

## EMPIRICAL ARTICLE

# Spontaneous Past and Future Thinking About the COVID-19 Pandemic Across 14 Countries: Effects of Individual and Country-Level COVID-19 Impact Indicators

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In 2020, the world was amid a global health crisis—the COVID-19 pandemic. Nations had varying levels of morbidity and mortality and adopted different measures to prevent the spread of infection. Effects of the pandemic on spontaneous (rather than voluntary) past and future thoughts remain unexplored. Here, we report data from a multicountry online study examining how both country- and individual-level factors are associated with this core aspect of human cognition. Results showed that national (stringency of measures) and individual (attention to COVID-related information and worry) factors separately and jointly predicted the frequency of people's pandemic-related spontaneous thoughts. Additionally, no typical positivity biases were found, as both past and future spontaneous thoughts had a negative emotional valence. This large-scale multinational study provides novel insights toward better understanding the emergence and qualities of spontaneous past and future thoughts. Findings are discussed in terms of the determinants and functions of spontaneous thought.

### General Audience Summary

The COVID-19 pandemic was a global phenomenon; people in countries across the world experienced the pandemic similarly, but did it affect the way we perceived the past and future? This study reports whether and how people experienced spontaneous thoughts about the past and future of the pandemic—that is, images of the past or future that appear in mind without warning and with little effort (e.g., remembering a recent lockdown or imagining a future announcement)—during the pandemic's first wave. Spontaneous past and future thoughts are important in daily life and can indicate poor mental health when negative in nature. Here, for the first time, we asked people from 14 different countries across four continents to report the frequency and emotional characteristics of their spontaneous past and

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future pandemic-related thoughts in the first wave of the pandemic. The study showed that the national context (in particular, COVID regulations) predicted the frequency of people's spontaneous thoughts about the pandemic. Emotional aspects of these thoughts were predicted by individual factors such as isolation, worry, attention to COVID-related information, and impact of COVID-19 on everyday life, in addition to national factors. Finally, in contrast to previous research showing a "positive bias," which is thought to be beneficial, past and future spontaneous pandemic-related thoughts had a negative emotional tone. This study allowed us to demonstrate that the tendency to experience spontaneous thoughts about an ongoing international event can be predicted by societal context, which may be valuable for examining the social predictors of spontaneous emotional thoughts about the past and future. The study also characterized the negative tone of past and future spontaneous thoughts about the pandemic, and future studies will be needed to examine the longer term consequences of these effects.

*Keywords:* spontaneous thought, mental time travel, involuntary memory, future thinking, COVID-19

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The emergence of the COVID-19 pandemic in 2020, in addition to having a major impact on public health and significant health consequences for those infected, led governments worldwide to adopt unprecedented measures in their attempt to control outbreaks, including lockdowns and stay-at-home orders, travel and social restrictions, and school and business closures (Thomas et al., 2020). Such extensive measures can disrupt daily life and a population's social, psychological, health, employment, and economic circumstances, creating an environment in which several determinants of human behavior and mental health may be profoundly affected (Torales et al., 2020). The present multicountry investigation focuses on spontaneous past and future thinking about the COVID-19 pandemic during its first wave and examines how different country- and individual-level COVID-19 impact indicators might predict this core aspect of cognition.

Mental time travel (mental representations of the past and future) is now a well-understood mental process that operates in a close bidirectional relationship with one's emotions, thoughts, and behaviors (Schacter et al., 2012). While studies on mental time travel have typically examined deliberate (i.e., voluntary) episodic past and future thinking (e.g., Schacter et al., 2017), there has been an increased realization that spontaneous (i.e., involuntary) thoughts—arising in one's conscious awareness without deliberately trying to think about them—are common, constituting a core part of the human experience (Berntsen, 2010, 2021; Cole & Kvavilashvili, 2019). Spontaneous past and future thinking allows us to rapidly consider memories and hypothetical future scenarios in response to current situational demands (Berntsen, 2021; Cole & Berntsen, 2016). Such situationally dependent forms of thinking may be especially important in crises, such as the COVID-19 pandemic, when rapid responses to highly changeable situations are needed.

Spontaneous episodic thinking is largely based on rapid, bottom-up associative processes in response to either cues in the environment or psychological context (Barzykowski & Mazzoni, 2022; Berntsen, 2010; Schlagman & Kvavilashvili, 2008). The form and characteristics of events that come to mind spontaneously are influenced by the cueing context, priming, current concerns, and their mental accessibility (Barzykowski & Niedźwieńska, 2018; Cole & Berntsen, 2016; Jordão & St. Jacques, 2022; Mace, 2005). Contrary to deliberately retrieved events, those arising spontaneously tend to be more distinctive, associated with higher levels of (p)re-living (Barzykowski et al., 2019;

Barzykowski & Mazzoni, 2022; Berntsen & Jacobsen, 2008; Finnbogadóttir & Berntsen, 2013), and more emotionally impactful (Berntsen, 2021; del Palacio-Gonzalez & Berntsen, 2020). Strong emotional impact can be expected when the features of such thoughts map onto one's current concerns and emotional state (Cole & Berntsen, 2016; del Palacio-Gonzalez & Berntsen, 2020), especially when the contextual features during encoding or retrieval are emotionally salient (Niziurski & Berntsen, 2019; Staugaard & Berntsen, 2014). In one study, the emotional tone of mind-wandering thoughts was associated with congruent mood recorded seconds later, showing moment-to-moment temporal associations between mind-wandering and mood (Ruby et al., 2013). In sum, evidence suggests there is a bidirectional relationship between ongoing thought and mood.

