p</i>	Adjusted <i>p</i>
H9a, Outcome: Mind-wandering NA ( <i>N</i> = 152, <i>n</i> = 1,496)						
Self in risk group (No)	-0.320	[-0.622, -0.018]	0.154	-2.076	<b>.038</b>	.252
Close ones in risk group (No)	0.246	[0.023, 0.468]	0.113	2.165	<b>.030</b>	.219
Age	-0.002	[-0.010, 0.006]	0.004	-0.463	.643	.894
Gender	0.052	[-0.212, 0.315]	0.135	0.384	.701	.904
Country	0.034	[-0.191, 0.260]	0.115	0.297	.767	.915
H9b, Outcome: Mind-wandering PA ( <i>N</i> = 152, <i>n</i> = 1,496)						
Self in risk group (No)	0.213	[-0.132, 0.558]	0.176	1.210	.226	.547
Close ones in risk group (No)	<0.001	[-0.253, 0.253]	0.129	0.001	.999	.999
Age	0.004	[-0.005, 0.014]	0.005	0.900	.368	.752
Gender	-0.233	[-0.535, 0.069]	0.154	-1.511	.131	.410
Country	-0.187	[-0.445, 0.070]	0.132	-1.425	.154	.422
H10a, Outcome: Dreaming NA ( <i>N</i> = 172, <i>n</i> = 1,755)						
Self in risk group (No)	0.031	[-0.246, 0.307]	0.141	0.219	.827	.928
Close ones in risk group (No)	0.185	[-0.012, 0.383]	0.101	1.837	.066	.348
Age	-0.008	[-0.015, -0.0004]	0.004	-2.069	<b>.039</b>	.252
Gender	0.065	[-0.174, 0.304]	0.122	0.535	.593	.894
Country	-0.169	[-0.372, 0.033]	0.103	-1.637	.102	.398
H10b, Outcome: Dreaming NA ( <i>N</i> = 172, <i>n</i> = 1,755)						
Self in risk group (No)	0.030	[-0.250, 0.311]	0.143	0.211	.833	.928
Close ones in risk group (No)	0.187	[-0.014, 0.387]	0.102	1.824	.068	.348
Daily sleep quality	0.233	[0.153, 0.312]	0.041	5.724	< <b>.001</b>	< <b>.001</b>
Age	-0.008	[-0.015, -0.0004]	0.004	-2.062	<b>.039</b>	.775
Gender	0.067	[-0.176, 0.309]	0.124	0.538	.590	.894
Country	-0.170	[-0.375, 0.035]	0.105	-1.622	.105	.399
H11a, Outcome: Dreaming PA ( <i>N</i> = 172, <i>n</i> = 1,755)						
Self in risk group (No)	-0.062	[-0.352, 0.229]	0.148	-0.418	.676	.894
Close ones in risk group (No)	-0.090	[-0.298, 0.118]	0.106	-0.850	.395	.775
Age	-0.003	[-0.011, 0.005]	0.004	-0.793	.428	.775
Gender	-0.027	[-0.279, 0.225]	0.128	-0.211	.833	.928
Country	-0.013	[-0.226, 0.200]	0.109	-0.119	.906	.951
H11b, Outcome: Dreaming PA ( <i>N</i> = 172, <i>n</i> = 1,755)						
Self in risk group (No)	-0.064	[-0.358, 0.230]	0.150	-0.426	.670	.894
Close ones in risk group (No)	-0.090	[-0.300, 0.121]	0.107	-0.833	.405	.775
Daily sleep quality	-0.246	[-0.329, -0.164]	0.042	-5.841	< <b>.001</b>	< <b>.001</b>
Age	-0.003	[-0.011, 0.005]	0.004	-0.804	.422	.775
Gender	-0.029	[-0.283, 0.226]	0.130	-0.220	.826	.928
Country	-0.013	[-0.229, 0.203]	0.110	-0.120	.904	.951
H12a, Outcome: Presence of nightmare ( <i>N</i> = 172, <i>n</i> = 1,755)						
Self in risk group (No)	-0.031	[-0.838, 0.776]	0.411	-0.076	.939	.951
Close ones in risk group (No)	0.084	[-0.491, 0.659]	0.294	0.286	.775	.915
Age	-0.013	[-0.034, 0.009]	0.011	-1.151	.250	.552
Gender	-0.233	[-0.895, 0.428]	0.337	-0.691	.489	.817
Country	0.365	[-0.238, 0.968]	0.308	1.186	.235	.546
H12b, Outcome: Presence of nightmare ( <i>N</i> = 172, <i>n</i> = 1,755)						
Self in risk group (No)	-0.030	[-0.860, 0.800]	0.423	-0.071	.943	.951
Close ones in risk group (No)	0.085	[-0.506, 0.676]	0.302	0.281	.779	.915
Daily sleep quality	0.751	[0.480, 1.022]	0.138	5.434	< <b>.001</b>	< <b>.001</b>
Age	-0.013	[-0.035, 0.009]	0.011	-1.201	.230	.546
Gender	-0.250	[-0.929, 0.429]	0.347	-0.722	.470	.801
Country	0.384	[-0.235, 1.003]	0.316	1.216	.224	.546

