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All the authors declare to have no conflict of interest.

All materials, datasets, and computer code (script) are publicly available at Open Science Framework (https://osf.io/htxck/; see Callizo et al., October 2024). The present work is fully reproducible using those materials. The data from the Temporal Focus Questionnaire and the Temporal Diagram Task from the sample collected before COVID-19 were used as part of the wider analyses in Callizo-Romero et al. (2020, 2022). In the present study, we report for the first time the data from the Religiosity Questionnaire collected before the pandemic and all the data collected during the pandemic.

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Abstract

Objective: Was the arrival of the COVID-19 pandemic associated with young adults' religiosity and time-related cultural values? If so, were there also associated changes in peoples' spatio-temporal preferences as predicted by the Temporal Focus Hypothesis?

Methods: We used a behavioral task and three questionnaires across young participants from eight cultures: Bosniaks, Chinese, Croats, Moroccans, Serbs, Spaniards, Turks, and U.S. Americans. In Study 1, we compared two matched samples, one collected before the pandemic (N = 497) and the other collected during the pandemic (N = 497). In Study 2, we used the entire sample of young participants collected only during the pandemic (N = 893).

Results: The results from Study 1 showed that young adults collected during the pandemic (compared to before the pandemic) were less religious (hypothesis 1), more future-focused in their temporal values (hypothesis 2), and represented the future in front of them to a greater extent (hypothesis 3). In Study 2, we observed that the more concerned the participants were by the pandemic, the lower their religiosity (hypothesis 4), the greater their future focus (hypothesis 5), and the greater their tendency to represent the future in front (hypothesis 6). This pattern of results held across cultural groups with varying religiosity levels.

Conclusions: Our findings show that during the pandemic, young people's religiosity seemed to decline, and their focus on the future increased. This suggests the possible role of age and generation in coping strategies.

Keywords: Coping, COVID-19 pandemic, culture, religiosity, Temporal Focus Hypothesis

Deus ex machina: The COVID-19 Pandemic and Young Adults' Religiosity, Temporal Values, and Time Spatialization Across Cultures

The COVID-19 pandemic arrived *deus ex machina*, i.e., without warning and endowed with the power to change everything. Its sudden arrival created enormous insecurity and forced governments to implement social restrictions —like total lockdowns— of a vast magnitude. During the psychological stress caused by events such as this social crisis, individuals may develop coping strategies to deal with the unpleasant emotions arising from the stressful context (Carver et al., 1989). Given that some coping strategies are religious (Ano & Vasconcelles, 2005), they could affect people's religiosity level (i.e., their amount of religious beliefs, practices, and knowledge; see Cohen et al., 2003). Moreover, given the existing relationship between religiosity and some cultural values (Saroglou et al., 2003; Schwartz & Huismans, 1999), changes in religiosity could be associated with changes in value temporal focus, i.e., the importance given to cultural values related to the past (such as tradition or conservation) versus those related to the future (such as progress, technological development or openness to change; see Callizo-Romero et al., 2022).

Among coping strategies, positive religious coping involves individuals turning to religion to reduce psychological stress in threatening situations and relying on divine help to overcome difficulties (Koenig et al., 2012; McDougle et al., 2016; Pargament, 1997, 2000; Park & Cohen, 1993). This approach could reinforce religious beliefs or behaviors, offering a sense of enhanced control and comfort and reducing uncertainty, which could have happened during the pandemic (Bentzen, 2021; Molteni et al., 2021). If this were the case, it is to be expected that the individuals would also increase their focus on past-related values. According to Schwartz's (2012) model of cultural values, religiosity is associated with tradition and conservation (Schwartz & Huismans, 1999), values that emphasize preserving established cultural norms and practices, which are considered past-oriented because they guide present decisions and behaviors based on historical practices. In times of crisis, such as a pandemic, adhering to these past-oriented values could provide stability and social cohesion, which help in coping with stress. This approach may result in greater relevance to traditions, reinforcing a belief in overcoming challenges through time-tested methods.

Conversely, if believers view the pandemic as divine punishment or abandonment, they might adopt negative religious coping (Cheng & Ying, 2023), potentially reducing their faith and religious practices. As this strategy does not effectively reduce stress (Areba et al., 2018), it could prompt both them and non-believers to adopt secular coping strategies (McDougle et al., 2016), i.e., non-religious methods for managing stress and threats. These methods might be linked to cultural values different from tradition and supportive of progress, technological development, and openness to change, which are future-oriented values (Schwartz, 2012; Schwartz & Huismans, 1999). In the COVID-19 pandemic, this could manifest, for example, as increased reliance on science and technology for vaccine development.

