The Blursday Database as a Resource to Study Subjective Temporalities During Covid-19

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Abstract

The Covid-19 pandemic and associated lockdowns triggered worldwide changes in the daily routines of human experience. The Blursday database provides repeated measures of subjective time and related processes from hundreds of participants (over 9 countries) tested on 14 questionnaires and 15 behavioral tasks during the Covid-19 pandemic. The easy-to-process database and all data collection tools are made fully accessible to researchers interested in studying the effects of social isolation on temporal information processing, time perspective, decision-making, sleep, metacognition, attention, memory, self-perception, and mindfulness. Blursday also includes vital quantitative statistics such as sleep patterns, personality traits, psychological well-being, and lockdown indices. Herein, we exemplify the use-value of the database with quantitative insights on the effects of lockdown (stringency, mobility) and subjective confinement on time perception (duration, passage of time, temporal distances). We show that perceived isolation affects time perception and we report an inter-individual central tendency effect in retrospective duration estimation.

Introduction

Subjective time is one of the most malleable aspects of personal experience, which can be altered by many exogenous factors (e.g., physical features of the environment, social interactions) as well as endogenous psychological and physiological states (e.g., arousal, attention, valence, febricity, circadian rhythms) [e.g. 1]. An altered sense of time can be indicative of individuals' well-being [2] and misguide individuals' decisions and judgments [3]. At a historically global scale, the Covid-19 pandemic and associated lockdowns and state of emergency measures deeply altered the living conditions, social interactions, and the psychological, physiological and economic well-being of the entire human population [4]. Psychological research has mostly focused on the effects of the pandemic and of the confinement on mental health (*e.g.,* WHO; https://www.covidminds.org; Yamada et al., 2021), but how the pandemic affected our sense of time, although a prominent topic of pandemic-related anecdotal reports, has not been examined in a comprehensive and systematic manner.

The Blursday project tackles this challenge and provides an unprecedentedly rich and comprehensive dataset for characterizing temporalities of hundreds of participants collected in 9 different countries (4 continents) during the peak of the lockdown periods. The uniqueness of the Blursday database is its large number of widely utilized behavioral tasks (performance measures) combined with questionnaires (self-reports), demographics and subjective confinement trackers (state measures). The database includes participants tracked longitudinally in and out of lockdown (from 2020 on) together with control groups of participants tested for the first time outside of Covid-19 lockdowns (from 2021 on). The study has thus been designed to serve as a rich empirical benchmark to investigate how temporalities and related processes changed during the historical episode of the Covid-19 pandemic.

There are several reasons why time perception is central, beyond the observation that disorientations in time were a phenomenologically vivid and widely shared experience during lockdowns. First, all animals keep track of time at multiple time scales regulated by physiological clocks e.g., circadian rhythms, interval timing, and motor timing [6,7]. Second, interval timing in the seconds-to-minutes range is most malleable because it holds strong ties with domain-general cognition including attention, memory, and decision-making [8]. Timekeeping systems also interact with each other: interval and motor timing fluctuate with circadian rhythms, which is essential for the adaptiveness of other cognitive functions and related behaviors [9]. In turn, the accuracy and precision of temporal representations and behaviors heavily influence decision-making [10]. Temporal phenomenologies are thus crucial for our understanding of how cognition generally, and timekeeping specifically, have been affected by the altered lifestyles and profound routine changes during the lockdown periods.

Recent studies started showing changes in sleep patterns [11–13], levels of physical activity [14] and increase in depression, anxiety, and fear across countries [5,15–17]. Covid-19 lockdowns have been suggested to negatively affect executive functions, attention, and anecdotally temporal orientation through the self-reporting of forgotten dates during that period [18]. Based on established relations between these cognitive and affective factors and interval timing, one would expect our timekeeping ability to be dramatically affected by lockdowns.

Self-reports on the passage of time during lockdown have been promptly published. In an Italian study [12], surveyed participants reported experiencing problems with keeping track of the hours and days, and they also reported an expansion of subjective duration which was associated with a sense of boredom. In French surveys, participants answered the question: *“What are your feelings about the speed of passage of time?”* [19–21]. The question was asked in reference to the individuals’ autobiographical recall of their experienced passage of time before the lockdown, then asked three times during lockdown in reference to “now”, to “yesterday”, and to “one week ago”. A trend towards the passage of time feeling slower during, as compared to before the lockdown was reported for all temporal scales. The best predictors of the experience of the passage of time were boredom and sadness, which contributed most to the well-being of French participants during and after lockdown. In the UK surveys [22,23], participants reported a significant distortion of the passage of time in both directions, attributable to stress but also to age, task load, and one’s satisfaction with the experienced social interactions. A comparable number of participants felt that the last day and the last week had either passed more quickly or more slowly than usual; additionally, the older and less socially satisfied British individuals were, the slower time seemed to pass during both UK lockdowns. In a Uruguayan study [24], which assessed the experience of university students, the authors reported an association between psychological distress due to the Covid-19 restrictions and the feeling of a slower passage of time, a blurred sense of time (not knowing what time or day it is), and more boredom. In a longitudinal Brazilian study [25], participants initially perceived an expansion of time which steadily decreased over the course of the following weeks. These surveys confirmed self-reported temporal distortions during lockdown but do not converge on their underlying explanatory causes. Several experimental limitations include the absence of controls, which prevents assigning a causal role of lockdown to temporal distortions, and the possibility that cross-cultural factors and differences in the stringency of the lockdown measures played a crucial role in the different trends observed across countries. All studies used questionnaires and ratings, and none included psychometric tasks. The Blursday database includes a large and diverse battery of questionnaires, tasks and tests across cultures, a longitudinal assessment of these factors within individuals and, importantly, control participants that are naive to all tasks, tested outside of lockdowns, and whose number can be incremented over time.

We provide a comprehensive dataset that captures subjective time and timing behaviors of a large number of participants on nearly all aspects of temporal information processing (interval perception and production, spontaneous tapping, synchronization, implicit timing) together with measures of working memory, decision-making, self-perception, metacognition, sleep patterns, personality traits, and well-being. The Blursday database provides an extensive benchmark for future studies that would incorporate new control data although the current database already contains some control data (see Methods; Supplementary Information Figure 1). We make all tools available online for researchers wishing to test participants post-lockdown using the same approach or parts of it. We fully describe the database and importantly, provide examples illustrating its potential use based on a few fundamental analyses providing quantitative insights on time perception during this historical period.

Results

We report quantitative observations regarding the effect of lockdowns on psychophysical measures of subjective temporality including retrospective duration estimation, and ratings of the felt passage of time and subjective temporal distances.

Retrospective duration on the scale of minutes to hours

In the retrospective duration task (see Task in Methods and Supplementary Figures 2 and 3), we asked participants to provide an estimate (in minutes, seconds) of how much time had elapsed since the last time they logged on to the study website, which was time-stamped in the collected data.

FIGURE 1 HERE

Retrospective duration estimates scale with clock duration

As a sanity check, we predicted that the retrospective duration estimates would be closely associated with the actual clock duration. To test this sanity check, we used a linear regression of the logarithm of retrospective duration estimates as a function of the logarithm of clock duration, separately for the data collected during the first lockdown (Session 1: S1) and those collected outside of lockdown (Control Session, SC). With this approach, we could show that participants performed the task as expected in both sessions and thus that the data passed our sanity check: retrospective duration estimates increased with increasing clock duration (Figure 1A). Participants' retrospective responses accounted for 59 % (η^2) of the actual variability.