*Note.* Bold values denote significant findings (*p* value < .05). CI = confidence interval; *LL* = lower limit; *UL* = upper limit; *N* = number of participants; *n* = number of observations; NA = negative affect; PA = positive affect. Adjusted *p*-values refer to *p*-values corrected using the False Discovery Rate (FDR) method.

consequences for mental health (Nolen-Hoeksema et al., 2008), it is possible that this constitutes one potential mechanism underlying the detrimental impact of the pandemic on well-being. Rumination may also adversely affect sleep quality the following night (Takano et al., 2014), which is, in turn, associated with more negative dreams. Future studies focusing on the content of mind-wandering (i.e., to what extent it is involved with rumination) will help shed on this explanation.

As to dreaming, only daily sleep quality was associated with dream affect at the within-person level: the worse the sleep quality during the night, the more negative affect and the less positive affect experienced in dreams and the more likely the person experienced a nightmare that night. Due to the correlational nature of the study, the causal direction between sleep quality and dream affectivity remains unclear: it is possible that poor sleep quality induces negative dreams and nightmares, but it may also be the case that negative dreams,

especially nightmares, provoke awakenings and lead to estimates of poorer sleep quality. Alternatively, the possibility that poor sleep quality leads to negative affect upon awakening that biases the ratings of dream affect cannot be ruled out. Nevertheless, as shown by exploratory analyses, concern, anxiety, and worry about COVID-19 did not explain poor sleep quality.

### Individual Differences in COVID-19 Worry and Affect Experienced During Mind-Wandering and Dreaming

Interestingly, a different pattern of results emerged at the between-person level. Individuals who, on average, experienced more daily COVID-19 worry during the study period, were also more likely to report experiencing negative affect not only during mind-wandering but also during dreaming. No such relationships occurred for positive affect. These findings demonstrate that the proposed continuity between our waking and dream experiences (Christoff et al., 2016; Windt, 2021) occurs not so much at the within-person level but at the between-person level, that is, spontaneous experiences do not seem to depend so much on daily concerns or experiences but on more stable individual differences. Similar conclusions were reached in another large-scale longitudinal daily dream diary study (Samson-Daoust et al., 2019). With regard to the mind-wandering literature, this is in line with the suggestion that the impact of current concerns on mind-wandering is determined not only by the significance of current concerns but also by the individual's executive control ability to inhibit the interference from these concerns (McVay & Kane, 2010).

As suggested by findings in previous studies, one such individual difference is emotion regulation (Sikka et al., 2019; Sikka, Pesonen, & Revonsuo, 2018; Sikka, Valli, et al., 2021). Emotion regulation refers to our ability to influence the emotions we have, when we have them, and how we experience and express these emotions (J. J. Gross, 1998). A large number of studies have shown that people with more adaptive emotion regulation processes experience higher levels of positive affect and lower levels of negative affect, whereas those using less adaptive emotion regulation experience higher levels of negative affect and lower levels of positive affect (J. J. Gross, 2015; McRae & Gross, 2020). Thus, it may well be that individuals who tend to use less adaptive emotion regulation are more likely to worry about COVID-19, tend to ruminate more about it, as reflected in negatively valenced mind-wandering, and experience more negatively valenced dreams. Future studies should include emotion regulation measures to test whether the relationship between COVID-19 worry and the affective quality of mind-wandering and dreaming is mediated by trait emotion regulation.

