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The flashbulb-like nature of memory for the first COVID-19 case and the impact of the emergency. A cross-national survey

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The flashbulb-like nature of memory for the first COVID-19 case and the impact of the emergency. A cross-national survey

Flashbulb memories (FBMs) refer to vivid and long-lasting autobiographical memories for the circumstances in which people learned of a shocking and consequential public event. A cross-national study across eleven countries aimed to investigate FBM formation following the first COVID-19 case news in each country and test the effect of pandemic-related variables on FBM. Participants had detailed memories of the date and others present when they heard the news, and had partially detailed memories of the place, activity, and news source. China had the highest FBM specificity. All countries considered the COVID-19 emergency as highly significant at both the individual and global level. The Classification and Regression Tree Analysis revealed that FBM specificity might be influenced by participants' age, subjective severity (assessment of COVID-19 impact in each country and relative to others), residing in an area with stringent COVID-19 protection measures, and expecting the pandemic effects. Hierarchical regression models demonstrated that age and subjective severity negatively predicted FBM specificity, whereas sex, pandemic impact expectedness, and rehearsal showed positive associations in the total sample. Subjective severity negatively affected FBM specificity in Turkey, whereas pandemic impact expectedness positively influenced FBM specificity in China and negatively in Denmark.

Keywords: flashbulb memory; COVID-19; canonical categories; autobiographical memory; cross-national study.

Introduction

8th December 2019: This was the date when the first case of Coronavirus 2019 (COVID-19) was identified in Wuhan, China. The whole world would soon witness how catastrophic a global pandemic can be. The infection 2019-nCoV was classified as a severe acute respiratory syndrome (SARS-CoV-2; Xu et al., 2020). The COVID-19 emergency and the subsequent measures adopted to contain the contagion were to have severe consequences on people's lives, in often irreparable and irreversible ways (Lanciano et al., 2020). The most up-to-date literature accepts the view that the COVID-19 pandemic has been an unprecedented catastrophic and traumatic event (Chamaa et al., 2021; Liu et al., 2020; Taurisano et al., 2022). Of all the preventive measures, according to the World Health Organization (WHO), the maintenance of physical distance turned out to be the most often adopted and one of the most effective in reducing positive cases and deaths (Yang et al., 2020). Physical distancing and lockdown led to psychological and social distance, resulting in people feeling mentally overburdened (Jacobson et al., 2020): People found themselves on their own, locked alone

with their thoughts, hopes and memories. Since the beginning of the COVID-19 pandemic, various studies have examined its impact on public health. Whereas some of these studies have reported relatively small and various effects on mental health, indicating the resilience of most individuals during this period (Prati & Mancini, 2021), other studies have highlighted significant increases in levels of depression, anxiety, general distress, and sleep disorders (Bartoszek et al., 2020; Bäuerle et al., 2020; Rajkumar, 2020; Wang et al., 2020). Consequently, the global health crisis was also viewed as a worldwide mental health crisis, with implications for cognitive abilities, such as memory encoding, storage, and retrieval (Wolf, 2017).

COVID-19 pandemic and remembering the past

The COVID-19 pandemic has thoroughly affected everyone around the world, leaving no one untouched, with significant direct and indirect impacts. These long years linked to COVID-19 represent a benchmark between the autobiographical memory of the individual (*personal history*) and the collective memory of the world (*worldwide history*). Day after day, scientific literature undoubtedly portrays the short, medium and long-term effects of COVID-19 in various life domains, including the economy, tourism, health, work, and mental well-being (Feyisa, 2020). However, what remains not sufficiently investigated is how events from this period are stored in our memories. How has COVID-19 affected our way of remembering the past and the contents of our memories? What do we actually remember from those early days of terrifying and shocking news? Any event which is significantly upsetting and life-changing unavoidably leaves indelible marks on our memory, and this impact deserves to be investigated more deeply. Examining how people encode, store, and retrieve COVID-related events is fundamental to examine the cognitive and emotional aftermath of the emergency itself. This study attempts to address some of these issues empirically.

Although much has been written on the topic of COVID-19 (about four years have now passed since December 2019), few studies have been specifically focused on the pandemic's effects upon the contents and organisation of autobiographical memory. To illustrate, through an online survey, Niziurski and Schaper (2021) investigated the features of past and future thoughts related to the pandemic and the extent to which these are related to psychological well-being. The authors concluded that participants i) recalled and predicted negative and positive events related to the COVID-19 pandemic, ii) exhibited higher levels of re-experiencing for past compared to future events, and iii) rehearsed future events more than past events. Strictly related to the aim of the above-

mentioned study, in a cross-national study¹, Öner and colleagues (2022) investigated global and national events people reported as remarkable, from the beginning of the spread of COVID-19 (past events) to the near future (future events). The authors found that past events - both national and global - reported themes related to infections, lockdown, and politics, whilst future events - also both national and global - contained the themes of economy, a second wave, and lockdown. Additionally, the study's findings reported national events as being less negative and more vivid than global events, and country differences in emotional valence were greatest for future events.

Moreover, Brown (2021) adopted the Transition Theory (TT; Brown, 2016) to describe how memory of COVID-19 onset diverges from other personal and collective transitions, and how memory of the COVID-19 pandemic period diverges from other autobiographical phases. The author concluded that the TT made it possible to predict i) higher frequencies of event memories at the beginning of COVID-19; ii) subsequent lower frequencies of event memories from quarantine phases compared to other established periods; iii) higher perception of COVID-19 importance for people's lives when they perceive discontinuity in their pre- and post-pandemic life. Additionally, Leon and colleagues (2022) assessed the role of psychological distress related to the COVID-19 pandemic on the people's ability to encode and consolidate memories, finding an impairment for the aversive episodic memory (compared to neutral memory) in both free recall and recognition tasks. Still related to the topic of remembering-wellbeing, in a two-year longitudinal study, Vanaken and colleagues (2022) assessed narrative coherence as a factor for adaptive emotional responses in the face of stressful experiences, such as the COVID-19 pandemic. Being involved in a longitudinal study that had started before COVID-19, the authors had the opportunity to test the role of narrative coherence - assessed before the stressor happened - in predicting successive future emotional adjustment to a stressful situation as well as COVID-19. Findings suggested that greater baseline coherence of narratives concerning positive autobiographical events predicted an enhancement in emotional well-being during the COVID-19 pandemic, and that the coherence-wellbeing link was partially mediated by the social support people perceived to have. In a brief report on older adults, Ford and colleagues (2021) tested their idea that how adults remember the COVID-19 pandemic also varies with age. Across two surveys, the authors concluded that although the pandemic was a common event shared by all, the way of remembering actually differed from person to person, with older people more inclined to remember positive aspects of the pandemic.

¹ The survey has been conducted on the partially same sample as the present study, see Sample Section of the current study.

Flashbulb-like memories

The unprecedented uniqueness of the COVID-19 pandemic sets up conditions to investigate people's memories of the news about the first COVID-19 case in their country. When a shocking, consequential, and surprising public event occurs, people retain for a long time not only details related to the original event but also details linked to the reception context of the news. This special type of memory was pioneered by Brown and Kulik in 1977, calling it Flashbulb Memory (FBM). The reception context under which people learn of public news has been traditionally described by the following so-called canonical categories: Where people were when they learned the news, their ongoing activity at the time, the source of the news, the aftermath of the event, personal reactions to the event, and the reactions of others (Brown & Kulik, 1977). This set of canonical categories has been extended over time through the great deal of research on the topic up to and including other details, such as when people learned the news (Bohannon, 1988; Christianson, 1989; Neisser & Harsch, 1992), what people were thinking as they learned the news (Christianson, 1989; Kaya Kızıloz & Tekcan, 2013; Weaver, 1993), other people present at the moment of the news (Christianson, 1989; Kaya Kızıloz & Tekcan, 2013; Neisser & Harsch, 1992), weather or clothing (Kaya Kızıloz & Tekcan, 2013; Kraha & Boals, 2014; Lanciano et al., 2018).