Interestingly, these relationships also abided Vierordt's law and the central tendency effect typically reported in magnitude estimations [26–28], despite the between-participants design. The deviations of retrospective duration estimates from clock durations were scale-dependent such that all participants tended to overestimate the short durations and underestimate the long durations, as shown by the regression coefficients of clock duration against retrospective duration below 1 for both the lockdown and the control sessions (S1: 0.89 ± 0.019 s.e.m., two-tailed t-test against 1, $t(1739) = -5.4$, $p < 0.0001$; SC: 0.77 ± 0.042 s.e.m., $t(1739) = -5.6$, $p < 0.0001$). In terms of Stevens's psychophysical law mapping a sensory continuum to a psychological representation [29,30], a coefficient of regression below one can be understood as a power exponent being lower than one. In duration estimation, a value below one is consistent with an overestimation of shorter durations and an underestimation of longer durations. In a Bayesian framework, this value can also be interpreted as specifying the weight of uncertainty relative to prior knowledge [28].

Thus, we then hypothesized that the parameters of the linear function mapping subjective time and objective time would differ during and after lockdown (S1 and SC, respectively). To test this working hypothesis, we used a linear regression with Session (2 levels: S1, SC) and the logarithm of clock duration (in minutes) as regressors. An ANOVA on the outcomes of the fitted model confirmed a significant main effect of the log of clock duration on subjective retrospective duration estimates ($F(1,1739) = 2462.05$, $p < 2e^{-16}$, $\eta^2 = 0.59$, 95% confidence intervals (C.I.) = [0.86, 0.93]) and a significant interaction between retrospective duration and session ($F(1,1739) = 7.57$, $p = 0.006$, $\eta^2 = 4.3e^{-3}$, 95% C.I. = [-0.22, -0.036]. This interaction captures the observation that the regression slopes in each session differed significantly. To illustrate these effects and make this observation more tangible: the model fits show that a clock duration of 10 minutes was overestimated by 30 s ± 15 s (estimated mean ± s.e.m.) during the first lockdown (S1) but by 92 s ± 36 s during the control session (SC). Conversely, a clock duration of 1 hour was underestimated by 7 min and 10 s ± 54 seconds (thus, estimated as ~52 minutes) during the first lockdown (S1) but by 14 min and 20 s ± 108 seconds (thus, estimated as ~46 minutes) outside of it (SC).

As an extension to these observations, the durations that were most accurately estimated by the participants were expected to differ during and outside of the lockdown periods. Consistent with this prediction, our analyses revealed the existence of a possible "indifference interval" in retrospective duration estimation, which converges in both sessions at a relatively close clock duration of about a quarter of an hour.

Stringency and mobility affect retrospective duration estimates

Next, as stringency and mobility indices did not strictly map with the experimental sessions (Supplementary Information Figure 1), we used data from all sessions (S1, S2, S3, S4, SC) and quantified the severity of lockdown using the stringency, the mobility, and the subjective confinement indices described in Methods. We also included age and time of day as possible covariates, which are known factors arguably influencing the estimation of duration [e.g. 31,32]. First, we modeled the error term related to participants as a random intercept using a linear mixed model approach on participants' relative retrospective duration estimates [33]. We quantified the relative duration estimations as $retrospective\ duration\ estimation\ /\ clock\ duration$ to pull all temporal scales together. The standard deviation of the estimated random effects was smaller than that of the residuals, suggesting that random effects could be ignored and that running a linear model with the same fixed effects revealed similar outcomes. Hence, we solely report the fixed effects analysis.

Second, using an ANOVA on the coefficient estimates of the linear mixed model revealed a significant effect of the stringency index ($F(1, 2140) = 8.54$, $p = 0.003$, $\eta^2 = 4.0e^{-3}$, 95% C.I. = [$-2.1e^{-3}$, $-0.7e^{-3}$]; Figure 1b) and of the mobility index ($F(1, 2140) = 8.12$, $p = 0.004$, $\eta^2 = 3.8e^{-3}$, 95% C.I. = [$-1.3e^{-3}$, $-0.2e^{-3}$]; Figure 1c) on relative retrospective duration estimates. To translate this effect into words, an increase of 80 on the stringency scale (i.e., from least to most stringent states in the range of available data) corresponded to a decrease of 30% in estimated retrospective duration so that the more stringent the governmental measures were, the shorter retrospective duration estimates were. Conversely, the effect of the mobility index suggests that the closer to normal mobility participants were, the shorter the retrospective duration were. Thus, stringency and mobility distinctly affect retrospective duration during the pandemic. As seen in Figure 1c, our sessions and data collections seemed to align well with the mobility index. We observed no significant effects of the subjective confinement index, age, or hour of day on retrospective duration estimates (all $F < 1.7$, $p > 0.15$).

Passage of time on the scale of a few days

Studies that have explored the effects of lockdown on time perception converged on the notion that participants experienced temporal distortions, with a slowing down of the passage of time and an expansion of experienced time over days, both accounted for by factors like boredom, sadness or depression during lockdowns [19,20,22,23,25]. Herein, we hypothesized that participants' experienced temporal distortions could be affected by how stringent the lockdowns were as well as individuals' ability to move freely (stringency and mobility indices provided objective measures of confinement, respectively; see Methods). Alternatively, it might not be the objective levels of stringency and mobility, *per se*, that would cause the experienced temporal distortions, but the participants' subjective feeling of being confined and their felt social isolation (subjective confinement measures; see Methods). Therefore, we posited that these subjective measures could be a better predictor of the experienced feelings of how fast time seemed to pass during lockdowns.

To test these hypotheses, we explored four subjective time measurements collected using participants' ratings on a Visual Analogue Scale (VAS): the passage of time (over a few days), the subjective temporal distance to the first day of lockdown (past temporal orientation) and the subjective temporal distances to one week and to one month from now (future temporal orientation). For all four, we used a linear mixed effect model with covariates identical to those used for the retrospective duration estimates: stringency index, mobility index, subjective confinement index, age, and hour of day. For all measures of subjective temporal distances, a random intercept per participant was added.

To capture the temporal phenomenology of the felt passage of time, individuals can rate their feeling of how fast time is passing over a certain lapse of time using a VAS. This approach was used in previous studies [19–23,27,34]. In Blursday, we predicted that the degree of felt social isolation would affect the speed of subjective time as measured by the VAS. We asked participants to rate their feeling of the passage of time over the last few days. With a linear regression approach, we found that the passage of time was significantly related to participant subjective confinement score ($F(1, 1860) = 28.44$, $p = 1.087e^{-07}$, $\eta^2 = 0.02$, 95% C.I. = [0.58, 1.26]; Figure 2) so that the more isolated participants felt, the slower their impression of the passage of time were. Under the linear assumption (i.e., away from the boundaries of the VAS), the most extreme differences in subjective score of confinement (from 5 feeling most confined to 20 feeling least confined) corresponded, on average, to a difference of 13.8 on the passage of time VAS going from 53.9 ± 1.7 to 67.7 ± 1.3. No other tested factors were found to significantly affect participants' passage of time.

Ratings of the passage of time assessed with a VAS have been argued to provide a relevant tool for the experience of time in real-life situations [35]. Our analysis suggests that the experience of the "flow of time" is strongly affected by how isolated individuals felt over the scale of days, but not by actual stringency or mobility. Neither age nor time of day were found to significantly alter the subjective passage of time. To disentangle the contribution of objective and subjective measures of confinement on individuals' experience of time, we turned to well-known cognitive measures of temporal orientation and subjective temporal distances.

FIGURE 2 HERE

Temporal Orientation and Subjective Temporal Distances to past (from the start of lockdown) and future (week and month scales)

The dilation and slowing down of the passage of time previously reported during social isolation [25] would predict that the more isolated participants were, the longer they should estimate temporal distances. As above, we tested this working hypothesis with both objective and subjective indices using a linear mixed effect model with stringency index, mobility index, subjective confinement index, age, and hour of day as covariates and participant as random factor. In these tasks, participants reported on a VAS ranging from 0 (very close) to 100 (very far) their subjective temporal distance to the first day of lockdown (past orientation) or week and month to come (future orientation).