During the pandemic, age and generation may have influenced coping strategies. Young people, being less religious than older generations (Pew Research Center, 2018), are also less likely to use positive religious coping (Ahmadi & Ahmadi, 2015; Prati & Pietrantoni, 2009). While positive religious coping seemed to be linked to well-being during the pandemic (Pankowski & Wytrychiewicz-Pankowska, 2023), evidence suggests it did not reduce psychological distress for young people (Cheng & Ying, 2023; Özer et al., 2023). This may have led them to adopt secular coping strategies aligned with their focus on progress and future-related values (de la Fuente et al., 2014). While religiosity among the general population appeared to remain stable during the pandemic (Pew Research Center, 2020b), this study examines whether young people may exhibit a shift toward less religious and more future-oriented tendencies.

Furthermore, the pandemic may have influenced not only personal religiosity and value temporal focus but also time spatialization, the psychological mechanism of representing time as if it were in space. According to the conceptual metaphor theory (Lakoff & Johnson, 1980), people use concrete concepts like space to understand abstract ones like time. Time is often mapped onto a sagittal axis, with the past behind and the future in front, as reflected in gestures where people point forward for the future and backward for the past (Casasanto & Jasmin, 2012). However, not everyone visualizes time this way. The Temporal Focus Hypothesis (TFH; de la Fuente et al., 2014) suggests that those with past-oriented values may represent the past in front, while future-oriented individuals tend to place the future in front (Callizo-Romero et al., 2020). This raises a

question for our study: if young people became more future-oriented during the pandemic (possibly due to adopting negative religious or secular coping strategies), they might increasingly represent the future in front of them; conversely, the opposite could occur if they developed positive religious coping strategies.

Importantly, potential changes in religiosity, temporal values, and time spatialization may vary across cultures: During social crises, people from more religious societies tend to use positive coping strategies, while in less religious contexts the search for security might promote secular coping strategies that reinforce their trust in the state (rather than religion) as a provider of security and solutions (Gill & Lundsgaarde, 2004), thereby promoting the overall secularization process that already affects many cultures in the world (Norris & Inglehart, 2011). If this is so, we should expect the effect of the COVID-19 pandemic on religiosity, value temporal focus, and time spatialization to vary according to the religiosity levels of different cultures and contexts before the pandemic.

In the present study, we aim to investigate whether there were changes in religiosity, the importance given to cultural values related to the future or the past (i.e., value temporal focus), and time spatialization in young people from cultures with varying levels of religiosity and value temporal focus before the pandemic. For clarification, value temporal focus refers to 'cultural temporal values' (e.g., traditional vs. progressive values), a construct distinct from the 'personal time perspective,' which concerns the attention given to past or future personal events (Callizo-Romero et al., 2022). Although personal time perspective is linked to time perspective theories (Stolarski et al., 2015; Zimbardo & Boyd, 1999) and has been associated with religiosity (see Lowicki et al., 2018), this study focuses on value temporal focus, which prior research has shown to be related to time spatialization (Callizo-Romero et al., 2020; de la Fuente et al., 2024).

We collected data from Bosniaks, Chinese, Croats, Moroccans, Serbs, Spaniards, Turks, and U.S. Americans, since they vary in their temporal values and religious levels (see Callizo-Romero et al., 2020; Höllinger & Makula, 2021; Saroglou et al., 2003). Specifically, using data from the seventh wave (2017–2022) of the World Values Survey (Haerpfer et al., 2022), we examined the importance of religion among individuals aged 16 to 29 across cultures. Religiosity

ranked highest to lowest as follows: Moroccans, Turks, Serbs, Bosniaks, Croats, U.S. Americans, Spaniards, and Chinese. Agreement with the statement, "We depend too much on science and not enough on faith" (indicative of religious and past-focused cultural values), ranked Moroccans, Turks, Chinese, and U.S. Americans (no data for other cultures; see Tables S1 and S2). Based on correlations between religiosity and cultural values (Schwartz & Huismans, 1999), we grouped cultures into two clusters: traditional (more religious/traditional values) and progressive (less religious/more progressive values). This framework allows analysis of changes in religiosity, values, and time spatialization pre- versus during the pandemic, exploring whether pre-pandemic values shaped these shifts.

We collected data online during the COVID-19 regulations of spring and summer 2020, during or closely after the first total lockdown. Using the same tasks as in the pre-pandemic data collection, we measured religiosity, value temporal focus, and time spatialization (along with other dimensions; see Methods). Additional questions assessed concern about the pandemic's social crisis and compliance with restrictions. To address our research goals and hypotheses, we analyzed pre- and during-pandemic samples using two complementary approaches, reported as Studies '1' and '2'. Study 1 examined changes in religiosity, value temporal focus, and time spatialization by matching pre-pandemic and pandemic participants on culture, education, age, and sex.