Emotional state and motivational biases play pivotal roles in shaping the phenomenological qualities of episodic thoughts and can increase their frequency (Johannessen & Berntsen, 2010). Healthy individuals generally show dissociable positivity biases in their past and future thoughts, with the future being more positive (Berntsen & Bohn, 2010). However, positivity biases are reduced in individuals with depression (del Palacio-Gonzalez et al., 2017; Watson et al., 2012), anxiety (del Palacio-Gonzalez & Berntsen, 2020; Finnbogadóttir & Berntsen, 2013), and posttraumatic stress disorder (Schönfeld & Ehlers, 2017). Here, we examined whether people show positivity biases in their spontaneous thoughts about the pandemic.

The emergence of the COVID-19 pandemic has had a profound impact on the world's population. Therefore, there is an imperative to investigate how different COVID-19-related impact indicators may predict core mental phenomena that determine behavior, mood, and mental health. In the present study, we document the frequency and emotional characteristics of spontaneous thoughts about past and future events related to the COVID-19 pandemic in a sample of almost 3,000 individuals across 14 countries.

## Hypotheses of the Present Study

During the pandemic, people were exposed to a constant stream of COVID-19-related information, from hygiene- and social distancing-related signs in public spaces to daily media briefings. These environmental cues could act as associative triggers for relevant spontaneous thoughts. Additionally, the extent to which

the pandemic became a current concern for people may have led pandemic-related information to be highly accessible.<sup>1</sup> Thus, we expected that participants would report experiencing frequent spontaneous thoughts about past and future pandemic-related events.

Given that emotional characteristics of spontaneous thought are affected by environmental and psychological contexts, we expected pandemic-related spontaneous past and future thoughts to be both predominantly negative in valence, with thoughts about future events being less negative than thoughts about past events (Niziurski & Schaper, 2021).

Furthermore, we examined the extent to which the frequency and emotional dimensions of past and future spontaneous pandemic-related thoughts were predicted by COVID-19-related environmental context parameters. We expected individuals residing in the worst-hit countries (based on *severity* of COVID-19 and *stringency* of government measures) to report more frequent and more emotionally negative and intense spontaneous thoughts. Additionally, because the COVID-19 pandemic impacted people differently (McBride et al., 2021), we examined COVID-19 impact at the *individual level*, measuring perceived psychological effects, isolation experience, and worry levels. We expected that these individual-level COVID-19 impact indicators would also influence the frequency and emotional qualities of spontaneous pandemic-related thoughts.

Given commonalities in neuropsychological processes that support remembering the past and imagining the future (Schacter et al., 2007), we hypothesized that past and future spontaneous thoughts would be similarly predicted by country- and individual-level parameters.

## Method

### General Procedure

This study is part of an ongoing collaboration on different memory phenomena during the COVID-19 pandemic among memory researchers from different countries around the world (see Öner, Watson, et al., 2022). A master survey was first developed in English and then translated by the investigators located in each specific country into the primary language of their country. Ethical approvals from local ethics committees were obtained prior to the data collection across all participating countries, and informed consent was obtained from all participants prior to the participation.

Data collection took place during the first COVID-19 wave between the 11th of April and 28th of June 2020. Most countries recruited participants through social media outlets and undergraduate subject pools; other recruitment platforms were also used when possible (e.g., MTurk in the USA and Wjx in China). Most participants completed the survey on Qualtrics, although other platforms were also used. The survey consisted of nine sections covering demographic information, the personal impact of the COVID-19 pandemic, flashbulb memory, past and future collective events, spontaneous past and future thinking, and postpandemic expectations (see Öner, Watson, et al., 2022). The master survey and procedures for data collection and other relevant information can be accessed on the project's Open Science Framework page (Cole et al., 2021; <https://osf.io/m46nq/>). The hypotheses and analysis plan of the present study were also preregistered after the period of

data collection but before any data analysis (<https://doi.org/10.17605/OSF.IO/7ZW8Q>).

### Participants

The initial sample consisted of 4,406 individuals from Canada, China, Denmark, France, Germany, Greece, Italy, Malaysia, New Zealand, Poland, Russia, Spain, Turkey, United Kingdom, and the United States. Any participant with at least one missing data point across the variables of interest was excluded from analysis ( $N = 1,407$ ), including all participants from Germany ( $N = 118$ ) who were excluded for not having completed all items of the survey due to a technical issue. Thus, the final sample consisted of 2,999 participants. Participants' age ranged from 18 to 89 years ( $M = 33.07$ ,  $SD = 13.73$ ), and 69.10% of them were female. Thirty-eight participants were identified as multivariate outliers with the Mahalanobis distance statistic, with the criterion set at  $\chi^2(14) > 36.01$  at  $p < .001$ . Given that some multivariate outliers are expected in large data sets and that they represented less than 1.3% of our sample, we retained them in analysis. Participant information across each country is presented in Table 1.

### Materials and Measures

Six measures were examined as dependent variables: frequency, emotional valence, and emotional intensity of spontaneous thoughts about past events related to the COVID-19 pandemic, and frequency, emotional valence, and emotional intensity of spontaneous thoughts about future events related to the COVID-19 pandemic. In addition, nine individual-specific and three country-specific COVID-19 impact indicators were examined as independent variables.