So defined, FBM represents an autobiographical memory formation for which an objective record of the original experience hardly exists; in other words, it is generally impossible to establish if the reception context people remember corresponds to what really happened. Regarding FBM assessment, a remarkable body of studies converge in proposing three different parameters (Bohannon & Symons, 1992): How many details people retrieve in the memory (specificity), how sure people are about their memory (confidence), and how stable the memory is over time (consistency). The first index – FBM specificity – refers to the amount of richness and details recovered in the memory, achieved by summing up all the canonical categories people remembered in their free or probed accounts (Bohannon, 1988; Bohannon & Symons, 1992; Brown & Kulik, 1977; Julian et al., 2009). This proxy has been frequently adopted in one-session studies in which the only FBM measure assessed is the number of details remembered (Bohannon & Symons, 1992). In addition to these approaches, other researchers emphasized the self-reported vividness as a phenomenological distinctive feature of flashbulb richness (Demiray & Freund, 2015; Kvavilashvili et al., 2010; Niedźwieńska, 2003; Talarico & Rubin, 2003, 2007). The FBM specificity index takes its first steps in the fascinating idea of *'live quality'*, originally put forward by Brown and Kulik (1977): Emotionally vivid memories are supposed to be recorded in the brain through a camera-like mechanism, which immortalises a personal event, by saturating memory with all sensory and

perceptual details available. This concept of FBM as a special memory different from other ordinary autobiographical memories is the subject of a long-standing debate between supporters and sceptics of this view (Curci & Conway, 2013). The debate revolves around the existence (or not) of a special encoding mechanism underlying FBM formation and maintenance, so that a series of factors act at the encoding level to trace this long-lasting memory vividly and indelibly. These encoding factors are the emotional impact of the event, the level of surprise and novelty, and the personal and social significance of the event (Brown & Kulik, 1977; Conway et al., 1994). This special encoding hypothesis sustains the idea that FBM is a fairly faithful record of the original event. On the other hand, researchers sceptical or opposed to this “special memory” view embrace the idea that FBMs are not significantly different from any other emotional autobiographical memory. They argue that FBMs arise due to post-encoding social factors, such as rehearsal mechanisms (rumination, social sharing, news searching), previous knowledge of the event, and attitude (Christianson, 1989; Larsen, 1992; McCloskey et al., 1988; Neisser & Harsch, 1992; Pezdek, 2003; Talarico & Rubin, 2003; Wright & Gaskell, 1995). Therefore, this reconstructive hypothesis sustains the idea that FBM maintenance follows a reconstructive pattern, adhering to narrative schema or familiar scripts (Neisser, 1982; Neisser & Harsch, 1992). Finkenauer and colleagues (1998) tried to recompose this debate by proposing an emotional-integrative model in which the relationship between emotion and FBM may be both direct – through the appraisal of novelty and surprise of the original event – and indirect – through rehearsal processes (Curci & Luminet, 2006; Lanciano et al., 2010).

The different views on FBM proposed in the literature have remarked upon the role of factors crucial for the formation and maintenance of memory for the reception context. Among these factors, emotional appraisals of novelty and importance–consequentiality play a fundamental role. The well-known cognitive theories of emotion (e.g., Frijda, 1986; Lazarus, 1982; Leventhal, 1984; Scherer, 1984) supported novelty, with its consequent emotion of surprise, as an important condition for encoding an event in long-term memory. The appraisal of importance–consequentiality has also been proposed as a critical factor associated with memory for the reception context, leading to consequent emotional states of sadness, anger, or fear, which in turn impact the individual’s memory (Brown & Kulik, 1977; Christianson, 1989; Christianson & Engelberg, 1999; Conway, 1994; Finkenauer et al., 1998; Rubin & Kozin, 1984). There is no doubt that the target event of the present study - the news of the first COVID-19 case - fully reflects the FBM characteristics of unexpectedness, exceptionality, and importance/consequentiality at both a local and global level. To support this view, Frei and Carlson (2021) coined the term ‘COVID flashbulb memories’ in the school context when referring to

memories that teachers and students had of the news that classes should have moved online in the Spring of 2020.

The dimension of importance/consequentiality may be conceptualised in different ways. Some authors have considered the dimension in terms of social group membership entailing a specific level of concerns in the original event (social/national membership, political concerns, religious affiliation; Curci et al., 2015; Curci & Luminet, 2009; Kvavilashvili et al., 2009; Tinti et al., 2009). Others have conceptualised the appraisal of importance/consequentiality as a function of the emotional involvement defined by the direct experience of the event (Er, 2003; Neisser et al., 1996) or its psychological distance (Tekcan et al., 2003). Cross-national studies comparing FBM and Event Memory (the memory of the target event) in different social groups found that people shape and maintain the recollection of an event and its reception context as a function of how involved and interested in the event they are with respect to their own experience (Curci et al., 2001; Curci & Luminet, 2009).

Following this reasoning and translating it to the COVID-19 context, one might expect that the impact of COVID-19 across countries – in terms of severity and restrictive measures adopted – affected memory for the reception context of the news of the first case recorded in the participant's country. Supporting this hypothesis, Öner and colleagues (2022) observed in their cross-national study that the recollection of events was not homogenous across different nations. Rather, the distinctive experiences of each country during the pandemic, marked by varied levels of pandemic severity and governmental stringency, were found to significantly influence how national and global events were remembered. This heterogeneity suggests that the unique context of each country during the pandemic played a key role in shaping subjects' memory, leading to variations in the perception and recall of significant events.

The literature also identifies rehearsal processes as a factor of interest for FBM formation and maintenance, which includes long-term cognitive and social processes, such as the need to ruminate on and rethink the event, the need to socially share the event with others, or the need to search for news about the event in the media (Bohannon & Symons, 1992; Christianson, 1989; Finkenauer et al., 1998; McCloskey et al., 1988; Neisser, 1982; Páez et al., 2008; Wright, 1993). The COVID-19 emergency immediately showed us the dramatic implications of news seeking, such as information overload and infodemic (Rathore & Farooq, 2020).

The Present Study

The dynamic nature of the pandemic offered a unique opportunity to explore the formation of FBMs beyond the typical framework of a “brief episode”. This unprecedented and evolving scenario encouraged us to expand our focus beyond traditional FBM analysis to include various aspects of the pandemic to investigate how an ongoing global event can shape and potentially impact these memories. The present study aimed i) to explore the formation of a FBM following the news of the first COVID-19 case in people’s own country; ii) to test the effects of pandemic-related emotional and cognitive variables on the FBM formation, such as objective variables (i.e., government restrictions) and subjective variables (i.e., COVID-19 subjective severity, pandemic impact expectedness, personal and global importance of pandemic, and rehearsal of pandemic); and iii) to explore whether FBM and its formation varies across countries. To address these aims, participants from eleven countries around the world (Canada, China, Denmark, Greece, Italy, Malaysia, New Zealand, Poland, Russia, Spain, and Turkey) were asked to report details of the reception context of the news of the first COVID-19 case in their own country. First, we expected that following the news of the first COVID-19 case, people would be able to provide a specific and detailed memory of their reception context which would include canonical categories (date, place, ongoing activity, informant, others present) (Hypothesis 1). Second, we also expected that high levels of emotional and cognitive dimensions and high impact of objective and subjective distress would be associated with high levels of FBM specificity (Hypothesis 2). Moreover, in the present study, we acknowledge the importance of exploring FBM for COVID-19 cases in countries having markedly different levels of concerns in the original news, moved by the hypothesis that the shorter the physical and psychological distance from a target event (in terms of number of COVID-19 cases, number of COVID-19 deaths, government restrictive measures, etc.), the higher the specificity level of FBM and the greater the impact of emotional and cognitive factors associated with the FBM formation (Conway et al., 1994; Er, 2003; Finkenauer et al., 1998) would be (Hypothesis 3).

Method

The current study originates from an international collaboration involving researchers from fifteen countries (i.e., Canada, China, Denmark, France, Germany, Greece, Italy, Malaysia, New Zealand, Poland, Russia, Spain, Turkey, United Kingdom, and United States of America) who initially expressed an interest in participation on March 24, 2020. For the present study, four countries (France, Germany, United States of America, and United Kingdom) declined their participation, resulting in a sample of eleven countries. Researchers from each country were responsible for

translating the survey into the main language of their country and obtaining IRB/Ethics approval in line with local standards. The FBM section of the survey was translated into English, and a FBM coding system (see the Method section) was adopted to score data. The study was pre-registered and all collaborators provided consent (<https://osf.io/m46nq/>).