Although this paper focuses solely on observed changes without examining underlying mechanisms, our interpretation (to be studied further) suggests that religious coping theories may provide context for understanding potential behavioral shifts. An increase in religiosity and a traditional temporal focus during the pandemic, compared to pre-pandemic data, might indicate a positive religious coping approach. Conversely, a decrease could signal a shift toward negative religious coping or secular strategies among young adults. Given the negative correlation between positive religious coping and age and the youth of our participants, we approached the analyses from the latter perspective, and therefore, the hypotheses were that the subsample collected during the pandemic would be less religious (hypothesis 1) and more future-oriented and less past-oriented (hypothesis 2) than the subsample collected before the pandemic. We also have predictions regarding how time spatialization should covary with any change in temporal values: an increase in

future focus should occur together with a greater tendency to place the future in front of oneself, while a decrease should go with a reduction in this preference or even a reversal (a tendency to place the past in front). Therefore, we also hypothesized (hypothesis 3) that the subsample collected during the pandemic would tend to represent the future as if it were in front of them to a greater extent than the subsample collected before the pandemic.

As any potential differences between the two subsamples in Study 1 could be due to factors other than the pandemic, in Study 2, we used the entire dataset of young participants collected during the pandemic (which was larger), from whom we had also measured the participant's psychological and behavioral responses to the pandemic. In Study 2, we hypothesized that the greater the psychological and behavioral responses to the pandemic, the lower the religiosity (hypothesis 4), the greater the future focus (hypothesis 5), and the greater the tendency to place the future in front (hypothesis 6). Finally, we explored whether or not there were differences between the traditional and the progressive cultural clusters.

Study 1

Methods

Transparency and Openness

We hereby assert that we here report how we determined our sample size and the criteria for post-data collection exclusion of participants, and we indicate all the tasks performed by the participants. All materials, datasets, and computer code (script) with detailed explanatory comments for the statistical analyses (developed in R version 4.1.1; see R Core Team, 2021) of Study 1 and Study 2 are publicly available at Open Science Framework (https://osf.io/htxck/; see Callizo et al., October 2024). The present work is fully reproducible using those materials. The studies reported here were not preregistered.

This study is part of the COVID-19 Time Project, which examines the pandemic's impact on various psychological temporal dimensions previously explored by our research group. Specifically, this research investigates the relationship between the pandemic, religiosity, value temporal focus, and time spatialization. It builds on a prior study testing the Temporal Focus Hypothesis (Callizo-Romero et al., 2020), which highlighted the role of value temporal focus in

shaping temporal spatialization across cultures and identified religiosity as an area for further exploration. Additionally, the COVID-19 Time Project has examined how the pandemic affects perceived asymmetry between the past and future in other temporal tasks (e.g., self-continuity, temporal distance, time discounting, and temporal depth) and their connections to value and personal temporal focus. Findings from this line of research, which follow a different prior study (Callizo-Romero et al., 2022), will be reported separately. This project received approval from the University of Granada Ethics Committee, and the authors report no competing interests.

Participants

As part of studies conducted before the pandemic (see Callizo-Romero et al., 2020), data from 1075 participants were collected (67% female; *mean age* = 21.37 years old, *SD* = 3.68, NA = 80; 96% university student). Most participants completed the study at their universities in exchange for academic credits. The samples were collected at seven different locations using paper and pencil questionnaires throughout three waves: 2015, 2016, and 2019: The Bosniak sample (*N* = 99) was collected in Tuzla (a Bosniak city from Bosnia and Herzegovina) in the second wave; the Chinese group (*N* = 96) was tested in Xuzhou (China), in the third wave; the Croatian sample (*N* = 99) was collected in Mostar (a Croat city from Bosnia and Herzegovina) in the second wave; the Moroccan group (total *N* = 142) was tested in Tetouan (*N* = 96) and Tanger (*N* = 46), both in Morocco and in the second wave; the Serbian sample (total *N*= 190) was collected in Banja Luka (a Serbian city from Bosnia and Herzegovina) in both the first wave (*N* = 96) and the second wave (*N* = 94); the Spanish sample was collected in Granada (Spain), both in the first (*N* = 96) and the second wave (*N* = 96); the Turkish sample (*N* = 96) was tested in Istanbul (Turkey), in the second wave; and the U.S. American sample was collected in Pittsburgh (USA) in both the first wave (*N* = 64) and the second wave (*N* = 96).

We set out the target sample size as 96 participants from each cultural group since this was double the minimum number (48) required for complete execution of the counterbalance of all the tasks that participants had to perform during the session (which included tasks not described here, some of which had several versions, see Methods). Note that the sample size *N* = 96 is greater than

the minimum required (67 per group) to find a medium effect size (d = .5) with 80% power and an alpha = .05 for comparing means between two independent groups.