The subjective temporal distances to the first day of lockdown (past orientation) were significantly affected by the mobility ($F(1, 3814) = 80.25$, $p <= 2.2e^{-16}$, $\eta^2 = 0.02$, 95% C.I. = [0.20, 0.32]; Figure 3a) so that the closer to normal mobility, the further away participants rated their first day of lockdown to feel. Under the linear assumption (i.e. away from the VAS boundaries), the most extreme increase in mobility transit going from -90 to 0 corresponded, on average, to a difference of 23.5 points on the subjective temporal distance scale, which went from 52.9 ± 1.2 to 76.4 ± 1.8. Conversely, participants' subjective confinement scores significantly affected their subjective temporal distances to the first day of lockdown ($F(1, 2742) = 9.6$, $p = 0.0019$, $\eta^2 = 3.5e^{-3}$, 95% C.I. = [-0.79, -0.18]; Figure 3b). Under the linear assumption, the less subjectively isolated participant felt (subjective confinement score going from 5 to 20), the closer in time that day felt. On average, an increase of subjective confinement score (interpreted as feeling less isolated) of 7.3 yielded participants' subjective temporal distance to be rated as closer (from 65.7 ± 1.6 to 58.4 ± 1.1).

We then explored participants' future orientation with the subjective temporal distances at two time scales, "next week" and "next month" (Figure 3c, light and dark green, respectively). A first effect common to both time scales was driven by the age of participants (week: $F(1, 910) = 12.23$, $p = 0.00049$, $\eta^2 = 0.01$, 95% C.I. = [-0.25, -0.07]; month: $F(1, 949) = 25.63$, $p = 4.97e^{-07}$, $\eta^2 = 0.03$, 95% C.I. = [-0.35, -0.16]; Figure 3d and 3e, respectively). Under the linear assumption, the most extreme differences in age (going from 18 to 88 years old) corresponded to an average difference of –11.2 on the subjective temporal distance scale for "next week" (from 36.7 ± 1.19 to 25.5 ± 2.51) and of -17.9 for "next month" (from 60.4 ± 1.20 to 42.5 ± 2.78). In other words, the older participants were, the shorter they rated their subjective distances to the future, and this finding applies to both the week and the month time scales.

Participants' subjective confinement scores also significantly affected their subjective temporal distances at both time scales (week: $F(1, 1437) = 6.46$, $p = 0.01$, $\eta^2 = 4.47e^{-3}$, 95% C.I. = [-0.84, -0.11]; month: $F(1, 14846) = 16.84$, $p = 4.29e^{-05}$, $\eta^2 = 0.01$, 95% C.I. = [-1.24, -0.44]; Figures 3f and 3g, respectively). The more isolated participants felt, the more distant their subjective future felt. Under the linear assumption, the most extreme increase in subjective confinement score (from 5 to 20) corresponded to an average difference of -7.09 on the subjective temporal distance scale for "next week" (from 31.0 ± 1.34 s.e.m to 38.1 ± 1.95 s.e.m.) and of -12.6 for "next month" (from 63.5 ± 2.15 s.e.m to 50.9 ± 1.48 s.e.m).

While the subjective distance to "next week" was not significantly affected by stringency ($F(1, 1105) = 1.93$, $p= 0.16$, $\eta^2 = 1.75\ e^{-3}$, 95% C.I. = [-0.03, 0.16]; Figure 3h), we observed an increase of felt distance to "next month" with an increase in stringency measures (month: $F(1, 1165) = 8.54$, $p = 0.004$, $\eta^2 = 7.72e^{-3}$, 95% C.I. = [0.05, 0.25; Figure 3i). Under the linear assumption, the most extreme increase in stringency (from 25 to 90) corresponded to an average difference of 9.88 on participants' subjective temporal scale to "next month" (going from 49.7 ± 2.34 s.e.m, to 59.6 ± 1.554 s.e.m.).

FIGURE 3 HERE

In brief, as was the case for the passage of time ratings, participants' felt isolation affected nearly all measures of subjective temporal distances: the more isolated the individual felt, the further away temporal landmarks were rated at both time scales (week, month) and on both orientation (past, future) measures. Also, while the objective mobility impacted past temporal distances at the week time scale, the objective stringency rather had an effect at the month time scale. Finally, and interestingly, at all time scales, age affected participants' future, but not past, temporal distances.

Discussion

The Covid-19 pandemic is one of those rare historical episodes during which the entire world adopted comparable constraints on the human population at the same time. The initial measures against Covid-19 were state-of-emergencies and partial to full lockdowns. Herein, we report a comprehensive database, which provides tangible quantitative and qualitative assessments documenting a wide range of factors mediating the temporal distortions and disorientations experienced during this historical episode. Making accessible the database and the online tools to collect additional data is motivated by the observations that, as we write this paper, we have not yet returned to a global normality level. Our experimental tools have been and can be easily translated to additional languages, providing an easy stepping stone for inclusive cross-cultural studies using multidimensional variables. We made efforts for the Blursday database to be highly accessible and readable to all researchers. We provide a graphical user interface that researchers without programming background can use for parsing and retrieving the data as required by their research questions. We also include optional outcomes of some of our preliminary analyses as part of the data (e.g., objective lockdown measures and subjective confinement indices).

Herein, we wished to highlight the existence of Blursday as well as showcase the reliability of the collected data on measures like sleep disturbances and anxiety, and well-established empirical facts typically measured in laboratory settings (see Supplementary Information). To this end, we provide a replication and extension of previously reported sleep disturbances and borderline anxiety during the first lockdown in France [36], showing that questionnaires included in the database can be reliably exploited independently of research interests dedicated to timing research (Supplementary Figure 4). A number of questionnaires in the database could be exploited on their own for epidemiology, demographic, psychiatry, or chronobiology, or as covariates of other experimental measurements provided in the database. We also illustrate the distributions of several dependent variables in some of the timing tasks measured in Blursday, all of which pointing to the psychophysical and psychometric utility of our experimental approach for future investigations dedicated to these timing properties (Supplementary Figure 5).

Importantly, by exploring the effects of stringency, mobility, subjective confinement, age, and hour of day on several measures of subjective time (Table 1), we report novel empirical findings showing that both objective measures of lockdown and subjective measures of confinement influence participants' time perception at different time scales.

We found that participants' subjective confinement scores, designed to capture how isolated participants felt, systematically accounted for changes in temporal orientation at the scale of a few days to week and month. Notably, the more isolated participants felt, the slower time seemed to pass. This observation generalizes how feeling isolated contributes to temporal distortions and the felt slowing of the passage of time, which has been noted in a Brazilian study [25]. It also accounts for the diversity of passage of time changes reported during lockdown and attributed to possible consequences of isolation such as boredom [19–24]. Thus, evaluating the degree to which participants felt isolated is an important psychological factor that provides additional insights on participants' subjective well-being independently of the objective lockdown situation. Indeed, our analyses were applied to all sessions (in and out of lockdown) over months during which objective lockdown measures were difficult to track.

Time Scale	Orientation	Task	Objective Stringency	Objective Mobility	Felt Confinement	Age	Time of day
Minutes to Hours	Past	Retrospective duration	✓	✓	✗	✗	✗
Few days	Past	Passage of Time	✗	✗	✓	✗	✗
Few days to weeks	Past	Subjective distance to 1st day of confinement	✗	✓	✓	✗	✗
Week	Future	Subjective distance to *next week*	✗	✗	✓	✓	✗
Month	Future	Subjective distance to next month	✓	✗	✓	✓	✗

Table 1: Summary of preliminary observations. To illustrate the use-value and richness of the Blursday database, we selected only a few measurements testing participants' time perception at different time scales (from minutes to one month) and orientation (past/future). We explored the effect of stringency (objective index), mobility (objective index), subjective confinement (subjective isolation index), age and hour of day on distinct measures of subjective time. A green checkmark indicates a significant effect of the covariate on the time measurement; a red cross marks an absence of significant effect. This table provides a succinct summary of otherwise more complex effects subjected to the limitation of our selection of relevant factors and choice of statistical models. Size and directionality of the effects are described in Results.