Participants

Researchers in each country were responsible for recruiting participants enrolling in the study, between the 11th of April and the 28th of June 2020. Various strategies were adopted during the original data collection to maximise the involvement of participants across countries, including social media channels and undergraduate subject pools. Other recruitment platforms (e.g., MTurk in the USA and Wjx in China) were used when possible. We only included data obtained from participants aged 18 years and above. The original sample included 3304 people, but we excluded participants who had not completed all questions of interest (i.e., FBM measures, COVID-19 subjective severity, pandemic impact expectedness, personal and global importance of pandemic, and rehearsal of pandemic). Final analyses were conducted with 2306 participants, whose ages ranged from 18 to 89 years (72.03% women, $M_{\text{age}} = 34.69$, $SD = 14.28$). Forms and materials are available on the Open Science Framework (<https://osf.io/m46nq/>).

Measures and Procedure

Participants were administered an online survey presented in their native languages (except in Malaysia, where it was performed in English due to the country's multiple languages) to assess 1) general demographic information, 2) pandemic-related questions, 3) FBM measures, and 4) emotional and cognitive dimensions of the COVID-19 pandemic, such as 4.1) COVID-19 objective severity, 4.2) COVID-19 subjective severity, 4.3) pandemic impact expectedness, 4.4) personal and global importance of pandemic, and 4.5) rehearsal of pandemic (see <https://osf.io/m46nq/> for the complete version of the survey).

Socio-demographics characteristics. This section recorded the participant's country of residence, age, sex, and number of people in the household.

Pandemic-related information. Participants answered general questions about the pandemic. That is, if they had received a COVID-19 diagnosis themselves (1=yes, 2=no), if they had a diagnosed person in their environment (1=yes, 2=no), and, if so, their personal relationship with that person, choosing from a list (1=partner, 2=close relative, 3=close friend, 4=co-worker, 5=other). Participants rated their health-related worries on a 5-Point Likert scale (1=not at all, 5=extremely) prior to the COVID-19 pandemic.

In addition, objective information regarding the pandemic were highlighted (see Table 2), including total COVID-19 cases, cases per millions of people, and total COVID-19 deaths, along with the average stringency level for each country involved. These data were obtained from databases of pandemic information available on the *Our World in Data* site and also included in previous research (Öner et al., 2022).

FBM. The FBM questionnaire adopted in the current survey is similar to that developed by Luminet and colleagues (2004) and Curci and Luminet (2006). Participants were asked to answer questions concerning their reception context of the news of the first COVID-19 case in their own country. The items corresponded to five FBM canonical categories (Bohannon, 1988; Brown & Kulik, 1977; Curci & Luminet, 2006; Finkenauer et al., 1998): 1) day, month, and year they first heard of the first COVID-19 case (FBM-Date), 2) where they were (FBM-Place), 3) what they were doing (FBM-Activity), 4) the source of the news (FBM-Informant), and 5) other people present when the news was received (FBM-Others). All countries adopted the same FBM scoring system, available on OSF (<https://osf.io/m46nq/>). For each of the five canonical categories, a score of 2 was assigned if participants provided a completely detailed memory, a score of 1 was assigned if participants provided a partially detailed memory, and 0 was assigned if an answer was missing or incorrect (see Table 1 for the FBM scoring system and examples). Kappa's Cohen interrater reliability was computed for each canonical category by each country (excluding New Zealand, where only one coder was involved), and it was found to range from 0.62 to 1.00. Interrater reliability coefficients for each country and for each FBM category are reported in the Supplementary Material (<https://osf.io/m46nq/>). Item scores were summed up to get a composite index of FBM specificity.

<<< Insert Table 1 about here >>>

COVID-19 Subjective Severity. Participants were asked 1) the percentage of people in their own country they thought would have been infected by COVID-19 (on a slider from 0 to 100), and 2) where they placed their own country considering the impact of COVID-19 compared to other countries (on a slider from 0=low impact to 100=high impact). The scores were averaged to obtain a composite index of Subjective Severity (Cronbach's alpha = 0.38)².

Pandemic Impact Expectedness. Participants assessed on a 5-point Likert scale (1=not at all; 5=extremely) how much they initially expected the pandemic impact and effects on the world the first

² The low Cronbach's alpha value may reflect the diverse experiences and perceptions of respondents from 11 different countries, highlighting the influence of individual and cultural differences on perceptions of COVID-19's impact.

time they heard about the situation in Wuhan. This measure is pivotal in assessing participants' initial perception of the crisis and its potential global impact. Whereas subjective severity measures the perceived impact at the time of answering the survey, initially expected impact of the pandemic measures retrospectively the expectation of the pandemic's impact at the time of the announcement of the first case in the participant's country.

Global Importance of Pandemic. Participants were asked to rate the worldwide impact of COVID-19 on several aspects: 1) Economic, 2) Social, 3) Psychological, 4) Health, and 5) Work. They rated their responses for each aspect on a 5-point Likert scale (1=not at all; 5=extremely). The scores were averaged to obtain a composite index of Global Importance (Cronbach's alpha = 0.76).

Personal Importance of Pandemic. Participants were asked to rate on a 5-point Likert scale (1= not at all; 5= extremely) their concerns for COVID-19. Additionally, they had to evaluate the valence of how COVID-19 affected their life in different fields: 1) Economic 2) Social, 3) Psychological, 4) Health and 5) Work, giving their response for each aspect on a 5-point Likert Scale (5=very negative; 1=very positive). The scores were averaged to obtain a composite index of Personal Importance (Cronbach's alpha = 0.64).

Rehearsal of Pandemic. Participants were asked how much time they spent 1) searching for news about the pandemic (on a slider from 0 to 100) and 2) thinking about and discussing COVID-19 (on a slider from 0 to 100). Results were averaged to obtain a composite index for Rehearsal (Cronbach's alpha = 0.68).

COVID-19 Objective Severity. As an objective measure of the severity of the COVID-19 pandemic across countries, a stringency index was used. This value is recorded as a score from 0-100, with 100 indexing the strictest form of governmental response. We opted to use this index because it represents a composite measure derived from multiple indicators (school closures, workplace closures, cancellation of public events, restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements, and international travel controls), and it effectively captures the objective difficulties of the pandemic period and their reflection on governments choices and individuals' responses (Hale et al., 2020). The stringency index, along with other objective pandemic information (e.g., total COVID-19 cases; cases per millions of people; total COVID-19 death; see Table 2), was obtained by consulting a dataset with COVID-19 information available on the website run by *Our World in Data* (2020) and has already been presented in a previously published paper (Öner et al., 2022).

<<< Insert Table 2 about here >>>

Statistical Methods

Data analysis was conducted with IBM SPSS 25 package. First, a preliminary analysis was employed to determine the most appropriate type of test considering the sampling distribution. Descriptive statistics were performed, and the assumption of normality of the distributions of the variables was tested. A machine learning algorithm – called Classification and Regression Tree (CART, Breiman et al., 1984; Hastie et al., 2013) – was applied to examine how sex, age, country of residence, objective and subjective severity, pandemic impact expectedness, global and personal importance of pandemic, and rehearsal of pandemic may influence FBMs. CART is a nonparametric procedure useful for identifying the strongest associations between a target variable and its predictors. In general, it is an exploratory approach enabling the identification of mutually exclusive and exhaustive subgroups within a population whose members share common characteristics, influencing the dependent variable. Classification trees produce a diagram showing a structure similar to the branches of a tree. The CART algorithm identifies the paths from the root node (a predictor) to the terminal node (the dependent variable), by reducing the so-called data impurities at each successive split (i.e., the threshold that separates the subgroups of the sample at a given node). The approach of a tree-based method, often used in data mining contexts with large datasets, is particularly efficient with a categorical response variable, and, most important, has a strong tolerance for missing responses and the lack of strict constraints on distributional assumptions for the data. Moreover, the classification rule tree is easy to interpret. For the purpose of the present analyses, we adopted the Classification and Regression Trees (CRT) growing method for CART procedure, because it enables the maximisation of homogeneity within nodes.

Finally, a hierarchical regression model (HRM) was used to examine how the above-mentioned variables predicted FBM Specificity. In hierarchical regression, predictors are classified into blocks or levels based on their theoretical or conceptual relevance. The blocks are added to the model in a predetermined order, usually starting with a basic block containing demographic variables or other covariates. Subsequently, additional blocks are added to the model, each representing a particular set of predictors. The purpose of using a HRM is to determine the unique contribution of each block of variables to explain the outcome variable while controlling for the effects of the preceding blocks. This approach enables the examination of the additional variance explained by each set of variables associated with FBM Specificity.