During the pandemic, we conducted new data collection through an online survey distributed via university participant platforms and social networks. Most participants completed the study in exchange for academic credits, and two $50 raffles were held among participants. We collected a total sample of 893 young participants (684 females, 202 males, seven other, *mean age* = 21.94 years old, range 18-28) from the eight previous cultural groups: Bosniaks (N = 22), Chinese (N = 156), Croats (N = 76), Moroccans (N = 45), Serbs (N = 80), Spaniards (N = 384), Turks (N = 46), and U.S. Americans (N = 84). All participants from each cultural group completed questionnaires in the country/location corresponding to their cultural group: Bosniaks in the Bosniak part of Bosnia and Herzegovina; Chinese in China; Croats in either the Croatian part of Bosnia and Herzegovina or Croatia; Moroccans in Morocco; Serbs in either the Serbian regions of Bosnia and Herzegovina or Serbia; Spaniards in Spain; Turks in Turkey; and U.S. Americans in the U.S.

In Spain, data collection occurred between May 8th and 19th, 2020, during a total lockdown. Data from other cultural groups were collected between July 8th and 24th, 2020, when countries were under strict social restrictions (often total lockdown), and China had just emerged from a period of stringent measures (see Taylor, 2021, for a global timeline of the pandemic). We aimed to collect as many participants as possible in each cultural group, targeting a minimum equal to the pre-COVID-19 samples, though some groups did not meet this target. Data collection was stopped at the end of July when restrictions were eased in most places. No data were analyzed before concluding data collection.

After collecting participants in each location (associated with each cultural group) and period (pre- and during the pandemic), we applied inclusion criteria to assign participants to a specific cultural group. Participants had to meet at least two of the following three criteria: 1) being born in the country/location associated with their cultural group, 2) being a long-term resident in that location, and 3) speaking the official language of that country/location as their first or native language. While we also asked participants about their cultural identity, responses varied widely.

Some identified with their national identity (e.g., "American" for the U.S., "Spanish" for Spain), while others referenced regional identities, race, hobbies, or other categories. To address this variability, we broadened identity categories to include both general and specific identifiers relevant to each cultural context. However, since these identity categories were processed based on some assumptions, they were not used as inclusion criteria or variables for participant matching in the study.

Participants Matching

In Study 1, we compared participants collected before the pandemic with those collected during the pandemic in terms of religiosity, temporal values, and temporal spatialization. To achieve this, we matched participants from the two periods using random multilevel pairing within each cultural group based on age, sex, and education. We only included participants who passed the cultural affiliation filter and disclosed all matching criteria. This process resulted in 497 participants from the pre-COVID sample (21 Bosniaks, 87 Chinese, 48 Croats, 22 Moroccans, 63 Serbs, 175 Spaniards, 35 Turks, and 46 U.S. Americans) being matched with 497 participants from the post-COVID sample, with the same sample size for each culture as in the pre-pandemic sample.

To assess equivalence between matched samples collected before and during the pandemic, we compared pre- versus during-pandemic samples both overall and across different cultural groups in each matching variable (i.e., cultural identity, country of birth, country of residence, native language, age, and sex). The results showed a 98% match with the adequate self-reported cultural identity, 96% were born in the country of inclusion, 100% resided in that country, and 100% spoke its official native language. The pre-pandemic group's average age was 20.96, and the post-pandemic group's was 21.09, with 82% and 86% women, respectively. No significant differences were found in any demographic variable, suggesting no substantial changes between the samples collected before and during the pandemic ($p > .05$). Table S3 in the supplementary materials details the matched participants by time period and culture for relevant demographic variables and Figure S1 shows the percentages of religious affiliations per culture.

As the time spatialization task appeared at the start of the online survey, 106 participants in the COVID-19 group completed it but exited before filling out the value temporal focus and

religiosity questionnaires. To maximize the sample size for the time spatialization task, these participants were included in the matching process. Specifically, we added three matches from Chinese participants, 18 from Moroccans, nine from Croatians, and 17 from Serbs, resulting in a total of 544 participants for each testing period in this task. Details of the expanded sample matching are provided in the supplementary materials (see Table S4).

Cultural Clusters

To examine whether changes in religiosity, value temporal focus, and time spatialization followed different patterns in cultures that were more versus less religious and future- versus past-focused before the pandemic, we divided the cultures into two groups based on their pre-pandemic religiosity and temporal values, as indicated by our data. For religiosity, we compared each culture's level to the overall pre-pandemic mean of 3.30 (on a 1–5 scale; see Figure S2). This division resulted in two groups: more religious cultures (Moroccans, Bosnians, Croats, and Serbs, with religiosity significantly above the mean) and less religious cultures (Turks, Spaniards, and Chinese, with religiosity significantly below the mean). U.S. Americans were excluded from this contrast as their pre-pandemic religiosity was not statistically different from 3.30 (see Figure S2).