How isolated participants felt consistently modulated their subjective assessment of past and future distances so that the more isolated individuals felt, the more distant in time past and future events seemed to be. These observations are essential in that temporal orientation is the ability to conceive of the self in subjective (past or future) time; an ability which has also been argued to be a core component of autonoetic consciousness [37]. We also found that the older the participants were, the closer their future appeared to be. Although previous timing research has shown differences on the perception of past and current passage of time [e.g. 38], future-oriented prospective timing has received less attention in the literature although it may entail differences in foresight across ages [39]. Indeed, ongoing work use these measures together with participants' time perspective personality trait (ZTPI) to explore individuals' self-perception and the behavioral consequences of temporal disorientations on delay-discounting (all collected measures in the Blursday database).

Two objective indices of lockdown (stringency and mobility) affected retrospective duration estimations in which a somewhat intriguing observation was found. It is now well-known that participants tested on a range of magnitudes display a behavior that conforms to the predictions of a Bayesian observer. Most studies assess this by using a range of magnitudes around a value of interest showing a generalizable pattern of central tendency or regression to the means [26,28,40]. The central tendency is described as a subjective under-estimation of values below the mean of the distribution and an over-estimation of values above this mean. The range of durations calibrates the central value and, thus, the cutoff or the intersection between a presumed ideal observer (identity line) and an individual's subjective magnitude estimates. Our observed retrospective duration estimations conformed to this typical central tendency pattern otherwise known as Vierordt's law in timing research [27].

However, a key issue is that a classification as "short" or "long" does not have any reference point in our current study other than the *prior belief* of each unique participant. In Blursday, the range of retrospective durations explored was uniquely wide (from 1 minute to 5 hours) and uncontrolled since the duration was set by each participant's last login. Considering that each data sample was drawn from an independent observer tested on a different duration, the observation of a central tendency unexpectedly suggests the possibility of an indifference time interval (or absolute human prior) of about a quarter of an hour.

Historically, Woodrow [41] considered that the indifference interval should not be defined as the duration at which the individuals' average errors is zero but instead, as *"the interval at which the average of all errors in any specified total distribution is zero".* In other words, Woodrow posited the possibility of an absolute indifference interval. To demonstrate this, he tested participants using durations from ~300 ms to 4000 ms and a temporal reproduction task; the temporal reproduction data showed a central tendency around ~600 ms. Each participant was tested several times, which could not test the initial hypothesis. Closer to our retrospective duration task in which individual samples are independent, data in two reports showed a possible central tendency between 16-50 minutes [42] or between 2-3 minutes in another [43]. In Blursday, the large-scale dataset, the wide-range of durations tested, and the multi-cultural inclusion make this result quite unique, the observation of a central tendency towards a 15 to 20 minutes value at the inter-individual level is a non-trivial novel observation. We can add to this that the central tendency for retrospective duration was significantly less pronounced during lockdown (S1) than outside of it (SC), so that the participants reports were closer to the ideal observer and conformed less to Vierordt's law during lockdown than outside of it.

Finally, the highlighted observations by no means exhaustively exploit the rich repertoire of tasks, tests, and questionnaires of the Blursday database. This stands as a limitation of our results considering that we have not fully exploited the numerous factors that were recorded, and which could help further disentangle their weighted contributions to the temporal distortions and disorientations we report. The Blursday database is amenable to cross-replication studies and feeds ongoing analyses testing specific working hypotheses. For instance, a first cross-cultural analysis revealed differences in anxiety and depression that can be partially attributed to differences in individuals and cultural time perspectives [17]. The motor timing tasks, designed to assess whether endogenous rhythms, sensorimotor productions and synchronizations were affected during isolation can be enriched with the personality traits collected on the same individuals as well as their demographics (age, gender). The foreperiod paradigm, which assesses implicit timing, is being explored with respect to some of the lockdown measures but also as a function of age, cultural diversity, and self-perception measures. The assessment of temporal landmarks taps into the possible distortions of temporal cognitive maps induced by the Covid-19 episode in the population, thereby enabling the exploration of how temporal distortions may link to episodic memory and participants' fluency reports.

In conclusion, we are confident that the *Blursday* dataset will act as a rich historical record of temporal disorientation and distortion during Covid-19 and serve as an empirical benchmark for future studies set out to use and build on the same tools to assess the effects of social isolation on temporal information processing across cultures and post-pandemic. In this Resource article, we highlighted only a few possible observations drawn from the current dataset. Our study demonstrates the feasibility of a large and ambitious international study in a short time only thanks to the help of community builders such as the Timing Research Forum (TRF; http://timingforum.org). As members of the timing community, we hope that *Blursday* sets forth an international "TimeLab" that can support and foster multi-cultural large-scale studies in timing and psychological time research.

Methods

Participants

As of November 8th 2021, a total of 2,840 participants contributed to the online "Time Social Distancing" study in 12 countries (Argentina, Canada, Colombia, France, Germany, Greece, India, Italy, Japan, Turkey, United Kingdom, United States of America) and completed at least one full questionnaire or task in the study.

The full participation to the entire study entailed completing 14 questionnaires, and 3 runs of 15 tasks in a given session (Table 2). The attrition rate was thus predictably very important in the course of the longitudinal study: 439 participants finished all tasks in the first session (S1; see Table 2 and Supplementary Figure 1) conducted during the first lockdown; 200 participants finished the second session (S2) and 244 the third session (S3) which took place outside the initial lockdown confinement and about 2 weeks and 3 months after it, respectively. In some countries (France and Italy) a shortened fourth session was conducted (S4) on the same participants during their second lockdown with 275 participants.

At least a year later, starting in May 2021, as restrictions started to be lifted in some countries, a control pool of naïve participants was recruited in each country. As of November 8th 2021, 243 participants completed the control session. This control population was tested on the full set of questionnaires and tasks originally tested in S1. As of November 8th 2021, these tests are finished in some countries (*e.g.* France, Japan, Italy, Germany), ongoing (e.g., Turkey) or planned (e.g., Argentina, Greece) in others. For ease of report, we named this session "control session" to highlight that this pool of participants did not take part in the previous sessions (hence, were naïve to the questionnaires and tasks) but also, that they were tested outside the most severe series of lockdowns in the tested countries (France, Japan, Italy, and Germany). However, we also contend that even as of March 2022, the world situation cannot be considered a control in a rigorous and empirical sense of the term. A rigorous control would require the same study to have been performed before the Covid-19 pandemic. While it is conceivable that some of the tasks and questionnaires we tested during the pandemic could find matching controls tested before the pandemic, no such data are currently part of the database. Hence, we loosely refer to this group of participants as "control participants" and to the session as "control session" to emphasize, for instance, that learning effects and familiarity to the task in the longitudinal data can be controlled for. It is also noteworthy that our analysis takes into account a more nuanced approach to lockdown by using a continuous index of stringency as opposed to the categorical dichotomy of being "in and out of lockdown" adopted in the existing literature (see Assessment of objective and subjective confinement indices). In all sessions, participants reporting drug usage and psychiatric disorders were *a priori* excluded from data collection; some of the included questionnaires otherwise allow for an evaluation of depression, stress, anxiety and attenuated symptoms of psychosis. Data from Colombia, UK, and USA were too few to be included and were *a priori* discarded from most analyses (although made available in the database). Due to the exceptional nature and speed of change in governmental policies, experiments started *during* the first lockdown or state-of-emergency of each country in 2020 (Supplementary Figure 1) and continued longitudinally at a different pace according to local policies. We report in Supplementary Figure 1 the full demographics of the database during the experiments along with lockdown dates and general timelines of the study.