Results

The main results are described in this section. The descriptive analyses for the FBM variables and Pearson's correlations among variables by country are reported in Supplementary Material (<https://osf.io/m46nq/>).

Descriptive Analysis and Correlations

As reported in Table 3, a large number of participants came from China (27%), Turkey (16.8%), Italy (11.5%) and Spain (8.8%), with the remaining 35.9% representing the other seven countries. Participants from the sub-samples reported a COVID-19 diagnosis for themselves (0.52%) or for a family member/acquaintance (22.38%). Table 4 shows the frequency distribution of memory for each canonical category in the eleven countries and the total sample. Supporting Hypothesis 1, in the total sample, the highest frequencies were for the canonical categories of FBM-Date and FBM-Others, followed by Place, Activity, and Informant. For all canonical categories, in the total sample, low percentages of people did not provide specific information. Confirming Hypothesis 3, China, Denmark, Italy, New Zealand and Turkey showed the highest detailed memory for the date of reception of COVID-19 news; China, Italy, and Turkey showed a partially detailed memory for Place; China, Italy, New Zealand, and Canada exhibited partially detailed memories for Activity. As to the canonical category of Informant, China showed the highest detailed memory, whereas Greece, Italy, and New Zealand mainly exhibited partially detailed memories. Poland, Denmark, and Turkey showed a fully detailed memory for Others, whereas participants from the other countries exhibited similar frequency distribution for partially and totally detailed reports. In each country, a low percentage of participants did not provide memories for all canonical categories (see Table 4).

Additionally, Table 5 reports descriptive statistics for all continuous variables (FBM Specificity, Objective Severity, Subjective Severity, Pandemic Impact Expectedness, Personal Importance, Global Importance, and Rehearsal). Again, supporting Hypothesis 1, all participants exhibited medium-high levels of FBM Specificity, medium levels of Objective Severity, low levels of Subjective Severity and Rehearsal, and high levels of Pandemic Impact Expectedness, Personal Importance, and Global Importance. China was the country with the highest value of FBM Specificity, followed by Turkey, Malaysia, Italy, Canada, and New Zealand. The countries displaying the highest level of COVID-19 Objective Severity were China and Italy; whilst those reporting the highest level of COVID-19 Subjective Severity were Spain, Italy, and Russia. Additionally, all countries generally assessed the COVID-19 emergency as very important both at the individual and

global levels, and rehearsed the event fairly frequently by talking, thinking and/or following the news through mass media.

Supporting Hypothesis 2, Pearson's correlations among all measures in the total sample³ (Table 6) revealed that FBM Specificity was positively correlated with Objective Severity, Pandemic Impact Expectedness, and Global Importance. However, against our expectations, Subjective Severity exhibited a negative correlation with FBM Specificity. Objective Severity was positively associated with Subjective Severity, Pandemic Impact Expectedness, and Global Importance, and negatively with Personal Importance and Rehearsal. Subjective Severity was negatively associated with Pandemic Impact Expectedness, and positively with Global Importance, Personal Importance and Rehearsal. Pandemic Impact Expectedness was positively related with Global Importance, Personal Importance and Rehearsal. Finally, Global Importance showed a positive correlation with Personal Importance and Rehearsal, and Personal Importance and Rehearsal were associated with each other.

<<< Insert Tables 3, 4, 5, and 6 about here >>>

Classification And Regression Tree Analysis

To perform the CART analyses, the FBM Specificity was transformed into a dichotomous variable dividing respondents scoring less than 7 on the five canonical categories ($n = 758$, low FBM) from respondents scoring 7 or above ($n = 1548$, high FBM). The score was obtained after assigning a maximum of 2 points for each of the FBM canonical categories. Category scores were then summed up so that the total FBM score ranged from 0 to 10, but they were not normally distributed (Kolmogorov-Smirnov with Lilliefors correction $p < 0.001$ Shapiro-Wilk $p < 0.001$). The cut-off point selected for the dichotomization corresponds to the median of the FBM total score. The tree shown in Figure 1 outlines the role of the variables associated with FBM upon the level of FBM Specificity and helps us identify the characteristics of the resulting subgroups of respondents.

As shown in Figure 1, 67.1% of the respondents recalled a high recall of the FBM canonical categories, whereas the rest of the respondents had a low recall. The tree has 8 terminal nodes with a depth of 5 levels. An examination of the classification of cases in the model for each of these nodes yields significant results, which are shown in Table 7. The model classifies nearly 90% of individuals

³ Pearson's correlation among measures by country are reported in Supplementary Material

(<https://osf.io/m46nq/>).

with a high FBM recall. The first split divides the right side of the tree, corresponding to 27% of respondents living in countries with an Objective severity index above 66.88, from the left side, which includes individuals less affected by the pandemic. Table 8 displays the measures of importance for predictors of the model, which correspond to an index of heterogeneity reduction produced by each predictor on the response variable. As shown in Table 8, Objective Severity is the variable mostly associated with FBM and recurs as a splitting factor in several levels, suggesting that people who experienced tighter government restrictions appeared to have the highest FBM recall. Furthermore, an inspection of the tree also shows that people living in countries with high protection measures rated the highest Pandemic Impact Expectedness (terminal nodes 5 and 6). The left branch of the tree contains 73% of participants with lower Objective Severity, and 60% of them displayed a high FBM recall. The role of Objective Severity as a strong predictor is confirmed by the fact that it recurs several times (nodes 7, 8, 11 and 12), along with Subjective Severity (nodes 9, 10, 15 and 16). Finally, the variable Age (nodes 13 and 14) also seems to play an important role in determining the FBM score. The present results confirm that living in an area with high protection measures for COVID-19, along with the individual's perception of Pandemic Impact Expectedness and the individual's age strongly influence the formation of a specifically detailed FBM.

<<< Insert Table 7, 8 and Figure 1 about here >>>

Hierarchical Regression Model

Hierarchical Regression Models (HRMs) were tested to examine the independent contribution of different groups of variables on the outcome variable FBM Specificity, while controlling for the effects of other variables in a systematic and ordered manner. We first included in the model the demographic variables (Age and Sex) and then added the FBM associated variables (Subjective Severity, Pandemic Impact Expectedness, Global Importance, Personal Importance and Rehearsal) in the second step (see Table 9). When the second set of variables was added, we found partial support for Hypothesis 2, in that the HRM for the total sample showed that Age and Subjective Severity were negatively associated with the outcome variable, whereas Sex, Pandemic Impact Expectedness and Rehearsal were positively related ($F_{(7, 2299)} = 7.30, p < .001$).

The HRMs were also conducted separately from each country, as shown in Table 9. Age was found to be positively associated with FBM Specificity in the Danish sample ($\beta = 0.204; t = 2.17, p < .05$) and negatively in the Spanish and Turkish samples (respectively, $\beta = -0.185; t = -2.48, p < .05$; $\beta = -0.111; t = -2.19, p < .05$). Subjective Severity negatively impacted FBM Specificity in the Turkish

sample ($\beta = -0.167$; $t = -2.61$, $p < .05$). Pandemic Impact Expectedness was related with FBM Specificity positively in the Chinese sample ($\beta = 0.085$; $t = 2.07$, $p < .05$) and negatively in the Danish sample ($\beta = -0.263$; $t = -3.19$, $p < .05$).

<<< Insert Table 9 about here >>>

Discussion

When a shocking, significant, consequential, and surprising public event occurs, people retain in their memory both details related to the original event and details linked to the reception context of the news for a long time (Brown & Kulik, 1977). The unprecedented and distinctive nature of the COVID-19 pandemic provides an opportunity to examine individuals' memory of the reception context of the news regarding the first reported case, as well as the affective and cognitive components associated with the general phenomenon of the pandemic in their respective countries. The present study employed a sample of 2306 participants from eleven countries to examine the phenomenon of FBM formation in response to the initial news of the first COVID-19 case. The interest was addressed to how people have stored the context in which the news of the first COVID-19 case in their own country had been received.

FBM Specificity for the first COVID-19 case

As support for Hypothesis 1, results showed that all participants provided a detailed memory for the contextual details, above all the date and others present, followed by the location, ongoing activity, and informant. All countries exhibited high levels of richness of flashbulb-like memories. Our findings confirm the effectiveness of the target event to generate FBMs (Frei & Carlson, 2021). Indeed, this type of autobiographical memory is linked to unexpected, emotionally charged, and personally or globally important events (Er, 2003; Ma & Wan, 2022), and the COVID-19 phenomenon perfectly aligns with these criteria (Chamaa et al., 2021; Liu et al., 2020; Taurisano et al., 2022). The pandemic has been categorised by some as a Type III trauma (the continuous ongoing trauma) due to its continuous/persistent impact on the individual's perceived stress (Kira et al., 2023). COVID-19 has profoundly affected people's life worldwide with direct and indirect significant consequences and economic and social repercussions resulting from the measures taken to address the infection's effects (Cori et al., 2020).