Secondly, to classify cultures based on value temporal focus, we grouped participants from cultures that emphasized past values over future values (i.e., with a Value Temporal Focus Index (VTFI) significantly below zero: Moroccans, Bosnians, Croats, and Serbs) and those that prioritized future values over past values (i.e., with a VTFI significantly above zero: Spaniards, Chinese, and Turks). U.S. Americans were excluded as their pre-pandemic VTFI was not significantly different from zero (see Figure S3 for pre-pandemic VTFI by culture). Notably, the past-focused cultures aligned with the most religious cultures (Moroccans, Bosnians, Croats, and Serbs), while the future-focused cultures matched the least religious cultures (Spaniards, Chinese, and Turks). These clusters will henceforth be referred to as the traditional cluster (past-oriented and more religious: Moroccans, Bosnians, Croats, and Serbs) and the progressive cluster (future-oriented and less religious: Spaniards, Chinese, and Turks).

Materials

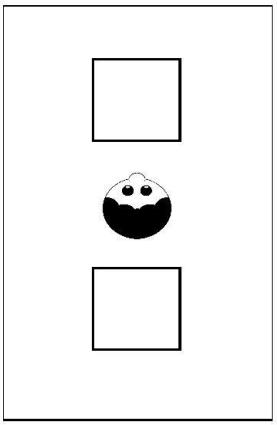
The tasks were translated into the language of each sample (Arab, Chinese, English, Serbo-Croatian, Spanish, and Turkish). Back-translation performed by professional bilingual researchers confirmed translation equivalence between different language versions. The following tasks were used (see Callizo-Romero et al., 2022 for other materials used in the project but not reported in this study).

Temporal Diagram Task. This task, developed by de la Fuente et al. (2014), assesses time spatialization—how individuals mentally represent the past and future along the sagittal axis from front to back of the self. Participants were shown a schematic drawing of a person's head from an overhead view, with one empty box in front and another behind (see Figure 1). They read a short story about a character (whose name was localized) who visited a friend who likes animals yesterday and plans to visit a friend who likes plants tomorrow. In the pre-COVID-19 paper-and-pencil version, participants had to place the initial letter of the word "Animal" (in their language) in the box representing the past and "Plant" in the box representing the future. In the online version used during the pandemic, participants first identified which box (front or back) corresponded to the object "Animal" and then did the same for "Plant." The task included four counterbalanced versions, varying the order in which the animal, the plant, the past, and the future, were mentioned in the story. Despite its simplicity as a binomial test, this task has demonstrated high diagnostic value (Callizo-Romero et al., 2020; de la Fuente et al., 2014).

It is worth noting that while the reading direction of participants' languages—Chinese, English, Serbo-Croatian, Spanish, and Turkish (left-to-right) and Arabic (right-to-left)—influences time spatialization along the lateral axis (Ouellet et al., 2010), there is no evidence to date suggesting that reading direction affects temporal spatialization on the sagittal (front-to-back) axis, which is the focus of this study.

Figure 1

Image Used in the Temporal Diagram Task



Temporal Focus Questionnaire. We measured participants' value temporal focus using the Temporal Focus Questionnaire developed by de la Fuente et al. (2014) and adapted by Callizo-Romero et al. (2020). This scale assesses the balance of importance people place on past-related (traditional) versus future-related (progressive) cultural values. Callizo-Romero et al. (2022) distinguished this operationalization, termed "value temporal focus," from "personal temporal focus," which measures the attention and thought devoted to one's personal past and future. The scale comprises 20 items: 10 reflecting past-related values (e.g., "For me, traditions and old customs are very important") and 10 reflecting future-related values (e.g., "It is important to innovate and to adapt to changes"). Participants rated their agreement with each item on a scale from 1 (total disagreement) to 5 (total agreement). Due to an error, the American version in the first wave and the Turkish version in the second wave pre-COVID sample used a 9-point scale, which was later converted to a 1-5 range. Item presentation varied across waves. In the first wave, items were presented randomly, while in the second and fourth waves, they alternated strictly between past and future items, as in de la Fuente et al. (2014). In the third wave, an alternating order was used with two exceptions caused by an experimenter error, where two items switched positions.