### Spontaneous Thoughts About Past and Future Events

Six questions assessed spontaneous thoughts about past and future events related to the pandemic. In a fixed order, rating first their past-oriented and then their future-oriented thoughts, participants reported on a 5-point scale (a) the frequency ("Memories of events/imaginary future events related to pandemic pop into my mind by themselves without me consciously trying to remember them"; 1 = *never*, 5 = *always*), (b) emotional valence ("How positive or negative are these memories/future events in general?"; 1 = *very negative*, 3 = *neither positive nor negative*, 5 = *very positive*), and (c) emotional intensity of these events ("How emotionally intense are these memories/future events in general?"; 1 = *not at all intense*, 5 = *extremely intense*). It should be noted that this frequency scale has been adapted from previous studies that used an equivalent scale to assess the extent to which spontaneous past and future thinking was thought about previously (Berntsen & Jacobsen, 2008; Schlagman & Kvavilashvili, 2008). Additionally, emotional

<sup>1</sup> For the sake of clarity, we do not propose that environmental cues are the direct cause of spontaneous thoughts, or their content (see Jordão & St. Jacques, 2022 for a related discussion), rather current concerns can sensitize one to related environmental cues (i.e., current concern of *avoiding sickness*, will make one sensitive to public health guidance, and thus increase thoughts related to health and ill health). This synthesis between *cue—current concern—thought* has been experimentally and theoretically supported in the work of Klinger (Klinger et al., 2018).

**Table 1**  
*Background Participant and Country Information*

Country	Country information			<i>N</i>	<i>M</i> <sub>age</sub> ( <i>SD</i> )	Gender (% female)	Up to high school (%)	Higher education (%)
	Stringency index	Infection rate	Mortality rate					
Canada	39.55	2012	150.47	185	31.52	38.90	75.68	24.32
China	69.83	58	3.22	610	23.54	75.40	84.26	15.74
Denmark	43.90	2066	100.14	146	41.79	77.40	76.71	23.29
France	57.89	2,922	443.41	103	43.61	69.90	88.35	11.65
Greece	49.29	285	172.69	127	42.02	74.00	77.17	22.83
Italy	63.93	3,848	551.42	265	30.55	75.10	62.64	37.36
Malaysia	47.78	218	3.52	107	22.93	82.20	70.09	29.91
New Zealand	50.54	312	4.56	76	26.78	88.20	50.00	50.00
Poland	48.26	583	27.06	136	31.21	85.20	80.15	19.85
Russia	50.33	4,228	60.10	140	38.73	73.20	89.29	10.71
Spain	53.57	5,260	605.76	194	37.17	63.90	77.84	22.16
Turkey	51.74	2,338	60.44	408	36.79	73.80	68.63	31.37
United Kingdom	47.79	3,891	567.29	72	29.28	84.70	80.56	19.44
United States	37.69	4,927	303.46	430	38.39	47.40	73.26	26.74
Total	53.10	2,387	194.89	2,999	33.88	69.10	75.33	24.67

*Note.* Stringency index = measure of governmental response to pandemic (higher scores = stricter response). Infection rate = total of confirmed COVID-19 cases per million. Mortality rate = total of confirmed COVID-19 deaths per million. These indices were calculated for each country by taking the average value for that country from the outbreak of COVID-19 to the final day of data collection in that country.

valence and intensity measures have been used to measure subjective characteristics of spontaneous past and future thoughts previously (Cole et al., 2016; Schlagman & Kvavilashvili, 2008, originally from Johnson et al., 1988) and have demonstrated clear positivity biases when comparing past and future thinking (Cole et al., 2016). The valence measure is a bidirectional scale and has satisfactory face validity, as participants interpret the anchors in relation to neutral emotions (midpoint). Here, we use them to assess past and future spontaneous thoughts, in general, per participant. These six measures were used as dependent variables. Here, a distinction between current and prior research should be noted. Whereas these scales have been used previously to assess qualities and frequencies of past and future thoughts experienced in the moment (e.g., Schlagman & Kvavilashvili, 2008), they have not been validated as retrospective measures so one cannot infer, for instance, how high-frequency ratings map on to actual frequencies (these are, at best, estimations).

### **Individual-Specific Variables**

At the beginning of the survey, participants reported (a) how worried they were because of COVID-19 (1 = *not at all*, 5 = *extremely*) and how the COVID-19 pandemic affected different aspects of their lives, including their (b) finances, (c) social life, (d) psychology, (e) health, and (f) work (1 = *very negative*, 5 = *very positive*). Participants then rated (g) their isolation experience (1 = *very negative*, 3 = *neither positive nor negative*, 5 = *very positive*). These questions were presented among other items, but in the chronological order above. In a subsequent section of the survey, participants provided personal estimations of (h) the time they spent thinking and discussing COVID-19 and (i) the time they spent following COVID-19-related media coverage (from 0% to 100% of their time, on an average day), as measures of individual interest and engagement with COVID-19 news topics. These eight measures were used as independent variables.