Emotional and Cognitive FBM determinants

Concerning Hypothesis 2, findings partially supported our predictions. Overall, our results indicated a positive relationship between FBM specificity and emotional and cognitive dimensions. However, we obtained unexpected results from the analysis of subjective severity. Subjective severity correlated positively with rehearsal, global and personal importance, but negatively with pandemic impact expectedness and, interestingly, with FBM specificity. This surprising result should be interpreted with caution, given the long-term nature of the target event (unlike other target events studied in the literature), and the potential influence of external factors over time on the perception of the situation. Indeed, the increased accessibility of unverified publications on the internet may have influenced personal perceptions and contributed to confusion due to the availability of conflicting online information (Ko et al., 2019). On the other hand, our study highlights the importance of other factors in determining FBM specificity, such as rehearsal processes and pandemic impact expectedness, as well as the perception of the global importance of the pandemic (including the overall impact of the event on economy, social interactions, psychology, health, and work). These results are in line with Brown and Kulik (1977)'s pioneering theory viewing surprise (i.e., the emotion strictly related to the appraisal of unexpectedness and novelty) and importance/consequence of an event as the two necessary conditions to generate a FBM. The impact of surprise on memory has long been documented, demonstrating that when a surprising event is experienced within a familiar context, the capacity to store and retrieve that event can improve (Quent et al., 2021). Additionally, other factors, such as the emotional dimension and the significance of the event, considerably contribute to FBM formation as well. Indeed, some evidence supports that FBMs can also be produced for expected but emotionally relevant events (Curci et al., 2001; Curci & Luminet, 2006). The significance assigned to an event is essential for differentiating noteworthy episodes from ordinary ones that do not necessitate the retention of reception details. By identifying what is memorable versus forgettable based on personal importance, individuals can promote mental efficiency and optimise cognitive economy (Pillemer, 1984). From this perspective, it is evident that COVID-19 pandemic can be considered a significant event with substantial consequences on both individual and societal levels that could have facilitated a greater attention to details (Singh & Singh, 2020). Individuals' perceptions of the pandemic as a catastrophic event contributed to the activation of rehearsal mechanisms (rumination, social sharing, news searching), which have shown a positive correlation with objective severity, global importance, personal importance, and pandemic impact expectedness, as well as the FBM specificity. Our results appear in line with existing evidence supporting the importance of rehearsal in the formation and maintenance of FBMs (Bohannon &

Symons, 1992; Christianson, 1989; Finkenauer et al., 1998; McCloskey et al., 1988; Neisser, 1982; Wright, 1993).

In our study, we adopted the stringency index, which measures the government's level of response during the data collection period in each country, to investigate the COVID-19 objective impact upon individuals' lives. This index was chosen due to its composite nature, incorporating multiple indicators, such as school closures, workplace closures, cancellation of public events, restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements, and international travel controls. By using this index, we aimed to effectively capture the objective challenges of the pandemic period and their impact on governments and individuals (Hale et al., 2020). This measure takes into account the need for government organisations worldwide to implement systematic public health protective measures in an attempt to slow down the spread of COVID-19 and avoid the overloading of healthcare systems (Ebrahim et al., 2020). China and Italy showed the highest objective severity scores among all countries examined, indicating more rigorous government responses to the pandemic phenomenon, followed by Spain, Turkey, New Zealand, Russia, Greece, Poland, Malaysia, Denmark, and Canada (which had the lowest score). Overall, our results suggest that living in a country with strong restrictions aimed at containing the COVID-19 pandemic had a considerable impact on the formation of specific FBMs.

FBM Specificity across countries

As support for Hypothesis 3, China had the highest FBM specificity, followed by Turkey, Malaysia, Italy, Canada, and New Zealand. The observed disparity between countries is reasonable because they experienced the target event differently. For example, for the participants from China, the first case coincided with the first case in the world, leading them to receive the highest scores in Global importance, FBM specificity, and pandemic impact expectedness. Individuals living in countries with strong security measures reported higher levels of pandemic impact expectedness. This finding can be attributed to awareness individuals were gradually developing what was happening, and their trust in the government, which reflects people's confidence or satisfaction with government performance and the perceived credibility of the government (Viskupič, Wiltse & Meyer, 2022; Zaki et al., 2022; Han et al., 2023). Thus, the introduction of stringent security measures by the government may have triggered a strong emotional reaction in people (Le & Nguyen, 2022), which would have raised expectations about the pandemic's potential escalation in the future. The result could also be consistent with the positive correlation we found between the expected impact of COVID-19 and its

estimated global and personal importance (which were also positively correlated with each other). Indeed, the anticipated consequences of the pandemic may have heightened public awareness and intensified the emotional impact of the event and the importance attributed to the event, contributing to the formation of detailed FBMs (Er, 2003; Ma & Wan, 2022).

Our findings propose that the implementation of government protection measures is related to people's subjective perceptions of the pandemic's severity. This result could be enlightened by the level of trust placed in different institutions, which is closely related to a country's ability to survive during a crisis and the magnitude and speed of post-crisis recovery efforts (Kye & Hwang, 2020). Countries have adopted varying approaches in addressing the COVID-19 pandemic, reflecting several levels of institutional trust. This aspect evolves over time (Esaiasson et al., 2021) and tends to increase when individuals perceive proactive responses from institutions during a crisis (Kye & Hwang, 2020). The positive correlation we found between objective and subjective severity supports the reasonable explanation that during the pandemic crisis, individuals expressed overall trust in institutions to effectively address the challenges and considered the measures implemented to reflect the real severity of the situation. As a result, it is possible that people adopted restrictive measures to shape their perception of the severity. Furthermore, higher levels of governmental stringency index were associated with a lower perception of personal importance of the pandemic and reduced employment of rehearsal mechanisms. These results could be associated with a high level of trust in the government's ability to address the situation and care for individuals.

The role of media can provide an intriguing perspective to gain a deeper understanding of results. Indeed, the media can have a substantial impact on how people perceive various situations (He et al., 2021; Yang & Xin, 2020) and how frequently people may experience spontaneous past- and future-oriented thoughts about an event like the pandemic (Cole et al., 2022). Its value as a tool for long-distance communication became evident during the pandemic emergency that required social and physical distancing. When any direct contact with others was made impossible, the media provided the primary source of information to communicate knowledge about the infection's rate of spread and the associated risks, while simultaneously promoting safety measures implemented to contain the virus' spread (He et al., 2021; Hussain, 2020). Media contributed to the discussion of the situation by acting as "social amplification" and helped people to know and interpret incoming information (Lanciano et al., 2020), facilitating rehearsal processes impacting upon memory productions (Curci & Luminet, 2006; Tinti et al., 2014). Interestingly, the dissemination of pandemic-related news varied across countries, with different strategies to influence public opinion or focus

audience attention on specific details (Yakunin et al., 2021). This evidence can be consistent with our results that show a high variability of perceived subjective severity among countries.

Our study findings provide valuable insights into the impact of gender and age on shaping the richness of flashbulb details. Previous research suggests that although some effects of the pandemic are widespread, there are specific aspects that have a greater impact on women (Almeida et al., 2020; Thibaut & van Wijngaarden-Cremers, 2020), given that, tendentially after traumatic events, women report intrusive memories to be more prevalent than men (Kendler et al., 2001; McLean & Anderson, 2009). Regarding FBM, research has often overlooked the effects of gender on their formation, content, and distribution. However, it is well known that men and women not only recall episodes differently but also develop distinct ways of representing and describing the events they remember (Niedźwieńska, 2003), and this difference could potentially explain why women obtained higher scores in our study.

Regarding age, our findings are consistent with previous studies that have demonstrated how younger individuals tend to develop FBMs to a greater extent as compared to older individuals (Cohen et al., 1994; Kopp et al., 2020). This difference could be attributed to the fact that younger individuals generally have increased access to information dissemination systems, allowing them to be more informed and potentially more engaged with the events (Czaja & Lee, 2007; Ma & Wan, 2022). With the availability of technology enabling people to capture their daily life via digital media at any time and location, COVID-19's memory has been shaped differently than any similar events in the past (Hoskins, 2017; Ma & Wan, 2022).