Outliers in reported analyses

In the retrospective duration analysis, we used three criteria for defining outliers: the first criterion rejected data points with a clock duration shorter than 1 minute and longer than 5 hours due to the implausibility of these timings in our study protocol. The second criterion excluded data with subjective retrospective durations shorter than 12 s and larger than 25 hours (i.e., subjective estimates that were 0.2 times the shortest possible clock duration and 5 times the longest possible clock duration). The last criterion removed data points with relative duration errors computed as

$[(retrospective\ duration\ estimation\ -\ clock\ duration)\ /\ clock\ duration)]$ beyond the 95 central percentiles per country and per session. The application of these criteria discarded 8.8 % of the original dataset.

The passage of time ratings used data collected right after the retrospective duration estimation. For this reason, we considered that trials in which the clock duration responses were aberrant were also unreliable for the passage of time. Therefore, we applied the same criteria and rejected Passage of Time trials in which the reported clock duration was shorter than a minute, or longer than 5 hours, as well as trials in which the clock duration was beyond the central 95 percentiles. The application of these criteria discarded 8.3 % of the original dataset.

We performed no outlier removal for the analyses of subjective temporal distance (next week, month) beyond missing responses, which were discarded on a per-trial basis.

For all VAS measures (passage of time and subjective temporal distances, Figure 2a and Figure 3c, respectively) the extreme and middle responses of the VAS tended to be over-represented. Since we had no clear criterion to distinguish whether such values indicate a miss-use of the VAS scale or not, we did not exclude them.

Ethics

All participants were provided with full instructions and signed an online consent form following the Declaration of Helsinki (2018) and the ruling of Ethical committees. Participants were provided with a contact email if they had any questions before proceeding. The approval to run the study internationally was obtained from the University Paris-Saclay (CER-Paris-Saclay-2020-020; all countries). Whether the ethical approval obtained in the main PI's country is sufficient to run an international online (non-interventional) human study is an unresolved question [44]. In this context, each PI sought local ethical approval for each country: Comité de Etica de la Universidad Nacional de Quilmes CE-UNQ No 2/2020 (Argentina); Université Laval, 2020-114 / 14-04-2020 (Canada); Institute for Frontier Areas of Psychology and Mental Health, Freiburg, IGPP_2020_01 (Germany, Switzerland, Austria); Ethical Committee for the Psychological Research of the University of Padova (Italy); Institutional Ethics Committee, Indian Institute of Technology Kanpur, IITK/IEC/2019-20/18-Apr-20/I (India); The Institutional Review Board of the University of Tokyo, #705 (Japan): UCLA Office of the Human Research Protection Program, IRB#20-000612 (USA); Koç University, 2020.113.IRB3.053 (Turkey).

Data Acquisition Procedure

We used the Gorilla Experiment Builder (www.gorilla.sc) to build and host our study [45] in several languages and countries. The original project was designed in English. French, Japanese, Italian, Greek, Portuguese, German, Spanish, and Turkish were cloned from the original English templates, translated, and beta-tested by the local teams, and eventually adapted to the needs or cultural specificities of the country. All questionnaires and tasks are freely accessible in English (and other languages, see below) under the Gorilla Open Materials Attribution-NonCommercial Research-Only licensing: https://app.gorilla.sc/openmaterials/278377.

In most countries, participants were recruited by means of general advertisement using institutional newsletters and/or outside the institution through social media channels. In Japan, participants were recruited through an agency or online (half of the participants for the control session); all participants were given monetary rewards for completing each session. In France, control participants were given the option to receive a small compensation for their participation (80 out of 184 participants asked to receive compensation). In Turkey and Greece, a group of participants was recruited through classes and compensated with bonus course credits.

General information was provided in different languages and updated over time for each country on a specific web page (https://brainthemind.com/covid19/) as well as locally in printed form (https://osf.io/359qm/). When participants connected to the protocol website, they were first provided with general information about the study and asked to provide their consent. Then, they were invited to create an anonymized public identification, which they kept for the rest of the study. Participants could leave the website and come back where they stopped at any time. They were free to stop the experiment when they wanted to. Any technical issue, bug, or any problem participants would have was handled by email.

Protocol

The full experimental protocol consisted in three to four longitudinal sessions (S1, S2, S3, S4) and one control session (SC, new participants). In all sessions, participants went first through a series of questionnaires administered in a random order across participants, which they had to take once per session for the majority of them. After the series of questionnaires, they entered in a series of diverse behavioral tasks presented in pseudo-random order (latin-square design) across participants. Each task was presented up to three times within a session. In the course of the study, the number of runs was reduced to lighten up the requirements of the study. A general insight on the full session is described in Supplementary Figure 2 and Table 2. Both provide a comprehensive description of the content of each session. A detailed description of questionnaires and tasks used in the study is provided below.

Questionnaires

We included an extensive number of questionnaires that have been (cross-)validated in different languages and in several countries as well as designed new ones. Answering the first series of questionnaires took about an hour. We designed a Confinement Tracker questionnaire and an Isolation Questionnaire adapted to the circumstances to provide basic information on the state of lockdown (Supplementary Materials). We included the UCLA Loneliness Scale [46,47] which provides several metrics of self-reported loneliness. The clinically-oriented Hospital Anxiety and Depression Scale or HADS [48] provides reliable measures of the state of anxiety and depression of participants. The PQ16 [49] was used to screen participants' attenuated symptoms of psychosis. Mindfulness was assessed using the Freiburg Mindfulness Inventory or FMI [50]. Circadian preferences and sleep disturbances were assessed using the Morningness-Eveningness Questionaire reduced version or rMEQ [51], the ultra-short version of the Munich Chronotype

Questionnaire µMCTQ [52], as well as monthly and weekly versions of the Pittsburgh Sleep Quality Index or PSQI [53,54], and a daily sleep quality questionnaire (Supplementary Materials). The general personality traits of participants were assessed using the Big Five Inventory or BFI-10 [55,56]. The Zimbardo Time Perspective Inventory or ZTPI [57,58] provides a general assessment of the individual's temporal orientation trait [59]. The attentional orientation trait of participants was assessed using the Attentional Style Questionnaire or ASQ [60,61]. An analysis of sleep disturbances (PSQI) and anxiety (HADS) on the French subsample of data collected in Blursday replicates previous findings and is fully described in Supplementary Figure 4.