### Theoretical and Methodological Implications

The findings that COVID-19 worry was associated with dream affect not at the within-person level but at the between-person level provide only partial support for the continuity hypotheses (Domhoff, 1996, 2017; Schredl, 2003; Schredl & Hofmann, 2003) and the threat simulation theory (Revonsuo, 2000) of dreaming. According to these theories, daily worry about COVID-19 should be reflected in more negative dream content the following night. However, it is possible that COVID-19-related worry is reflected more in the pandemic (e.g., health, diseases, and masks) or threat-related content rather than affective tone of the dream, something

that should be tested in future studies. Furthermore, given that sleep-dependent memory consolidation take place over time, worry about COVID-19 on a particular day may be incorporated into dreams not necessarily the following night but after 5–7 nights, akin to the “dream lag” effect (Blagrove et al., 2011). Nevertheless, our findings suggest that the theoretical frameworks of spontaneous thought (Christoff et al., 2016; Windt, 2021) need to distinguish between state- and trait-like continuity of experiences.

Differences in results at the within- versus between-person level also help shed light on the inconsistencies between studies on pandemic dreaming using questionnaires versus daily logs of dreaming. Questionnaire-based studies on COVID-19 dreams have often asked people to estimate the frequency and affectivity of their dreams and nightmares during and before the pandemic. However, it is questionable to what extent such questions manage to capture actual episodic memories of people's experiences, especially if participants did not intend to remember their dreams at the time of occurrence. The longer the time elapsed since the experience, the more likely reports of the experience are influenced by memory biases and waking beliefs (Sikka, 2019, 2020). Such general evaluations of dream experiences are especially problematic when participants have low dream recall rates, that is, they have less access to actual memories of dream experiences (Beaulieu-Prévost & Zadra, 2005; Schredl, 2002). As a result, with questionnaires, instead of capturing the *experience*, or even the *memory* of the experience (Kahneman & Riis, 2005), researchers end up tapping into trait-like semantic knowledge or *beliefs* about one's experiences (Conner & Barrett, 2012; Robinson & Clore, 2002; Sikka, 2020). These beliefs (e.g., “things are pretty bad”) arguably form a more stable background based on which individuals make judgments about their experiences, be it about how much they tend to worry about COVID-19 or how negative their dream experiences are. As such, with trait-like questionnaires, it is not surprising to observe more negative dreams during the pandemic. However, if we are interested in people's experiences, instead of relying on cross-sectional questionnaire studies, we need to use methods that come closer to capturing momentary experiences (i.e., ecological momentary assessment; Sikka, 2019; Windt, 2015).

### Limitations and Future Directions

It is important to note that, in the present study, participants were asked to rate their daily COVID-19 worry after having carried out the mind-wandering task: in the daily mind-wandering log participants first rated the affect they experienced during mind-wandering and then how much they had worried about COVID-19 on that particular day. Thus, it is possible that the mind-wandering task itself, and the affective experiences participants had during that task, may have (at least partly) biased the daily COVID-19 worry ratings, leading to a stronger relationship between COVID-19 worry and mind-wandering than between COVID-19 worry and dreaming. While this calls for caution in drawing conclusions regarding the within-person relationship between daily COVID-19 worry and affect experienced during mind-wandering, the finding that daily COVID-19 worry was associated with both mind-wandering and dreaming at the between-person level gives credence for the latter.

Relatedly, we asked participants to engage in intentional mind-wandering. While intentional mind-wandering is as common as unintentional mind-wandering, it may differ in content and have different correlates (Seli et al., 2016, 2018). Typically, in mind-wandering