### **Country-Specific Variables**

Three country-level parameters reflecting the impact of COVID-19 were also used as independent variables: (a) the infection rates (total of confirmed COVID-19 cases per million) and (b) the mortality rates (total of confirmed COVID-19 deaths per million) were calculated on the last day of data collection in each participating country. In addition, (c) a summary stringency index was calculated for each country as a measure of the governmental response to the pandemic (including lockdown mandates, travel bans, school and workplace closures) from the beginning of the pandemic to the last day of data collection in each country. The stringency index was recorded as a score between 0 and 100, with higher scores representing a stricter form of governmental response. We extracted country-specific variables from the Our World in Data Ritchie et al. (2020) database, which is an international research and data source on various domains. We requested the values between the outbreak of COVID-19 and the last day of data collection for a country and averaged the values between these dates to formulate an index score representing the infections, deaths, and the stringency in each country (for more details regarding the calculation of the stringency index, see Öner, Watson, et al., 2022). Table 1 presents the infection and mortality rates as well as the stringency index for each country.

### **Data Analytic Plan**

The results are presented in two main sections to address the study's aims and hypotheses. First, we report the descriptive statistics of all variables considered, and we summarize the qualitative characteristics of spontaneous past and future thoughts in terms of their frequency, emotional valence, and intensity and examine possible similarities and differences between them. Next, we examine the factorability of the independent variables and whether distinct indices can be formed using principal component analysis. Finally, we utilize the results from the principal component analysis

and examine which country-specific parameters and individual differences can predict the frequency, valence, and intensity of spontaneous past and future thoughts, respectively, with a series of hierarchical regression models.

### Data Availability

The materials and preregistration associated with the study are available at the project's main Open Science Framework page (<https://osf.io/m46nq/>), where data will also be available 1-year post publication (embargo period).

## Results

### Descriptive Statistics

Descriptive statistics for all variables are presented in Supplemental Table 1 and Supplemental Figures 1–3. Results showed that the skewness and kurtosis values for each variable ranged well within the acceptable limits of  $\pm 2.0$  for normally distributed data obtained from large samples.<sup>2</sup> Descriptive statistics for all variables across each participating country are presented in Supplemental Tables 2 and 3.

Only 6.6% of the participants reported not ever having experienced spontaneous past thoughts about the pandemic; 30.3% indicated they had rarely had such thoughts, while most participants reported having spontaneous past thoughts sometimes (37.4%) or often (21.5%; Supplemental Figure 1). Approximately, 4% of participants reported experiencing spontaneous thoughts about COVID-19-related events from the past all the time. Similarly, only 7.4% of the participants reported not ever having experienced spontaneous future thoughts about the pandemic; 27.6% had rarely experienced such thoughts, while 38.9% and 22.6% had sometimes or often experienced spontaneous future thoughts, respectively (Supplemental Figure 1).

With respect to the perceived effects of the pandemic on different aspects of life, a large percentage of participants reported that their finances (42.2%), social life (59.7%), psychology (51.1%), health (29%), and work (48.6%) were negatively affected by the pandemic (Supplemental Figure 2). In addition, 74.4% of participants reported they were moderately to extremely worried because of COVID-19 (Supplemental Figure 3). Finally, almost a third of the participants (30.9%) evaluated their isolation experience as negative, and 33.8% as positive, while most individuals (35.3%) rated it as neither positive nor negative (Supplemental Figure 3).

### Characteristics of Spontaneous Past and Future Thoughts About the COVID-19 Pandemic

Spontaneous past and future thoughts about the COVID-19 pandemic were highly positively correlated in terms of frequency ( $r = .54, p < .001$ ), valence ( $r = .42, p < .001$ ), and intensity ( $r = .58, p < .001$ ; Supplemental Table 4). More specifically, individuals who were likely to experience frequent, intense, or negative spontaneous thoughts about past events tended to also experience frequently, intensely, and negatively spontaneous thoughts about future events. In addition, there were strong positive correlations between frequency and intensity for both past and future spontaneous thoughts, while valence was not associated with frequency. Moreover, the emotional valence of spontaneous thoughts about past events was associated

with their intensity, but no equivalent association was observed for spontaneous future thoughts.

A series of paired-samples *t* tests showed no significant differences in how frequently participants reported experiencing spontaneous past and future thoughts about the pandemic,  $t(2,998) = -.53, p = .596$ , Cohen's  $d = -.01$  (Supplemental Figure 1). Spontaneous future thoughts were significantly less negative than spontaneous past thoughts,  $t(2,998) = -14.87, p < .001$ , Cohen's  $d = -.27$ . Most participants (60.1% of the sample) rated their spontaneous past thoughts as negative, 30% as neither positive nor negative, and only 9.9% rated them as positive (Supplemental Figure 1). By contrast, 47.9% of the sample rated their spontaneous future thoughts as negative, 30% as neither positive nor negative, while 22% rated them as positive (Supplemental Figure 1). Nevertheless, neither mean value extended beyond the scale midpoint (emotionally neutral), reflecting a negative valence for both past and future spontaneous thoughts. Finally, spontaneous past and future thoughts differed with respect to intensity,  $t(2,998) = 9.13, p < .001$ , Cohen's  $d = .17$ , with past thoughts being rated by the participants as more intense than future thoughts (Supplemental Figure 1).