Regarding psychometric characteristics, McDonald's omega (ω) indicated acceptable internal consistency for the TFQ. For the pre-pandemic sample, ω = .86 (past) and ω = .73 (future), while for the during-pandemic sample, ω = .88 (past) and ω = .75 (future). Omega was used as a more reliable measure than Cronbach's alpha (Hayes & Coutts, 2020). A Confirmatory Factor

Analysis (CFA) showed a poor fit for the theoretical structure ($CFI \approx 0.55$), indicating configural invariance between cultural clusters cannot be assessed.

Religiosity Questionnaire. We used the Religiosity Questionnaire by Cohen et al. (2003), comprising three scales measuring religious belief, practice, and knowledge. The belief scale assesses agreement with six statements (e.g., "I believe in God") on a 1-5 scale, excluding an item on reincarnation as it is not central to most studied religions. The practice scale evaluates the importance of seven religious practices (e.g., "Attending religious services regularly") on a 1-5 scale. The knowledge scale measures understanding of three aspects of one's religion (e.g., "The structure and content of religious services") on a 1-5 scale. Due to a technical error, U.S. data (first wave) and Bosnian data (first and second waves) used a 0-5 scale, which was converted to a 1-5 range.

McDonald's omega (ω) indicated strong internal consistency for the belief, practice, and knowledge scales, as well as the overall scale: $\omega = .95$, $\omega = .93$, $\omega = .93$, and $\omega = .96$ (pre-pandemic) and $\omega = .95$, $\omega = .92$, $\omega = .95$, and $\omega = .97$ (during-pandemic). A CFA supported the questionnaire's three-factor structure (knowledge, practice, and belief) across all subsamples. Configural invariance was achieved across the two cultural clusters, with fit indices slightly below the ideal range ($.85 < CFI < .89$). However, consistent item-factor loadings confirmed that both clusters interpreted the constructs similarly, ensuring measurement stability.

Procedure

Pre-COVID-19 data were collected in university facilities using paper and pencil. Participants completed a leaflet containing instructions, a consent form, and a series of tasks in a fixed order: demographic questionnaire, one of four versions of the Temporal Diagram Task, additional tasks (not used in this study), the Temporal Focus Questionnaire, and the Religiosity Questionnaire. Instructions emphasized completing tasks sequentially without turning pages prematurely, with warnings repeated on each page. The Temporal Focus Questionnaire and Temporal Diagram Task data from this sample were previously analyzed by Callizo-Romero et al. (2020, 2022), but the Religiosity Questionnaire data are reported here for the first time. During the pandemic, data were collected online using LimeSurvey, maintaining the same task order as the

pre-COVID-19 sample. Pandemic-related concern items (described in Study 2) were added after the socio-demographic section. The study includes new data from all three tasks collected during the pandemic.

Data Processing and Analysis Plan

The ratings of the past and future scales of the TFQ were averaged per participant and combined to create the VTFI following the formula proposed by de la Fuente et al. (2014): index = [mean of future items – mean of past items] / [mean of future items + mean of past items]. For each participant, this VTFI expressed the asymmetry between agreement with past-related (tradition) and future-related (progress) values on a scale from −1 (strong past focus) to +1 (strong future focus). Thus, positive scores indicated a future value focus and negative scores indicated a past value focus.

We also created three indexes by averaging the items of the three subscales from the Religiosity Questionnaire: belief, practice, and knowledge. We then computed a general religiosity index by averaging the indexes from the three subscales (which were strongly correlated to each other: $.54 < \tau b < .65$, $p < .001$ in all cases). Finally, in the Temporal Diagram Task, placing the future event in the front box was coded as '1' and in the back box as '0'. We used the following criteria for post-data collection exclusion of participants: Participants who left four or more items blank in either the Temporal Focus Questionnaire ($N = 196$) or the Religiosity Questionnaire ($N = 210$), or who placed both the past and future event in the same box in the Temporal Diagram Task ($N = 38$), were filtered out before matching the samples collected before and during the pandemic.

The data did not follow a normal distribution. Lilliefor tests revealed deviations from normality in both VTFI and the religiosity index across the overall samples (pre- and during COVID-19) and in both cultural clusters. To visually assess normality, we created histograms and Q-Q plots (see Figure S4, supplementary materials) and analyzed skewness and kurtosis indices. All samples showed deviations from normality, particularly the religiosity index of the traditional cluster pre-pandemic group, which had skewness = 1.09 and kurtosis = 3.19, indicating a right-skewed distribution with heavier tails. Consequently, we used non-parametric statistical analyses for this study.

In Study 1, we compared (using the Mann-Whitney tests and the Chi-square test of independence) the scores of the pre-COVID-19 group versus the during-COVID-19 group across all religiosity subdimensions (belief, practice, and knowledge) and the overall index, the value temporal focus subdimensions (past focus and future focus) and the overall index, as well as time spatialization (proportion of future in front). The analyses are reported below for both the overall sample and each cultural cluster.