Analysing the countries individually, we observed that there was no homogeneity regarding the pattern of FBM formation. For instance, we observed that age positively predicted FBM specificity in Denmark but negatively in Spain and Turkey. Similarly, subjective severity negatively affected FBM specificity in Turkey, whereas the pandemic impact expectedness positively predicted FBM specificity in China but negatively in Denmark. These differences may be attributed to the distinct ways in which countries have experienced and responded to the target event, highlighting the crucial role of contextual factors in shaping FBM specificity. Socio-cultural, political, and economic factors unique to each country may have influenced the individuals' perception, interpretation, and emotional response to the event (Mesquita & Walker, 2003; Qiong, 2017), consequently impacting the formation and specificity of their FBMs. This evidence underlines the need for further research to explore the link between social factors and individual memory processes, providing a more comprehensive understanding of the complex dynamics supporting the formation of FBM in diverse cultural and socio-political contexts.

Strengths and future directions

The current study took advantage of analysing an extensive amount of data, with people recruited from eleven nations across four continents. To our knowledge, all studies on FBMs conducted thus far referred to immediate events that always occurred in the past and had clear beginnings and ends (e.g. Curci et al., 2015, 2020; Curci & Lanciano, 2009; Lanciano et al., 2013; Lanciano & Curci, 2012; Tinti et al., 2009), while few studies have explored long duration and ongoing events (as during collected data), such as the COVID-19 pandemic (Ma & Wan, 2022). Unlike other public events, which typically have a direct impact on small groups of people, the COVID-19 pandemic has been a universally experience that has left a significant impact on people's memories worldwide (Öner et al., 2022). This study emphasises the importance of implementing an approach that recognizes potential differences among countries, as well as their varying levels of concern and impact, to fully ascertain the formation and characteristics of FBMs during global events. Future studies should focus on the long-term impact of the COVID-19 pandemic on FBMs, as well as the factors that influence the creation and vividness of these memories over time. This information can be used to guide psychological interventions and approaches for promoting optimal management during and after a worldwide event of this magnitude.

Limitations

The current study has several limitations. First, the translation of the questionnaire into different languages could have introduced the possibility of discrepancies in understanding the items and, as a consequence, in the response options. Cultural nuances and the relevance of certain concepts may not fully translate, potentially leading to measurement errors or misinterpretations. This aspect could limit the accuracy and comparability of the data collected across different cultural contexts. Second, the questionnaire used to collect data was independently set up on the online distribution networks by each participating country, which may have resulted in variability in obtained responses due to the system settings. In addition, conducting the study online introduced limitations in terms of researchers' control over participants' environments. Distractions, interruptions, or external influences during the completion of the online questionnaire may have influenced participants' responses, potentially affecting the reliability of the data. Another limitation pertains to the sample characteristics, which varied across countries. Although we took demographic variables, such as age and sex, into account, this variability makes it challenging to generalise the findings and make direct country-wise comparisons. Furthermore, contextual factors within countries could have contributed

to variations in individuals' psychological responses. The study primarily focused on country-level severity and stringency measures, potentially overlooking possible variations within countries that may have influenced participants' memories and perceptions. Additionally, we did not specifically focus on the delay between the event (the first COVID-19 case) and the moment when memory is assessed, an aspect that could be particularly relevant. This aspect is important because it is uncertain how the impact of subsequent events might influence the recall of long-term FBMs. Finally, future research could employ a test-retest design to assess FBM consistency over time, participants' levels of self-reported confidence, and the phenomenological features of memories (vividness, visual clarity, memory accessibility, sense of re-experience, etc...). These limitations should be considered when interpreting the findings and considering their applicability to broader populations and specific cultural contexts. Future research efforts should aim to address these limitations to further enhance our understanding of collective memory in cultural settings.

Final remarks

Our results almost completely corroborate our hypotheses. First, in line with our expectations, we observed that individuals were able to provide detailed and specific recollections following the news of the first COVID-19 case, indicating the presence of FBMs within the total sample. The levels of specificity displayed by participants were moderate to high, accompanied by detailed memories of the canonical categories. Second, our hypotheses regarding the influence of emotional and cognitive factors, as well as the severity of the event, on FBM specificity were partially supported. Specifically, pandemic impact expectedness, rehearsal, and residing in an area with stringent COVID-19 measures were found to positively impact FBM specificity. This aspect suggests that the pandemic impact expectedness, the impact of the restrictive measures, and engagement in cognitive processing contributed to the formation of more specific FBMs. Contrary to our expectations, the subjective severity reflecting people's perceptions about the possibility of infection in their own country, and their valuation of their country's position concerning the effects of the COVID-19 compared to other countries, exhibited a negative relationship with FBM specificity. This result should be interpreted with caution due to the long-term nature of the target event (in contrast to other target events studied in the literature) and the potential influence of external factors over time on the perception of the situation (e.g., unverified information). Finally, we investigated the variability in FBMs across different countries, revealing a lack of homogeneity in the variables associated with FBM specificity. More specifically, our findings indicated that age was positively related with FBM specificity in Denmark but negatively in Spain and Turkey. Furthermore, subjective severity negatively impacted

FBM specificity in Turkey, whereas pandemic impact expectedness positively predicted FBM specificity in China and negatively in Denmark. Analyses of the general sample showed that gender, age, and the level of COVID-19 measures emerged as influential factors in shaping the detailedness of FBMs. Specifically, women exhibited higher levels of FBM specificity compared to men, whereas younger individuals and those residing in areas with more restrictive measures demonstrated greater levels of FBM specificity compared to older individuals and those in areas with less stringent COVID-19 measures, respectively.

Memory retention is vital because it allows people to approach future challenges with greater awareness generating insights from prior situations (Adams & Kopelman, 2022). This evidence has deep implications for public health, enabling society to better prepare and respond to a crisis by drawing on the collective memory of similar past occurrences (Hirst, 2020). Given the unpredictable and dynamic nature of public events, the importance of remembering extraordinary and impactful circumstances, such as a pandemic, becomes crucial in both the short and long term (Lutz et al., 2019). This is because an event may persist or re-emerge over time, necessitating a continuous awareness and recollection for adapting to and managing the situation. Our research focuses on the phenomenon of FBMs formation in response to the initial news of the first COVID-19 case, thereby maintaining the critical episodic component inherent in FBM studies. However, the unprecedented and evolving nature of the COVID-19 pandemic during our data collection period led us to extend our focus beyond traditional FBM analysis to include various aspects of the pandemic to explore how an ongoing global event can shape and potentially impact these memories. This research has enriched the memory literature and our understanding of FBMs and pandemic phenomenon by considering differences between countries and highlighting the significant impact of emotional and cognitive factors in shaping the process of memory formation. Recognizing the potential cultural, social, and contextual differences, our research significantly contributes to a more comprehensive understanding of the topic within a global context. This perspective allowed us to get a more comprehensive view of FBM and its variability across different populations, with attention to the emotional, cognitive and social short-and long-term effects linked to an important global event, such as the COVID-19 pandemic.

Conflicts of interest/Competing interests

The authors declare no conflict of interest.

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Ethical approval

This manuscript does not include any experiments conducted on animals. The procedures conducted in our research with human subjects followed the ethical guidelines set by institutional and/or national research committees, as well as the 1964 Declaration of Helsinki and its subsequent amendments or similar ethical standards. The study, including the treatment of participants, was approved by the Local Ethical Committees of each institution involved and is detailed in this article.

Consent to participate

The participants were given comprehensive written information about the study and their rights. Prior to their involvement, they provided informed consent, indicating their understanding and agreement to participate.

Consent for publication

The data in the manuscript were collected in a manner that guarantees anonymity. No potentially identifiable human images or data were included in the study.

Availability of data and materials (data transparency)

The preregistration, materials and further information about the study are available at the project's main Open Science Framework page (<https://osf.io/m46nq/>). Data from the current study will be publicly accessible on the same OSF webpage following an embargo period.

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Table 1. FBM scoring system.