### Predictors of Spontaneous Past and Future Thoughts About the COVID-19 Pandemic

#### Principal Component Analysis

Correlations among all variables are presented in Supplemental Table 4. To reduce collinearity between the independent variables, we examined their factorability and whether distinct indices can be formed. Based on the results of the correlational analysis (Supplemental Table 4), we submitted the five variables reflecting the perceived COVID-19 effects on different life aspects (work, finances, health, psychology, social life), the time spent thinking or discussing about COVID-19, the time spent following COVID-19-related media coverage, and the infection and mortality rates to a varimax-rotated principal component analysis with Kaiser normalization. A scree test and the empirical Kaiser criterion (Braeken & van Assen, 2017) were used to determine the number of components to retain for rotation. Pattern coefficients  $\geq .50$  were predetermined to be salient. Results from Bartlett's test of sphericity indicated that the correlation matrix was not random, approximate  $\chi^2 = 8071.59, df = 36, p < .001$ , and the Kaiser–Meyer–Olkin measure of sampling adequacy was .60, indicating the suitability of the data for principal component analysis. The model yielded a three-factor solution with eigenvalues greater than 1.00, which was also confirmed with a visual scree test. The resulting solution accounted for 65.28% of the total variance. Component loadings are presented in Supplemental Table 5. Component 1 accounted for the largest proportion of the variance (27.25%) and was interpreted as reflective of the perceived impact of the pandemic on different aspects of life. Infection and mortality rates loaded onto Component 2, which accounted for 21.36% of the variance and was interpreted as reflective of COVID-19 severity. Finally, time spent thinking and discussing about COVID-19 and time spent following COVID-19-related coverage

<sup>2</sup> Noticing that the left tail of the distributions of the time spent thinking/discussing about COVID-19 and time spent following COVID-19-related media coverage variables was heavier compared to the right tail, we applied square root transformations to those variables. As the transformations did not affect the results, we retained the raw data in the analyses reported below.

on media loaded on Component 3, which accounted for 16.67% of the variance and was interpreted as reflective of attention to COVID-19. Regression-based principal component scores were obtained and saved as variables for use in the subsequent hierarchical regression models. The three-component solution was robust across extraction (principal components, principal axis factoring) and rotation (varimax, oblimin) methods.

We then conducted a series of hierarchical regression analyses to determine which country-level factors and individual differences could predict the frequency, valence, and intensity of spontaneous past and future thoughts about the pandemic, respectively. Country-specific parameters (stringency and severity indexes) were entered in the first block of predictor variables, the subjective individual-level factors (COVID-19 impact on life aspects, worry, isolation experience) were entered in the second block of predictors, and the attention to COVID-19 factor was entered in the third step.

### *Spontaneous Past Thoughts*

The results of the regression models for spontaneous thoughts about past pandemic-related events are presented in Table 2.

**Frequency.** Stringency and severity significantly predicted the frequency of spontaneous thoughts about past pandemic-related events,  $F(2, 2,996) = 30.33, p < .001$ , and accounted for 2% of the variance. Introducing the impact on life aspects, worry level, and isolation experience variables in Step 2 substantially increased the model's predictive value,  $F(3, 2,993) = 132.70, p < .001$ , which explained an additional 12% of the variance. Stringency and severity remained significant predictors and worry held the highest predictive power. Introducing the attention to COVID-19 variable in the final step further increased the model's predictive power,  $F(1, 2,992) = 430.96, p < .001$ , explaining an additional 11% of the variance. In the final model, where the predictor variables accounted for 24.4% of the variance of spontaneous past thoughts' frequency, the standardized coefficients showed that country-level stringency and, to a lesser extent, severity remained significant predictors, although their predictive power was reduced. Attention to COVID-19 held the highest predictive power, followed by worry.

**Emotional Valence.** The first step of a separate similar model showed that stringency and severity significantly contributed to the emotional valence of spontaneous thoughts about past pandemic-related events,  $F(2, 2,996) = 137.56, p < .001$ , accounting for 8.4% of the variance. Introducing the impact on life aspects, worry, and isolation experience variables in Step 2 further increased the model's predictive power,  $F(3, 2,993) = 126.36, p < .001$ , which explained an additional 10% of the variance. All variables were significant predictors, although worry was marginally significant. Impact on life aspects was the strongest predictor, followed by the country-level stringency index and isolation experience. Introducing the attention to COVID-19 variable in the third step resulted in a minor but significant increase of the model's predictive power,  $F(1, 2,992) = 19.75, p < .001$ , explaining an additional 0.5% of the variance. In the final model, all variables apart from worry were significant predictors of the emotional valence of spontaneous past pandemic-related thoughts, cumulatively explaining 19% of the variance. Impact on life aspects remained the strongest predictor, followed by the country-level stringency index, isolation experience, and the country severity index. Attention to COVID-19 was also a significant predictor, although it held a relatively smaller predictive power.

**Emotional Intensity.** Results from a separate similar model showed that stringency significantly contributed to the emotional intensity of spontaneous past pandemic-related thoughts,  $F(2, 2,996) = 12.94, p < .001$ , accounting for 1% of the variance. Introducing the impact on life aspects, worry, and isolation experience variables in Step 2 substantially increased the model's predictive power,  $F(3, 2,993) = 126.12, p < .001$ , which explained an additional 11.8% of the variance. Worry had the strongest predictive power followed by isolation experience. Introducing the attention to COVID-19 variable in the third step further increased the model's predictive power,  $F(1, 2,992) = 330.61, p < .001$ , explaining an additional 8.8% of the variance. The predictors cumulatively accounted for 21% of the total variance in emotional intensity of spontaneous past pandemic-related thoughts. Attention to COVID-19 was the strongest predictor, followed by worry and the stringency index. The impact on life aspects and isolation experience variables also held a small predictive power in the final model.