Results

Mann-Whitney comparisons for independent samples showed that participants during the pandemic (as compared to those assessed before) scored lower in the overall religiosity index ($p <$ .001; see Figure 2; the results pooling all cultural groups together, are shown under the "overall" label). Figure S5a (supplementary materials) shows that this occurred across all three dimensions of religiosity—knowledge, practice, and belief (in all cases, $p < .001$). They also agreed less with traditional values and more with progressive values, increasing scores on the VTFI, which indicated a greater future focus ($p < .001$; see Figure 2). In addition, Table S5-S14, supplementary materials, shows all the numeric results. Finally, a chi-square test of independence of the Temporal Diagram Task showed that people during the pandemic were more likely to represent the future in front than before the pandemic, X^2 (1, N = 1086) = 8.07, $p < .01$, OR = 1.44 *95% CI* = [1.12, 1.86]. The effect size of differences in religiosity and temporal values ranged from medium to large, and for time spatialization, it was small (the rank biserial correlation, *rrb*, is the effect size associated with the Mann-Whitney test for independent samples; *rrb* values of 0.1, 0.2, and 0.4 represent small, medium and large effect sizes, respectively; see McGrath, & Meyer, 2006).

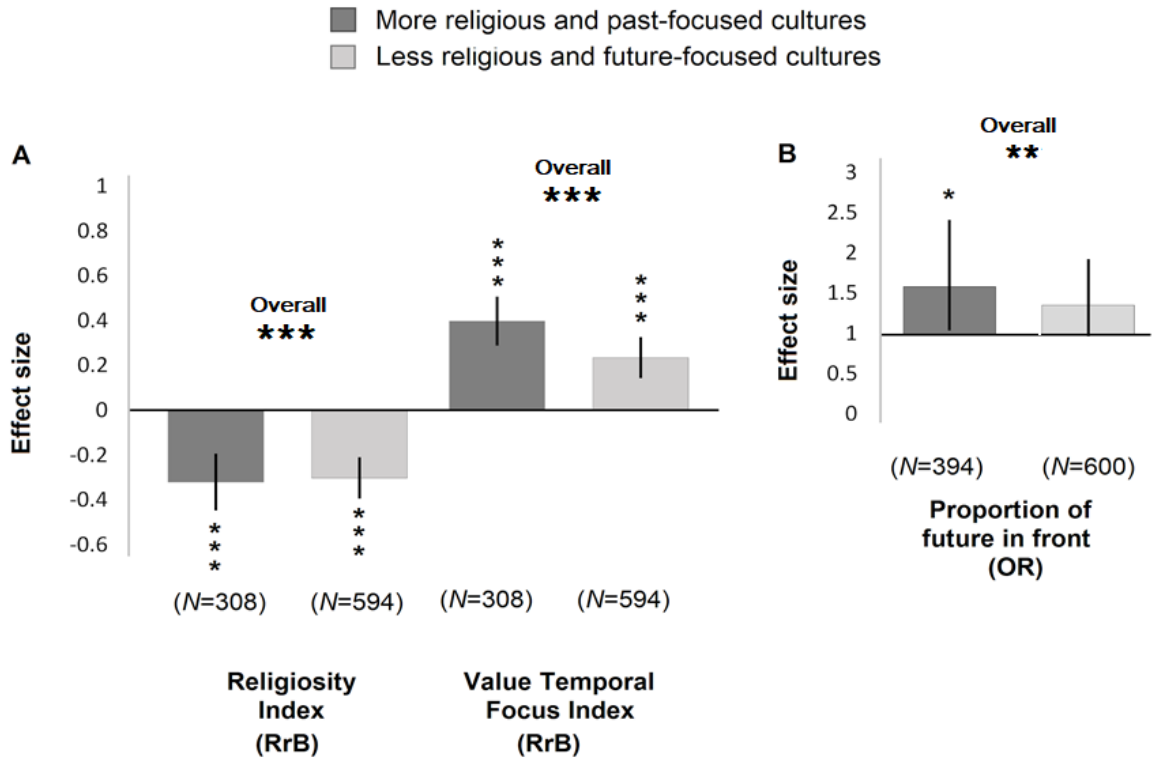
We also conducted the same analyses but excluded all participants who were non-believers or agnostics to verify that the inclusion of these participants did not alter the results. The adjusted sample sizes were 324 participants for the pre-COVID group and 279 for the during-COVID group, maintaining statistical power above 80% for calculating the religiosity index and VTFI. The results were consistent with those obtained using the sample with non-religious people: compared to the pre-pandemic group, the during-pandemic group showed significantly lower levels of religiosity and higher levels of VTFI ($p < .01$ in both cases). The effect of time spatialization was also in the

same direction, but the result was only marginally significant (p = .09), likely due to the reduced statistical power, as its effect size was smaller than the effects of religiosity and value temporal focus.