<i>FBM canonical category</i>	<i>Scoring</i>	<i>Examples</i>
<i>FBM-Date</i>	Score 2 = Totally specific details	- Month, Day, Year (e.g., ‘December 8 th 2019’; ‘January 3 rd 2020’)

	Score 1 = Partially specific details	<ul style="list-style-type: none"> - Only year (e.g., '2020') - Only month (e.g., 'February') - Only day (e.g., '23th') - Month + day (e.g., 'February 23th') - Month + year (e.g., 'February 2020') - Day + year (e.g., '23th 2020')
	Score 0 = No details	<ul style="list-style-type: none"> - Missing answer (e.g., answer left blank; 'I don't remember'; 'I don't know') - Incongruent answer with respect to the question (e.g., for the date question: 'It was raining')
<i>FBM-Place</i>	Score 2 = Totally specific details	<ul style="list-style-type: none"> - Country + City + Specific place - Specific place with details (e.g., 'I was at home in the kitchen'; 'I was in Italy, Rome, in my room, by the fireplace')
	Score 1 = Partially specific details	<ul style="list-style-type: none"> - Country + City (e.g., 'Italy, Rome') - Only City (e.g., 'Rome') - Generic answer (e.g., 'At home'; 'At work')
	Score 0 = No details	<ul style="list-style-type: none"> - Missing answer (e.g., answer left blank; 'I don't remember'; 'I don't know') - Incongruent answer with respect to the question (e.g. for the location question: 'It was Monday') - Only Country (e.g., 'Italy')
<i>FBM-Activity</i>	Score 2 = Totally specific details	<ul style="list-style-type: none"> - e.g., 'I was watching TV during dinner'; 'I was on the bus reading the news on the phone'; 'It was morning, I was having breakfast while watching the news on my mobile phone'
	Score 1 = Partially specific details	<ul style="list-style-type: none"> - Generic, routine, stereotypical and/or scripted activities (e.g., 'I was working'; 'I was having lunch'; 'I was studying')
	Score 0 = No details	<ul style="list-style-type: none"> - Missing answer (e, g, answer left blank; 'I don't remember'; 'I don't know') - Incongruent answer with respect to the question (e.g., for the ongoing activity question: 'I was at home') - Answer 'doing nothing'
<i>FBM-Informant</i>	Score 2 = Totally specific details	<ul style="list-style-type: none"> - The person who gave the information is clearly specified (e.g., 'my mother'; 'my partner')

		- The name of the newspaper, TV news, radio program, social network is clearly specified (e.g., <i>'CBC News'</i> ; <i>'Twitter'</i> ; <i>'Facebook homepage'</i>)
	Score 1 = Partially specific details	- More than one person not specified (e.g., <i>'my family'</i> , <i>'my co-workers'</i> , <i>'my friends'</i>) - The source of information is just mentioned but not specified (e.g., <i>'The news'</i> ; <i>'TV'</i> ; <i>'The phone'</i>)
	Score 0 = No details	- Missing answer (e.g., answer left blank; <i>'I don't remember'</i> ; <i>'I don't know'</i>) - Incongruent answer with respect to the question (e.g., for the informant activity question: <i>'I was studying'</i>)
<i>FBM-Others</i>	Score 2 = Totally specific details	- The person/people is/are clearly specified (e.g., <i>'my mother'</i> ; <i>'my brother'</i> ; <i>'my partner'</i>) - Answer <i>'alone'</i>
	Score 1 = Partially specific details	- More than one person not specified (e.g., <i>'my family'</i> ; <i>'my friends'</i> ; <i>'my colleagues'</i>)
	Score 0 = No details	- Missing answer (e.g., answer left blank; <i>'I don't remember'</i> ; <i>'I don't know'</i>) - Incongruent answer with respect to the question (e.g., for the others question: <i>'I was with my colleagues'</i>)

1 *Table 2.* Objective data regarding COVID-19 pandemic.

Country	Country Population	Total COVID-19 cases	Average COVID-19 cases per million (of people)	Total of COVID-19 deaths	Stringency index
<i>Canada</i>	38067913	75959	2012	5679	39.55
<i>China</i>	1444216102	84038	58	4637	69.83
<i>Denmark</i>	5813302	11971	2066	580	43.90
<i>Greece</i>	10370747	2967	285	180	49.29
<i>Italy</i>	60367471	232664	3848	33340	63.93
<i>Malaysia</i>	32776195	7059	218	114	47.78
<i>New Zealand</i>	5126300	1504	312	22	50.54
<i>Poland</i>	37797000	22074	583	1024	48.26
<i>Russia</i>	145912022	619936	4228	8770	50.33
<i>Spain</i>	46745211	245938	5260	28322	53.57
<i>Turkey</i>	85042736	197239	2338	5097	51.74

2

1 *Table 3. Participants' sociodemographic characteristics by country.*

Country	Sample size		Age		Sex (%)			Household		Health worry		COVID-19 diagnosis (%)	
	<i>n</i>	%	<i>M</i>	<i>SD</i>	<i>M</i>	<i>F</i>	<i>Other/not say</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	Self	<i>Other</i>
<i>Canada</i>	184	7.98	31.52	10.70	60.33	38.59	1.09	3.21	1.62	2.30	1.01	0.54	25.54
<i>China</i>	623	27.02	n.a.	n.a.	19.58	75.60	4.82	4.09	1.22	3.14	1.08	0.16	0.64
<i>Denmark</i>	149	6.46	42.59	19.15	21.48	78.52	0.00	3.30	1.63	2.20	0.85	0.00	30.20
<i>Greece</i>	46	1.99	41.28	9.16	36.96	60.87	2.17	2.55	1.09	2.43	1.09	0.00	13.04
<i>Italy</i>	265	11.49	30.55	10.85	24.53	75.09	0.38	4.45	1.80	2.52	0.84	0.00	34.34
<i>Malaysia</i>	107	4.64	22.93	5.25	17.76	82.24	0.00	3.89	1.67	1.86	0.94	0.00	13.08
<i>New Zealand</i>	76	3.30	26.78	10.14	11.84	88.16	0.00	4.82	2.23	1.86	0.95	0.00	17.11
<i>Poland</i>	128	5.55	31.34	9.52	14.20	85.00	0.80	2.94	1.57	2.36	0.86	1.56	12.70
<i>Russia</i>	136	5.90	39.37	15.69	25.40	74.60	0.00	3.52	1.53	2.63	0.82	0.74	31.62
<i>Spain</i>	204	8.85	36.81	13.89	35.29	63.73	0.98	3.92	1.21	2.76	0.90	0.49	52.94
<i>Turkey</i>	388	16.83	38.43	15.21	25.00	72.68	2.32	3.94	1.20	2.31	0.85	1.55	33.25
<i>Total</i>	2306	100.0	34.69	14.28	25.85	72.03	1.99	3.86	1.53	2.58	1.02	0.52	22.38

2

1 *Table 4.* Memory frequencies for each canonical category across countries.

Country	FBM-Date			FBM-Place			FBM-Activity			FBM-Informant			FBM-Other		
	% score			% score			% score			% score			% score		
	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
<i>Canada</i>	0.5	3.33	96.2	13.6	83.2	3.3	15.2	63.0	21.7	2.2	63.6	34.2	2.7	42.4	54.9
<i>China</i>	0.0	0.0	100.0	1.0	98.1	1.0	0.00	98.6	1.4	2.7	22.3	75.0	0.2	41.1	58.7
<i>Denmark</i>	0.0	0.0	100.0	17.4	77.2	5.4	26.8	53.7	19.5	9.4	60.4	30.2	19.5	13.4	67.1
<i>Greece</i>	2.2	30.4	67.4	10.9	87.0	2.2	54.3	43.5	2.2	2.2	93.5	4.3	4.3	34.8	60.9
<i>Italy</i>	0.0	0.0	100.0	3.0	95.5	1.5	10.9	68.3	20.8	1.1	74.3	24.5	5.3	45.3	49.4
<i>Malaysia</i>	0.9	3.7	95.3	18.7	75.7	5.6	11.2	60.7	28.0	2.8	61.7	35.5	4.7	35.5	59.8
<i>New Zealand</i>	0.0	0.0	100.0	14.5	77.6	7.9	11.8	63.2	25.0	3.9	72.4	23.7	6.6	46.1	47.4
<i>Poland</i>	3.9	15.6	80.5	10.9	85.9	3.1	27.3	60.9	11.7	7.0	64.8	28.1	8.6	18.0	73.4
<i>Russia</i>	0.0	25.0	75.0	10.3	89.0	0.7	19.1	61.0	19.9	19.1	61.0	19.9	12.5	27.9	59.6
<i>Spain</i>	2.0	24.0	74.0	14.7	81.4	3.9	18.6	60.8	20.6	8.3	66.7	25.0	11.3	33.3	55.4
<i>Turkey</i>	0.0	0.0	100.0	2.3	93.0	4.6	13.4	59.5	27.1	6.7	58.8	34.5	8.0	27.3	64.7
<i>Total</i>	0.5	5.5	94.0	7.3	89.8	2.9	12.7	71.1	16.1	5.3	53.6	41.0	6.2	34.6	59.2

2 0 = not detailed; 1 = partially detailed; 2 = fully detailed.