### *Spontaneous Future Thoughts*

The results of the regression models for future-oriented spontaneous thoughts about the pandemic are presented in Table 3.

**Frequency.** In the first step of the model, stringency was a significant predictor of frequency of spontaneous thoughts about future pandemic-related events,  $F(2, 2,996) = 14.44, p < .001$ , explaining 1% of the variance. Introducing the impact on life aspects, worry, and isolation experience variables in Step 2 increased the model's predictive value,  $F(3, 2,993) = 73.24, p < .001$ , which explained an additional 6.8% of the variance. Worry was the strongest predictor, while stringency and isolation experience also held a weaker but significant predictive power. Introducing the attention to COVID-19 variable in the final step further increased the model's predictive power,  $F(1, 2,992) = 280.32, p < .001$ , explaining an additional 8% of the variance. In the final model, where the predictors cumulatively accounted for 16% of the variance, attention to COVID-19 was the strongest predictor of the frequency of spontaneous thoughts about future pandemic-related events, followed by worry, and the country stringency index, while isolation experience was also a significant predictor.

**Emotional Valence.** In a separate model, the country-level stringency and severity indexes significantly contributed to the emotional valence of future-oriented spontaneous pandemic-related thoughts,  $F(2, 2,996) = 66.62, p < .001$ , accounting for 4.3% of the variance. Introducing the impact on life aspects, worry, and isolation experience variables in Step 2 increased the model's predictive power,  $F(3, 2,993) = 42.04, p < .001$ , which explained an additional 3.9% of the variance. All variables apart from worry were significant predictors, with impact on life aspects and country stringency index holding the highest predictive power, followed by isolation experience and then severity. Introducing the attention to COVID-19 variable in the final step further slightly increased the model's predictive power,  $F(1, 2,992) = 9.09, p = .003$ , explaining an additional 0.3% of the variance. In the final model, all variables apart from worry were again significant predictors of the emotional valence of future spontaneous pandemic-related thoughts, cumulatively explaining 8.4% of the variance. Impact on life aspects explained the greatest amount of the unique variance for the emotional valence of future thoughts, followed by the country

**Table 2**  
*Regression Summaries for Spontaneous Past Thoughts*

Predictors	R	R <sup>2</sup>	ΔR <sup>2</sup>	B (SE)	β	t value
Frequency						
Step 1	.14	.02	.02***			
Stringency				.01 (.00)	.12	6.13***
Severity				-.04 (.02)	-.05	-2.45*
Step 2	.37	.13	.12***			
Stringency				.00 (.00)	.04	2.08*
Severity				-.04 (.02)	-.04	-2.43*
Impact on life aspects				.01 (.02)	.01	0.26
Worry				.31 (.02)	.35	19.89***
Isolation experience				-.02 (.02)	-.02	-1.27
Step 3	.49	.24	.11***			
Stringency				.01 (.00)	<b>.09</b>	5.16***
Severity				-.03 (.02)	-.03	-1.99*
Impact on life aspects				-.01 (.02)	-.01	-0.62
Worry				.22 (.01)	<b>.25</b>	14.45***
Isolation experience				-.01 (.02)	-.01	-0.29
Attention to COVID				.33 (.02)	<b>.35</b>	20.76***
Valence						
Step 1	.29	.08	.08***			
Stringency				.02 (.00)	.24	13.08***
Severity				-.08 (.02)	-.10	-5.18***
Step 2	.43	.19	.10***			
Stringency				.01 (.00)	.19	10.31***
Severity				-.09 (.02)	-.10	-5.85***
Impact on life aspects				.20 (.02)	.23	13.30***
Worry about health				-.03 (.01)	-.04	-2.14*
Isolation experience				.14 (.02)	.17	9.54***
Step 3	.44	.19	.01***			
Stringency				.01 (.00)	<b>.18</b>	9.60***
Severity				-.09 (.02)	<b>-.11</b>	-5.99***
Impact on life aspects				.20 (.02)	<b>.24</b>	13.52***
Worry				-.01 (.01)	-.01	-0.78
Isolation experience				.14 (.02)	<b>.16</b>	9.33***
Attention to COVID				-.07 (.01)	<b>-.08</b>	-4.45***
Intensity						
Step 1	.09	.01	.01***			
Stringency				.01 (.00)	.09	4.87***
Severity				.02 (.02)	.02	1.05
Step 2	.35	.12	.11***			
Stringency				.00 (.00)	.03	1.57
Severity				.03 (.02)	.02	1.30
Impact on life aspects				-.03 (.02)	-.03	-1.54
Worry				.34 (.02)	.33	18.88***
Isolation experience				-.06 (.02)	-.06	-3.18**
Step 3	.45	.21	.09***			
Stringency				.01 (.00)	<b>.08</b>	4.24***
Severity				.04 (.02)	.03	1.90
Impact on life aspects				-.05 (.02)	-.04	-2.41*
Worry				.25 (.02)	<b>.24</b>	13.85***
Isolation experience				-.05 (.02)	-.04	-2.41*
Attention to COVID				.35 (.02)	<b>.31</b>	18.26***

Note. SE = standard error. Variables with the strongest predictive power are in bold; N = 2,999.  
\* p < .05. \*\* p < .01. \*\*\* p < .001.

stringency index and the isolation experience, and then the attention to COVID-19 and the country severity index.