	SESSION 1 confinement	SESSION 2 at least 2 weeks post-confinement	SESSION 3 at least 3 months post-confinement	SESSION 4 Confinement 2 *France and Italy only*	CONTROL at least 1 year post-confinement
QUESTIONNAIRES	▪ Confinement status ▪ Demographics ▪ Environment and social connectivity (UCLA) ▪ Isolation questionnaire ▪ Morningness-Eveningness Chronotype (rMEQ) ▪ µMCTQ ▪ Daily sleep quality ▪ Zimbardo Time Perspective Inventory ▪ Hospital Anxiety and Depression Scale (HADS) ▪ Pittsburgh Sleep Quality Index (PSQI) ▪ Big Five Inventory (BFI-10) ▪ Attentional Style Questionnaire (ASQ) ▪ Self-Perception (PQ16) ▪ FFA	▪ Confinement status ▪ UCLA ▪ Isolation questionnaire ▪ HADS ▪ PSQI ▪ µMCTQ ▪ Daily sleep quality ▪ FFA	▪ Confinement status ▪ UCLA ▪ Isolation questionnaire ▪ HADS ▪ PSQI ▪ µMCTQ ▪ Daily sleep quality ▪ PQ16 ▪ FFA	Questionnaires ▪ Confinement status ▪ UCLA ▪ Isolation questionnaire ▪ HADS ▪ PSQI week ▪ µMCTQ week ▪ Daily sleep quality	▪ Confinement status ▪ Demographics ▪ Environment and social connectivity (UCLA) ▪ Isolation questionnaire ▪ Morningness-Eveningness Chronotype (rMEQ) ▪ µMCTQ ▪ Daily sleep quality ▪ Zimbardo Time Perspective Inventory ▪ Hospital Anxiety and Depression Scale (HADS) ▪ Pittsburgh Sleep Quality Index (PSQI) ▪ Big Five Inventory (BFI-10) ▪ Attentional Style Questionnaire (ASQ) ▪ Self-Perception (PQ16) ▪ FFA
TASKS	▪ Retrospective Duration ▪ Passage of Time ▪ Subjective Temporal distance ▪ Temporal landmark ▪ Fluency tasks (Phonemic, Semantic, Time Semantic, Past, Future) ▪ Duration production and metacognition ▪ Tapping and synchronization ▪ Delay-Discounting ▪ n-back Working memory, prospective duration and passage of time ▪ Counting task and duration estimation ▪ Implicit timing / foreperiod ▪ Self Preference	▪ Retrospective Duration ▪ Passage of Time ▪ Subjective Temporal distance ▪ Temporal landmark ▪ Fluency tasks (Phonemic, Semantic, Time Semantic, Past, Future) ▪ Duration production and metacognition ▪ Tapping and synchronization ▪ Delay-Discounting ▪ n-back Working memory, prospective duration and passage of time ▪ Counting task and duration estimation ▪ Implicit timing / foreperiod ▪ Self Preference	▪ Retrospective Duration ▪ Passage of Time ▪ Subjective Temporal distance ▪ Temporal landmark ▪ Fluency tasks (Phonemic, Semantic, Time Semantic, Past, Future) ▪ Duration production and metacognition ▪ Tapping and synchronization ▪ Delay-Discounting ▪ n-back Working memory, prospective duration and passage of time ▪ Counting task and duration estimation (only in Sessions 1-3) ▪ Implicit timing / foreperiod ▪ Self Preference	▪ Subjective Temporal distance ▪ Retrospective Duration	▪ Retrospective Duration ▪ Passage of Time ▪ Subjective Temporal distance ▪ Temporal landmark ▪ Fluency tasks (Phonemic, Semantic, Time Semantic, Past, Future) ▪ Duration production and metacognition ▪ Tapping and synchronization ▪ Delay-Discounting ▪ n-back Working memory, prospective duration and passage of time ▪ Implicit timing / foreperiod ▪ Self Preference

Table 2: Overview of tasks and questionnaires. Sessions 1 and 4 took place during the first and the second lockdown, respectively. Sessions 2 and 3 were set at least 2 weeks and 3 months after the first lockdown. Thus, sessions 1, 2, 3, and 4 tested the same set of participants longitudinally in and out lockdown. The Control session tested a group of naive participants on the same set of questionnaires and tasks as those tested in Session 1 (during the first lockdown). A detailed description of Session 1 is provided in Supplementary Information.

Tasks

Retrospective Duration

The vast majority of studies in time perception use prospective timing tasks in which participants know *beforehand* they will be asked to estimate the duration of an upcoming event or stimulus [62]. While helpful (see below for prospective duration tasks), this paradigm also falls short of capturing temporal judgments that are commonly made retrospectively in daily life. Retrospective temporal judgments require individuals to make an estimate of elapsed time since a past event or during an activity that just happened without them knowing *a priori* they will have to time [29,62–64]. Cognitive components (*e.g.*, attention and memory) are considered to be differentially involved during retrospective *vs*. prospective timing [62] with retrospective duration estimates assumed to engage episodic memory processes. In the Blursday project, we included retrospective duration estimations (Supplementary Figure 3) at several moments after a series of questionnaires or after specific tasks. Herein, we report the first retrospective duration estimate participants had to make in the study, which followed a series of initial questionnaires and thus spanned a scale of minutes to hours. The outcomes are included in the Results section and illustrated in Figure 1.

Passage of Time Judgments

Passage of time judgments can be used to estimate the subjective feeling that time passes otherwise commonly referred to as the "flow of time" [34,65]. In this study, passage of time judgments were either implemented as Visual Analog Scales (VAS) ranging from "very slow" to "very fast" or as Likert scales offering a categorical choice between: "very slow", "slow", "normal", "fast", and "very fast". Like for retrospective duration estimates, we used passage of time judgments after several tasks during the study by asking participants to report how fast time felt in a given lapse of time (e.g., Supplementary Figure 8). Herein, we report the passage of time judgments that were estimated using a VAS and over the scale of the "last few days" (Supplementary Figure 3) in the Results section.

Temporal landmarks and event recording

By analogy to spatial landmarks, temporal landmarks are salient events that have been time stamped in memory. For instance, one's birthday tends to be an important landmark. One way to assess the existence of temporal landmarks is to evaluate the speed (response times) and ease (error rate) with which one answers a question about a point in time. Chronometry and performance can be driven by the psychological distance of that point in time from the operative landmark in one's temporal cognitive map. Temporal landmarks can be culturally and autobiographically idiosyncratic. For instance, when participants are asked to answer as fast and as accurately as possible "What day is it?", the closer a day is to a cultural temporal landmark (e.g. Sunday in Catholicism or Shabbat in Judaism), the faster the responses and the lower the error rates [66,67]. In this study, we prompted participants at various times with the question "What day is it today?", as well as asked them to report an important event for them on that same day (Supplementary Figure 3). The distribution of the collected responses times during lockdown in all participating countries are illustrated in Supplementary Figure 5d.

Subjective Temporal distance

An estimation of subjective temporal distance consists in asking participants to estimate how far away an event feels for them. Subjective temporal distances involve episodic memory processes and the abstraction of temporal relations between events [68,69]. Herein, we asked participants to use a VAS to report how far away their first day of lockdown felt with respect to the moment at which they were asked this question (i.e*.,* the present). This subjective temporal distance provides a subjective measure of elapsed time at the scale of days to weeks and months as recalled by the participant (Supplementary Figure 3). We also assessed participants' subjective distance to a week and a month ahead, to test their future orientation. Although subjective distances may be related to the actual passage of time, people may feel more or less close to a past event regardless of its actual temporal distance [70]. The outcomes of these ratings are included in the Results section and illustrated in Figure 3.

Fluency tasks: Semantic, Phonemic, and Time scales

Verbal fluency tasks involve reporting as many words as possible within an imparted lapse of time, based on phonemic or semantic criteria [71]. These tasks were originally developed for neurolinguistic and cognitive assessments. For instance, a semantic fluency task consists of asking participants to report as many animals as possible in 60 seconds (s); this was the semantic fluency task included in our study (Supplementary Figure 6). Similarly, the phonemic fluency task consisted here of reporting as many words as possible starting with the letter ‘P’ in 60 s. In addition to classic verbal fluency tasks, we included past and future event fluency tasks to assess the accessibility of mental representations of life events that participants experienced in the past or that they plan for the future [72]. These fluency tasks took the form of a question “Write as many events as possible that occurred last [week/month/year]” for past fluency or “that will happen next [week/month/year]” for the future fluency tasks (Supplementary Figure 6). Hence, these fluency tasks tested the scales at which the fluency was assessed, namely over a week, a month, or a year. An additional semantic fluency task inquiring about associations with the word “time” was tested by simply asking participants to report as many spontaneous associations as possible they had with this word. All fluency tasks in the Blursday database were 60 s long and the number of collected items was unlimited.