research outside the laboratory, participants are prompted at random times throughout the day and asked about the contents of their thoughts and experiences (Smallwood & Schooler, 2015). Mind-wandering is then operationalized as the thoughts and experiences that are unrelated to the activity or task participants are engaged in at that particular moment (Murray et al., 2020). However, we used the approach traditionally employed in resting-state functional magnetic resonance imaging studies in which participants are instructed to let their minds wander freely (i.e., the “task” is to mind-wander) during a particular period of time (Gonzalez-Castillo et al., 2021). This was done to ensure that the mind-wandering task, and the procedure for reporting and rating of experiences during the mind-wandering period, would be as similar as possible to the dream reporting and rating procedure. While such a task and procedure have worked well in previous studies (e.g., Noreika et al., 2010; Sikka, Valli, et al., 2021), and while morning dream diaries are very common in dream research (Sikka, 2019), such a procedure is not without problems. First, it is likely that the thoughts and experiences occurring in the absence of an external activity or task, or as a result of intentionally engaging in mind-wandering, differ from those when one is supposed to be actively engaged in another activity or task. Second, during a 10-min period, participants may experience a range of different affective experiences. Asking them to aggregate these over the 10-min period and translate them into affect ratings is challenging (Kane et al., 2021). For example, participants’ ratings of the overall period may be based on the most recent or the most intense affective experience (the peak/end effect; Kahneman & Riis, 2005). Thus, it is likely that the results would be different if spontaneous thoughts and experiences during mind-wandering and dreaming would have been sampled throughout the day and night and participants would have rated their experiences immediately after the experience (e.g., as in M. E. Gross et al., 2021). Nevertheless, despite these limitations, the procedure for obtaining reports and affect ratings of mind-wandering experiences matched the procedure for obtaining reports and affect ratings of dream experiences.

Additionally, we did not compare mind-wandering and dream experiences during the COVID-19 pandemic with those during the pre- or postpandemic period. Thus, comparing pandemic and postpandemic spontaneous experiences would shed more light on possible differences (or lack thereof) in the affective nature of these experiences. Also, we focused on the self-ratings of affect only. An increasing number of studies have shown that results differ greatly depending on whether self-ratings of affect or the analysis of the affective content of narrative mind-wandering and dream reports by external raters is used (Schredl & Doll, 1998; Sikka et al., 2014, 2017; Sikka, Valli, et al., 2021). In fact, waking mental well-being seems to be more strongly associated with the affective content of dream reports as assessed by external raters, rather than self-ratings of dream affect (Sikka, Pesonen, & Revonsuo, 2018). Thus, it may well be that different results regarding the relationship between COVID-19-related concern, anxiety, and worry would be obtained when analyzing the affective content of narrative reports. Similarly, the affective ratings and content of reports containing references to COVID-19 may differ from those not containing any references to the pandemic, something that needs to be investigated in future studies. Furthermore, provoked awakenings throughout the night, as compared to spontaneous recall upon morning awakenings, might also lead to differences in the affective quality of dream reports (Sikka, Revonsuo, et al., 2018).

Finally, it should be noted that this study likely included a self-selected sample of individuals who had the motivation and ability to take part in the study. The study was fully anonymous and involved no reimbursement for the participants. Yet, taking part in a 2-week study in which participants have to provide mind-wandering and dream reports every single day is a very time- and energy-consuming engagement. It is likely that some participants filled in a few reports and realized that they do not have the time (nor willingness) to take part in this study, or that they were really interested in writing down their dream reports (but not engage in mind-wandering task and write down their waking thoughts). Also, participants may have found the mind-wandering task difficult (as some participants also commented on), more so than writing down dream reports. Also, it is important to consider that the data collection took part during the time when COVID-19 restrictions were in place, and this means that many participants may have had daily engagements that prevented them from being fully engaged in the study (e.g., home-schooling their kids). Thus, it is unclear to what extent the findings of this study generalize to individuals less interested in, and perhaps less concerned with, the impact of COVID-19 on their daily experiences and dreams, or to those whose life situation prevented them from participating in this study.

## Conclusions

In summary, the present study showed that: (a) Daily measures of COVID-19 worry were associated with affect experienced during mind-wandering: on days when people reported higher levels of negative affect and lower levels of positive affect during mind-wandering, they experienced more worry. (b) Questionnaire measures of general COVID-19 concern and anxiety, and belonging to a COVID-19 risk group, were not associated with affect experienced during mind-wandering or dreaming. (c) Only daily sleep quality was associated with affect experienced during dreaming at the within-person level: on nights with poorer sleep quality people reported experiencing more negative and less positive affect in dreams and were more likely to experience nightmares. However, at the between-person level, (d) individuals who, on average, experienced more daily COVID-19 worry also reported experiencing more negative affect during mind-wandering and during dreaming. As such, the continuity between daily and nightly experiences seems to rely more on stable trait-like individual differences in affective processing.

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