**Emotional Intensity.** Results from a separate similar model showed that the stringency index was a significant predictor of the emotional intensity of future-oriented spontaneous pandemic-related thoughts,  $F(2, 2,996) = 47.02, p < .001$ , accounting for 3% of the variance. Introducing the impact on life aspects, worry, and isolation experience variables in 2Step increased the model's predictive power,  $F(3, 2,993) = 93.43, p < .001$ , which explained an

additional 8.3% of the variance. The country stringency index remained a significant predictor. Worry was found to be the strongest predictor, followed by the country stringency index and then the isolation experience. Introducing the attention to COVID-19 variable in the final step further increased the model's predictive power,  $F(1, 2,992) = 247.92, p < .001$ , explaining an additional 6.8% of the variance. Cumulatively, the predictors accounted for 18% of the variance in the emotional intensity of spontaneous future pandemic-related thoughts. Attention to COVID-19 was revealed as

**Table 3**  
*Regression Summaries for Spontaneous Future Thoughts*

Predictors	<i>R</i>	<i>R</i> <sup>2</sup>	$\Delta R^2$	<i>B</i> ( <i>SE</i> )	$\beta$	<i>t</i> value
Frequency						
Step 1	.10	.01	.01***			
Stringency				.01 (.00)	.10	5.30***
Severity				.02 (.02)	.02	0.95
Step 2	.28	.08	.07***			
Stringency				.00 (.00)	.05	2.38*
Severity				.02 (.02)	.02	1.06
Impact on life aspects				.01 (.02)	.01	0.34
Worry				.23 (.02)	.26	14.64***
Isolation experience				-.04 (.02)	-.04	-2.25*
Step 3	.39	.16	.08***			
Stringency				.01 (.00)	<b>.09</b>	4.85***
Severity				.03 (.02)	.03	1.60
Impact on life aspects				-.01 (.02)	-.01	-0.37
Worry				.16 (.02)	<b>.18</b>	9.88***
Isolation experience				-.05 (.02)	-.05	-2.57*
Attention to COVID				.28 (.02)	<b>.30</b>	16.74***
Valence						
Step 1	.21	.04	.04***			
Stringency				.02 (.00)	.19	9.92***
Severity				-.04 (.02)	-.04	-2.20*
Step 2	.29	.08	.08***			
Stringency				.01 (.00)	.15	7.83***
Severity				-.05 (.02)	-.05	-2.52*
Impact on life aspects				.16 (.02)	.16	8.52***
Worry				-.01 (.02)	-.01	-0.38
Isolation experience				.08 (.02)	.08	4.53***
Step 3	.29	.08	.08**			
Stringency				.01 (.00)	<b>.14</b>	7.33***
Severity				-.05 (.02)	-.05	-2.61**
Impact on life aspects				.16 (.02)	<b>.16</b>	8.66***
Worry				.01 (.02)	.01	0.50
Isolation experience				.08 (.02)	<b>.08</b>	4.37***
Attention to COVID				-.06 (.02)	-.06	-3.02**
Intensity						
Step 1	.17	.03	.03***			
Stringency				.02 (.00)	.17	8.79***
Severity				-.02 (.02)	-.02	-0.89
Step 2	.34	.11	.08***			
Stringency				.01 (.00)	.11	5.82***
Severity				-.02 (.02)	-.02	-0.84
Impact on life aspects				-.01 (.02)	-.01	-0.31
Worry				.27 (.02)	.29	16.31***
Isolation experience				-.06 (.02)	-.06	-3.29**
Step 3	.43	.18	.07***			
Stringency				.01 (.00)	<b>.15</b>	8.24***
Severity				-.01 (.02)	-.01	-0.41
Impact on life aspects				-.02 (.02)	-.02	-1.00
Worry				.19 (.02)	<b>.21</b>	11.76***
Isolation experience				-.04 (.02)	-.05	-2.60**
Attention to COVID				.27 (.02)	<b>.27</b>	15.75***

Note. *SE* = standard error. Variables with the strongest predictive power are in bold; *N* = 2,999.

\* *p* < .05. \*\* *p* < .01. \*\*\* *p* < .001.

the strongest predictor of the emotional intensity of spontaneous thoughts about the future, followed by worry and the country stringency index, which also held high predictive power, and then the isolation experience.

## Discussion

We collected data from fourteen countries across Europe, Asia, Oceania, and America to rapidly investigate past and future

spontaneous thinking about the COVID-19 pandemic, as it unfolded. As a situationally dependent aspect of cognition with well-established links to mental health (Schultebrucks et al., 2019), it is important to elucidate how spontaneous past and future thinking is predicted by an ongoing situation as threatening, ubiquitous, and uncertain as COVID-19. Our main aim was to examine whether national-level and individual-level factors predicted the frequency and emotional characteristics of spontaneous thoughts about the pandemic. We also assessed whether the present findings



corresponded with well-known phenomena from studies of past and future thoughts.

Using regression analyses, we found that national- and individual-level factors predicted the frequency of people's spontaneous thoughts about the pandemic. Governmental stringency measures predicted the frequency of both past and future spontaneous pandemic-related thoughts, while spontaneous past pandemic-related thoughts were also predicted by pandemic severity. Moreover, individual-level variables such as attention paid to pandemic-related information and worry levels also predicted the frequency of both past and future thoughts. This demonstrates that attention acts as a strong and reliable predictor of the frequency of spontaneous thoughts and accords with previous priming studies (Barzykowski & Niedźwieńska, 2018). These findings suggest that paying *less* attention to COVID-19-related information may reduce the frequency of spontaneous pandemic-related thoughts, and vice versa, although the present data were correlational so experiments should unpick the issue of causality.