Prospective duration estimation while counting up or down

When participants prospectively estimate a lapse of time, both attention and working memory influence their duration estimates. The demonstration of this influence is often based on a dual-task paradigm in which a participant is asked to perform both a temporal and a nontemporal task. Several nontemporal tasks have been used to show the impact of attention or working memory on prospective judgments of time [73–75]. Amongst these tasks, there is the possibility to ask participants to perform a counting task [73], a strategy that is adopted in the present investigation. Herein, participants were prompted with a prime number and asked to count up (addition) or down (subtraction) in steps of 3 or 7 as a way to control the difficulty of the task (Supplementary Figure 7). Following a trial, participants were asked to report the number they reached as well as the amount of time spent doing the task (which could be, unbeknownst to participants, either 12 s or 24 s).

Prospective duration estimation while performing an n-back task

Level of processing in working memory lengthened temporal production presumably by slowing down temporal integration [76]. One means to further explore the influence of working memory on time estimation is to use a parametrically variable n-back task in which a sequence of letters is displayed on the screen and participants decide on a trial-by-trial basis whether the displayed letter is identical to the previous one (n = 1) or to the one two letters before it (n = 2) and so on. It has recently been shown that increasing the working memory load (increasing the n) may proportionally shorten the prospective estimation of duration whereas paying attention to time may lengthen it in an additive fashion [77]. In this study, we asked participants to perform an n-back task (n = 1 or n = 3) and to report how long the trial was (in minutes:seconds) as well as how fast time felt on a Likert scale. Unbeknownst to participants, a trial could last 45 s or 90 s (Supplementary Figure 8).

Duration production and metacognition

Duration production is another prospective timing task which consists of asking participants to estimate a time interval using overt motor behavior. Herein, participants were asked to produce 3.6 s by pressing the spacebar to initiate their time estimation and, once they considered that 3.6 s had elapsed, pressing the spacebar again (Supplementary Figure 9). Following each duration production, we asked participants to assess their performance, which constitutes a metacognitive judgment task, and provide an assessment of temporal error monitoring [78,79]. In temporal production tasks, the substantial variability within individuals that is observed is assumed to result from the endogenous timing uncertainty between trials. The statistical features of this timing variability and its relation to the time intervals being judged has been one of the primary focuses of the psychophysical study in interval timing [80]. The fact that organisms can access their level of endogenous timing uncertainty as a form of temporal metacognition [78,79] might serve optimal temporal decisions in animals and humans [81]. Hence, this novel metacognitive assessment of temporal judgments was included here by asking participants to not only evaluate the signed error magnitude of their temporal production (using a VAS) but also to rate their confidence either of their temporal production (Turkey) or of their metacognitive judgment (most countries). The descriptive statistics of the duration productions (s) for all participating countries in S1 are illustrated in Supplementary Figure 5b.

Spontaneous finger tapping (Free tapping)

Spontaneous motor tempo, i.e., the rate at which an individual taps in the absence of any timing cue, is universally situated between around 1 Hz and 4 Hz with a bimodal or even trimodal distribution of the intertap intervals (peaks at around 250, 500 and 1000 ms; Hammerschmidt et al., 2021). The rate at which participants tap is assumed to reflect the speed or the period of a still largely unknown timekeeper, and it has been shown to be sensitive to alterations such as aging [83,84]. This has been argued to be because spontaneous tapping tasks are too simple to be compensated by alternative compensatory mechanisms i.e., they are not cognitively penetrable [85]. Basic information about the task is provided in Supplementary Figure 10. The descriptive statistics of the inter-tap-intervals (ITIs) for all participating countries in S1 are illustrated in Supplementary Figure 5a. A quantitative comparison of ITIs by browser and OS is provided in Supplementary Figure 11.

Synchronization-Continuation

In the field of motor timing, the classical synchronization-continuation paradigm [86] consists of asking participants to synchronize their finger tapping with an auditory metronome and then to continue finger tapping with a sequence of constant intervals at the pace they initially synchronized with [87]. In the continuation phase, the variability of the ITIs is the key dependent variable of interest [87]. When the stimulus period is varied parametrically, an auto-correlation analysis of the series of produced intervals can be used to sort out the part of observed variability due to the temporal component of the task (associated to the underlying timing mechanism) and the one due to the implementation of the intervals with finger taps (the motor component). The synchronization phase, also known as paced finger tapping, is one of the simplest tasks to study sensorimotor synchronization, which has been argued to capture the ability of coordinating one's own movement with an external metronome [88]. In paced finger tapping, it is the asynchrony (the time difference between response and stimulus) which is the fundamental variable of interest [89], both for isochronous and for perturbed sequences [90]. A succinct illustration of the task used in the study is provided in Supplementary Figure 12. We tested two conditions: tapping in-sync or out-of-sync with the stimuli. The measured asynchronies in the synchronization task and the ITIs in the continuation task during lockdown are illustrated in Supplementary Figure 5a for all participating countries. A quantitative comparison of timing by browser and OS is provided in Supplementary Figure 13 and Supplementary Figure 14.

Foreperiod paradigm and implicit timing

The implicit extraction of temporal regularities from the environment allows forming temporal predictions and orienting attention to particular moments in time [91], which can lead to more efficient behavior, such as faster response times, or improved perceptual sensitivity [92,93]. Here, we implemented an implicit timing task (Supplementary Figure 15), in which we varied the foreperiod (the time interval between a cue and target tone), such that the duration was either fixed (hence predictable) or variable (non-predictable) throughout a block, and measured response times as an index of efficient temporal prediction. The measured reaction times (RTs) in S1 for all participating countries are illustrated in Supplementary Figure 5c. A comparison of RTs by browser and OS is provided in Supplementary Figure 16.

Delay-Discounting

Delay discounting refers to the devaluation of the reward amount as a function of delay to its receipt [94], making the amount but also the proximity of the reward an important factor in determining the choice behavior of participants when they are asked to choose between two options. Some individuals may prefer the immediate reward over a delayed reward even when the amount offered immediately is substantially less than the amount offered after a delay (preferring to receive $5 now over receiving $20 in a year). Confinement is a condition that typically leads to the state of boredom, which can trigger impulsivity (Moynihan et al., 2017). In this task (Supplementary Figure 17), different amounts were offered to participants at different delays to estimate the subjective values of the offers as a function of time required to collect them. The amounts for each country were adjusted according to the purchasing power parities (Conversion rates - purchasing power parities (PPP) - OECD data. Retrieved September 20, 2019, from https://data.oecd.org/conversion/purchasing-power-parities-ppp.htm; OECD, 2012)

Self-preference

Phenomenological approaches have related time with self as early as the 20th century [96] leading psychiatrists to link time with disorders of the self in psychosis [97–99]. Such a link has been evidenced experimentally [100,101]. In addition to the PQ-16 questionnaire exploring attenuated psychosis, the self-preference task was added to provide an objective self-related measure. It has repeatedly been shown that a stimulus we associate with ourselves is processed faster and with higher accuracy than a stimulus we associate with others [102,103]. These effects can either be accounted for by a self-referent memory advantage [104] or by enhanced attention drawn to self-related information [105]. To test this, and in accordance with previous work, we used a reaction time task in which participants learn to associate a geometrical shape with a label ("Self", "Friend" and "Other"; Supplementary Figure 18). On subsequent trials, participants are presented with one shape and one label, which may or not match with the previously learned associations. Participants had to report as fast and as accurately as possible whether the shape and the label matched.

Assessment of objective and subjective confinement indices

The diversity of questionnaires included in the study provides a rich resource for numerous proxies of lockdown and subjective confinement indices. Herein, we illustrate four possible approaches illustrating the severity of lockdown experienced by an individual, objectively, semi-objectively, and subjectively.