3

1 *Table 5.* Descriptive statistics for all FBM continuous variables.

Country	FBM	Objective	Subjective	Pandemic Impact	Global	Personal	Rehearsal
	Specificity	Severity	Severity	Expectedness	Importance	Importance	
	<i>range 0-10</i>	<i>range 0-100</i>	<i>range 0-100</i>	<i>range 1-5</i>	<i>range 1-5</i>	<i>range 1-5</i>	<i>range 0-100</i>
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
<i>Canada</i>	6.76 (1.41)	39.55 (0.00)	40.24 (19.14)	2.48 (1.15)	3.16 (0.89)	3.46 (0.65)	23.19 (20.74)
<i>China</i>	7.32 (0.74)	69.83 (0.00)	25.02 (16.49)	3.40 (1.05)	3.76 (0.88)	3.29 (0.53)	14.20 (11.84)
<i>Denmark</i>	6.49 (1.81)	43.90 (0.00)	23.84 (16.43)	2.32 (0.98)	2.58 (0.76)	3.28 (0.50)	10.66 (9.06)
<i>Greece</i>	5.63 (1.32)	49.29 (0.00)	35.60 (21.97)	2.11 (1.06)	2.20 (0.78)	3.28 (0.57)	16.36 (15.01)
<i>Italy</i>	6.76 (1.17)	63.93 (0.00)	55.73 (18.29)	2.34 (1.04)	3.37 (0.81)	3.49 (0.59)	30.35 (20.83)
<i>Malaysia</i>	6.86 (1.44)	47.78 (0.00)	34.24 (17.41)	2.74 (1.08)	2.85 (0.81)	3.38 (0.49)	33.75 (23.80)
<i>New Zealand</i>	6.67 (1.39)	50.54 (0.00)	18.67 (17.25)	2.45 (0.99)	2.78 (0.74)	3.37 (0.49)	18.30 (15.83)
<i>Poland</i>	6.39 (1.63)	48.26 (0.00)	41.86 (21.74)	2.31 (0.95)	3.08 (0.93)	3.47 (0.56)	17.67 (16.89)
<i>Russia</i>	6.14 (1.81)	50.33 (0.00)	54.03 (21.15)	2.38 (1.09)	3.11 (0.93)	3.32 (0.54)	23.62 (21.01)
<i>Spain</i>	6.24 (1.76)	53.57 (0.00)	62.81 (17.77)	2.27 (1.14)	3.20 (0.96)	3.42 (0.54)	26.56 (19.20)
<i>Turkey</i>	7.01 (1.33)	51.74 (0.00)	21.72 (12.95)	4.54 (0.82)	3.26 (0.73)	3.68 (0.59)	53.73 (19.19)
<i>Total sample</i>	6.81 (1.40)	56.16 (10.19)	35.55 (22.73)	3.02 (1.31)	3.28 (0.92)	3.42 (0.57)	26.12 (22.32)

2

1 *Table 6. Pearson's correlation among measures in the total sample.*

Measures	<i>Objective Severity</i>	<i>Subjective Severity</i>	<i>Pandemic Impact Expectedness</i>	<i>Global Importance</i>	<i>Personal Importance</i>	<i>Rehearsal</i>
<i>FBM Specificity</i>	0.19**	-0.12**	0.13**	0.12**	0.00	0.01
<i>Objective Severity</i>		0.08**	0.15**	0.34**	-0.08**	-0.18**
<i>Subjective Severity</i>			-0.23**	0.05*	0.08**	0.17**
<i>Pandemic Impact Expectedness</i>				0.14**	0.08**	0.31**
<i>Global Importance</i>					0.34**	0.08**
<i>Personal Importance</i>						0.25**

2 * $p < 0.05$; ** $p < 0.01$

1 *Table 7. Classification of cases for CART.*

Observed	0	1	Percent
0	176	582	23.2%
1	159	1389	89.7%
Overall	14.5	85.5	67.9%
Percentage	%	%	

2 Growing Method: CRT

3 Dependent Variable: FBM dichotomous

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1 *Table 8. Independent Variable Importance.*

Independent Variable	Importance	Normalized Importance
<i>Objective Severity</i>	0.032	100.0%
<i>Pandemic Impact Expectedness</i>	0.003	10.2%
<i>Subjective Severity</i>	0.003	8.9%
<i>Age</i>	0.002	6.8%
<i>Sex</i>	0.002	6.5%
<i>Rehearsal</i>	0.001	4.3%
<i>Global Importance</i>	0.001	4.1%
<i>Personal Importance</i>	0.001	3.7%

2 Growing Method: CRT

3 Dependent Variable: FBM dichotomous

4

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1 *Table 9. Hierarchical Regression Models.*

Predictors	Total sample		Canada		China		Denmark	
	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2
	β	β	β	β	β	β	β	β
Age	-.072**	-.075**	.089	.069			.090	.204*
Sex (F)	.062*	.052*	.084	.093	.063	.065	-.024	-.063
<i>Block 2</i>								
Subjective Severity		-.067**		.088		.062		.008
Pandemic Impact Expectedness		.058*		-.077		.085*		-.263**
Global Importance		.054		-.018		-.014		.181
Personal Importance		.008		-.036		-.072		-.055
Rehearsal		.058*		-.134		-.011		.014
R^2	.010	.030	.014	.042	.004	.021	.009	.088
<i>Adjusted R</i> ²	.009	.026	.003	.003	.002	.012	-.004	.043
<i>F (df)</i>	8.207***** (2, 2304)	7.303***** (7, 2299)	1.288 (2, 182)	1.077 (7, 177)	2.450 (1, 622)	2.249* (6, 617)	0.687 (2, 147)	1.940 (7, 142)
Predictors	Greece		Italy		Malaysia		New Zealand	
	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2
	β	β	β	β	β	β	β	B
Age	-.107	-.090	.013	.008	-.158	-.121	-.011	-.062
Sex (F)	.212	.232	.072	.074	.101	.107	-.089	-.154
<i>Block 2</i>								
Subjective Severity		.177		-.009		-.124		.090
Pandemic Impact Expectedness		.236		.074		.047		-.166
Global Importance		-.032		.084		.061		-.188
Personal Importance		-.152		-.079		.123		.026
Rehearsal		-.086		.058		.002		.125
R^2	.049	.173	.005	.021	.033	.074	.008	.085
<i>Adjusted R</i> ²	.005	.020	-.002	-.005	.014	.009	-.019	-.009
<i>F (df)</i>	1.110 (2, 44)	1.133 (7, 37)	0.675 (2, 263)	0.804 (7, 258)	1.779 (2, 105)	1.135 (2, 100)	0.285 (2, 74)	0.903 (7, 69)
Predictors	Poland		Russia		Spain		Turkey	
	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2
	β	β	β	β	β	β	β	B
Age	-.108	-.102	-.145	-.079	-.198**	-.185**	-.111*	-.103
Sex (F)	.039	.024	-.002	.035	.108	.099	.098	.098
<i>Block 2</i>								
Subjective Severity		-.004		-.133		.040		-.167**
Pandemic Impact Expectedness		-.021		.104		.030		.070
Global Importance		-.039		.173		.094		.035
Personal Importance		.029		-.092		-.038		.117
Rehearsal		.155		-.048		-.037		.073
R^2	.015	.040	.021	.061	.052	.062	.025	.059
<i>Adjusted R</i> ²	-.002	-.022	.005	.005	.042	.026	.020	.042

<i>F (df)</i>	0.861	0.648	1.308	1.094	5.110**	1.719	4.906**	3.417****
	(2, 126)	(7, 121)	(2, 134)	(7, 129)	(2, 202)	(7, 197)	(2, 386)	(7, 381)

1 * $p < .05$; ** $p < .01$; *** $p < .005$; **** $p < .001$

2 **Note:** Chinese respondents did not provide age measure