Spontaneous thoughts about pandemic-related past and future events were predominantly negative, with people rating these thoughts as significantly less positive than they do their spontaneous thoughts more generally (e.g., Berntsen & Bohn, 2010; Cole et al., 2016). The link between the pandemic and negativity in past and future pandemic-related thoughts echoes recent studies showing that voluntary memories and future-oriented thoughts during the pandemic were less positive than expected (Niziurski & Schaper, 2021; Öner, Watson, et al., 2022) and that COVID-19-related events contain more negative details than non-COVID-19-related events, especially when about the future (Addis, 2021).

Contrary to the previous research (e.g., Berntsen & Bohn, 2010), we did not find a future positivity bias. Spontaneous past and future thoughts are known to impact mood (Cole et al., 2016) highlighting the possible downstream effects of these processes on mental health (Torales et al., 2020). Perhaps this was due to the impact caused by the pandemic (as measured here) as well as prompting people to report COVID-related thoughts rather than thoughts in general.<sup>3</sup>

In addition to finding that both past and future spontaneous thoughts about the pandemic were predicted by similar country- and individual-level factors, we also found positive correlations between qualities of past and future thought. This past and future correspondence is likely due to shared neurocognitive processes involved in these interrelated abilities (Schacter et al., 2007, 2012).

## Theoretical Implications

Theoretical insights into spontaneous thought can be categorized into four main questions: (a) *when* and (b) *how* they arise, (c) *who* is likely to experience them (depending on their context), and (d) *why* they occur (Cole & Kvavilashvili, 2019).

First, the study is relevant to question (a) as it elucidates situations in which spontaneous past and future thoughts occur—specifically, that the environmental context plays a key role. The COVID-19 pandemic allowed us to demonstrate, for the first time, that the tendency to experience spontaneous thoughts about an ongoing international event can be predicted by certain societal contexts (e.g., higher COVID-19 infection rates). Beyond COVID-19, the predictive validity of societal context (e.g., local health services, political instability) on spontaneous thoughts could prove a fruitful area for research.

Second, these data are particularly relevant to the “who” question. Although neurological impairments are known to affect spontaneous cognitive processes (e.g., Bertossi & Ciaramelli, 2016; Kvavilashvili et al., 2020), our findings highlight the role of worry in spontaneous thought. Worry and attention to COVID-19-related media coverage were the strongest predictors of the emotional intensity of both past and future spontaneous thought about the pandemic, an important finding given that high worry and negative mental imagery are risk factors for poor mental health (Holmes & Mathews, 2010; Klinger et al., 2018).<sup>4</sup>

Third, in terms of the “why” question, although we did not examine it explicitly, repeated and negative/emotionally intense spontaneous thoughts about the pandemic may have served an important function: awareness. Indeed, heightened awareness of the pandemic can increase protective health behaviors (e.g., mask wearing; Schneider & Kroska, 2021). Finally, due to the correlational nature of this study, we cannot address the “how” question.

## Limitations and Future Directions

An important lacuna in our study was the lack of qualitative data on the content of people's spontaneous past and future thoughts about the pandemic. This was part of a larger project (Öner, Ergen, et al., 2022) and the rapid nature of data collection across countries, covering multiple topics, meant we were unable to collect descriptions of spontaneous thoughts.

The limitations of relying on meta-level statistics as our country-level variables should also be considered, as the interpretation of these variables and how they interact is complex. Nevertheless, effects here chime with a 59-country study showing reliable effects of such meta-level data on psychological variables (Alzueta et al., 2021).

Finally, the lack of a non-COVID-related control condition means we cannot determine (a) whether the reported models would replicate for non-COVID thoughts, (b) how frequently people experienced spontaneous non-COVID thoughts, and (c) whether the reported negativity extends to all past and future spontaneous thoughts. Similarly, because we asked people to report on their spontaneous thoughts retrospectively, their ratings about the frequency and valence of these thoughts might not be accurate (for a review, see Kahneman & Riis, 2005). Nevertheless, within the context of the pandemic, our data show the effects individual- and country-level factors had on people's perceptions of their spontaneous thoughts related to COVID-19.

## Conclusions

To our knowledge, this is the first multinational study conducted during the COVID-19 pandemic examining spontaneous past and future thinking about the pandemic. This forms an important piece

<sup>3</sup> It is plausible that worsening of the severity of the pandemic was reflected in more pessimistic thoughts about the past and future (see correlations between country-level indicators of pandemic severity and emotional valence, Supplemental Table 4), and a co-occurring absence of positivity biases, which normally sustain motivation toward the future (Berntsen & Bohn, 2010).

<sup>4</sup> Additionally, although we measured perceived “psychological and social” effects of COVID-19 and worry, a limitation was the omission of a standardized mood measure.

of the puzzle in understanding the emergence and qualities of spontaneous past and future thoughts. Specifically, we showed the pandemic was associated with a downward shift in the emotional valence of past- and future-oriented spontaneous thoughts about COVID-19, and how environmental context and individual factors play joint roles in predicting these thoughts. Future research should further examine downstream effects of such thoughts on mental health, as well as whether and how these change in a postpandemic society.

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