A first objective measure (by country) is the Stringency Index derived by the OurWorldInData [106]. The Stringency Index is a composite measure of nine governmental response indicators that include school closures, workplace closures, and travel bans, rescaled to a value ranging from 0 to 100 with 100 being the strictest stringency. A second objective measure (by country) can be found in the Google mobility index measures during Covid-19 (Google, 2021). For the purpose of our concise report, we selected the Transit Station Mobility Index (henceforth referred to as Mobility Index), which quantifies how much time visitors spent in various transit stations (subway, taxi stand, rentals) during a selected period relative to a baseline period. In the Google dataset, the baseline was defined as the median value from a five-week period spanning January 3rd to February 6th, 2020. The more negative the mobility index, the less mobility compared to baseline. As visible in Supplementary Figure 1, while sessions were carefully aligned to the governmental lockdowns and state of emergency rules, they do not strictly map to the level of stringency or to the degree of mobility estimated in a given country. Some of our results and analyses indicate that objective measures of stringency and mobility may be adequate covariates to explore the effect of lockdown on behavior (for instance, see outcomes of our retrospective duration analysis below).

A third measure of lockdown is the number of days participants reported being stranded at home in our confinement tracker. Although the verbal report of participants could be used as an objective measure, this estimation is prone to subjective factors that include memory [108], idiosyncratic and cultural biases [67,109] and variable temporal orientation towards socially meaningful events [110]. Hence, the reported number of days in lockdown cannot be considered a veridical and objective measure of lockdown, but it can minimally provide a fair and subjective approximation for it. The degree of deviance of the subjective measure with the veridical day of confinement could be compared to the locally applicable rules and official dates of lockdown for each participant although uncertainty as to each individual case remains. Hence, the reported number of days in lockdown is considered a semi-objective measure.

Fourth, we defined a measure of subjective confinement based on participants' self-assessed feeling of being isolated. Out of the 20 items which we tested using the full UCLA questionnaire [46,47], we used the ratings to only 5 items which could be directly related to the consequences of lockdown and stringency measures. We made a proxy for the feeling of confinement using these 5 selected items: "I have nobody to talk to", "I lack companionship", "I feel completely alone", "I feel starved for company", and "I feel isolated from others". Answers to these questions were obtained using a four-level Likert scale. While objective measures of confinement captured the situation well, a large inter-individual variability may subsist in participants' subjective feeling of having to stay home, being fully confined or under various stringency rules. This could be due to factors such as personality traits (which can be assessed with the BFI included in Blurdsay), or social isolation (which can be explored with the remaining items of UCLA and various questions such as changes in social media use, number of people in the household, and changes in habits included in Blursday). For this concise report, we chose a direct and minimal approach using a Confirmatory Factor Analysis (CFA), which showed that responses to the five items selected *a priori,* could be aggregated along two dimensions, which we refer to as "self-reported loneliness" (capturing responses to statements "I have...", "I lack...") and "felt loneliness" (capturing responses to "I feel..."). These dimensions are available in the database but for simplicity, we combined these two estimates of loneliness as a proxy for "subjective confinement", which scored anywhere between 5 (feeling very isolated) to 20 (not feeling isolated).

We integrated the objective lockdown states and subjective confinement measures in the *Blursday* database as an optional feature of data downloading. Below, we use these measures as covariates and illustrate their impact on subjective time in the sampled population.

Code and data availability

Our databasing approach follows the FAIR principles [111] stipulating Findability, Accessibility, Interoperability, and Reusability of the data. In line with FAIR, we provide a graphical user interface to researchers, allowing them to easily and conveniently parse the data in a way that best fits their research needs (https://dnacombo.shinyapps.io/*Blursday*/). Data collected from each task and questionnaire are available at the individual trial/item level per participant in the database and will be incremented with quantified estimates per participant as analyses progress. The individual trial data are given to support modeling efforts that typically consider trial-based data sometimes based on the order of their occurrence. Due to the nature of the tasks, reliable timing is an important factor. To help researchers estimate the degree of timing uncertainty in data collected online [112], we provide the participant's operating system and browser information with which data were collected. To improve the readability of the data at this level of presentation, we also provide human-readable readme.txt files for each questionnaire and task in a dedicated OSF repository (https://osf.io/359qm/ in folder Study_design/README/) along with additional sources of information that facilitates the reusability of the data.

Project repository on OSF.io

The OSF repository provides a public access platform to published materials, guides, and codes associated with the Blursday database (https://osf.io/359qm/). The OSF hub will be updated and incremented as results using the database get published. Readme files are provided describing the independent and dependent variables for each task, the number of trials, and the number of possible runs. We provide a comprehensive listing of translation and associated references for the validation of the questionnaires used in Blursday. Additional resources such as the dates of the sessions, the timelines, or useful resources for a more detailed assessment of local governmental measures are also provided.

Code repository Github.com

https://github.com/dnacombo/TimeSocialDistancing

Server on Shinyapp.io

Live: https://timesocialdistancing.shinyapps.io/*Blursday*/

Source code: https://github.com/dnacombo/TSDshiny

Licensing of the database

CC BY 4.0

Tasks and questionnaires Gorilla.sc

All questionnaires and tasks used in the Blursday study are accessible as Open Materials in Gorilla in English (https://app.gorilla.sc/openmaterials/278377),
in French (https://app.gorilla.sc/openmaterials/27809),
in Greek (https://app.gorilla.sc/openmaterials/281196),
in Turkish (https://app.gorilla.sc/openmaterials/286114), and
in Japanese (https://app.gorilla.sc/openmaterials/286482).

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Competing interests

The authors declare no competing interests.

Figure Legends

Figure 1: Retrospective duration estimation is affected by lockdown, lockdown stringency, and mobility. **Panel a:** Retrospective duration estimates (minutes) as a function of veridical clock duration (minutes) during lockdown (S1; pink) and outside of it (SC; gray). Each dot is a single participant. Regression lines were estimated from the linear mixed effect model with their 95 % confidence interval (C.I.) in gray shading. **Panel b:** Relative retrospective duration estimates (unitless) as a function of the stringency index (a.u. between 0 and 100) for all sessions (colored). Colored dots are individual data points per participant and per session. Regression lines were estimated from the linear model with the 95% C.I. (gray shade). The more stringent governmental rules were, the shorter retrospective durations were estimated to be. **Panel c:** Relative retrospective duration estimates (no unit.) as a function of the mobility index (percent change relative to baseline, prior to lockdown, see main text) for all sessions (colored). Each dot is an individual data point per participant and per session. Black lines are regression lines estimated from the linear model with the 95% C.I. reported in gray shading. The closer to baseline mobility, the shorter retrospective durations were estimated to be.

Figure 2: Passage of Time and subjective confinement. Panel a: Distribution of VAS rating (0 to 100) counts for passage of time judgments as a function of session (color coded). **Panel b:** Passage of time ratings as a function of subjective confinement (5 to 20). Grey dots are individual data points (per participant, per session, per run). Black dots are the mean passage of time ratings binned by subjective confinement. The black line is a regression line estimated from the linear mixed effect model with the 95% C.I. (gray shade). The less lonely subjects felt, the faster the passage of time felt.

Figure 3: Subjective temporal distances. Panel a: Subjective temporal distances to the first day of lockdown as a function of the mobility index. Black dots are the mean subjective temporal distances binned by mobility**.** Black lines are regression lines estimated from the linear regression model with C.I. (gray shade). **Panel b:** Subjective temporal distances to the first day of lockdown as a function of the index of subjective confinement. **Panel c**: The distribution of future subjective temporal distances obtained for "next week" (pale green) significantly differed from those obtained for "next month" (dark green; $F(1, 3169) = 1171.9$, $p = 2.2e\text{-}16$). **Panel d, e:** Subjective temporal distances to "next week" (d) and "next month" (e) as a function of age. The pale and dark green dots are the mean subjective temporal distances binned by age. **Panel f, g:** Subjective temporal distances to "next week" (f) and "next month" (g) as a function of subjective confinement index. **h, i:** Subjective temporal distances to "next week" (h) and "next month" (i) as a function of stringency. Black lines are regression lines estimated from the linear model with 95 % C.I. (gray shade).