The contrast between the samples collected before versus during the pandemic in all three measures was always in the same direction in both cultural clusters: the progressive cluster and the traditional cluster. It was significant in all cases, with the exception of the progressive cluster in the time spatialization measure (see Figure 2 and Tables S15-S18, supplementary materials, for test results). The effect sizes did not differ significantly between the two cultural clusters in any measure (see Figure 2 and Tables S17 and S18, supplementary materials).

Figure 2

Effect Sizes for Religiosity and VTFI (A) and Time Spatialization (B), Both Overall and in Comparisons Between Samples Collected During and Before the COVID-19 Pandemic in Both Cultural Clusters



Note. The effect sizes for the Religiosity and VTFI are estimated by the Rank Biserial Correlation and for the proportion of participants who place the future in front by the Odds Ratio.

*Time spatialization indicates the proportion of participants representing the future in front. *The *N*s show the total sample size in each index and cultural cluster. Half of each sample size corresponds to the sample collected before the pandemic, and the other half to the sample collected during the pandemic.

*The error bars show the 95% confidence interval of the effect size. Statistically significant results are marked with asterisks: * $p < .05$, ** $p < .01$, *** $p < .001$.

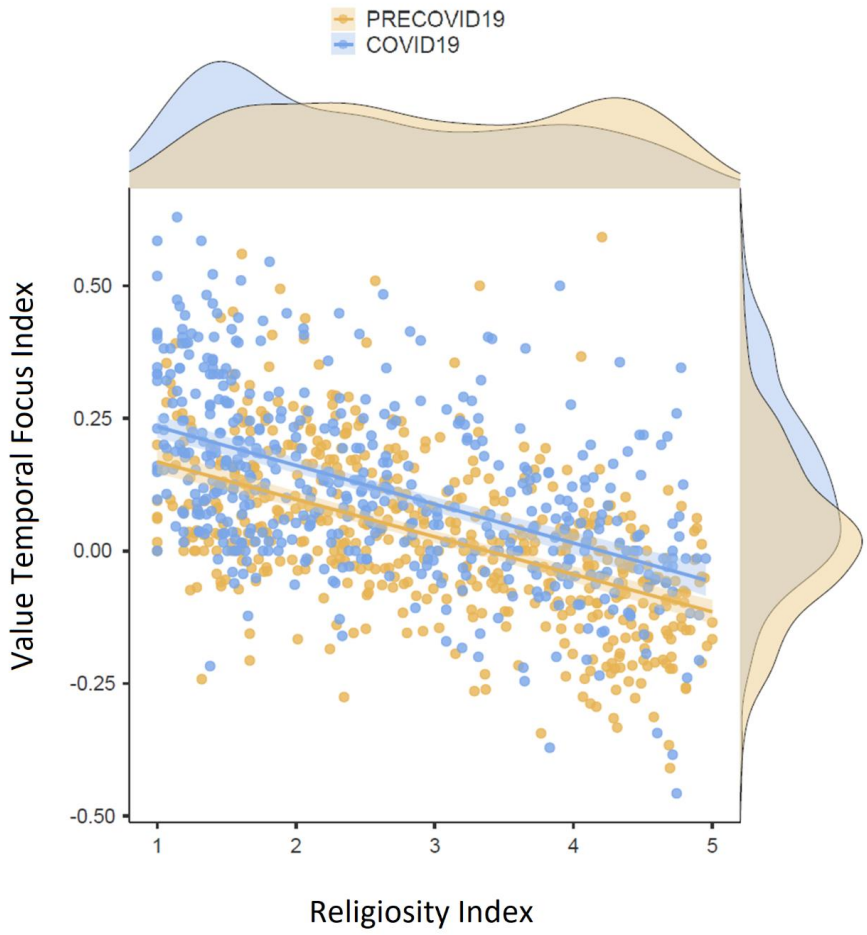
We also analyzed the contrast within each culture, which showed that the same differences were observed in the same direction as in the overall and cluster analyses, both for the religiosity

index and VTFI (see Figure S5b; see Tables S5-S14, supplementary materials, for the numerical results of all indexes and subscales in each culture). For time spatialization, the analyses across cultures found an increased tendency to place the future in front compared to before the pandemic, but this difference was statistically significant only in Croats and Chinese ($p < .05$; figure S6 in the supplementary material shows the effect sizes, Odds Ratios, within each culture). However, due to the small sample sizes in several groups, the group-wise results should be interpreted with caution.

For correlation analyses, we used Kendall's Tau-b, a nonparametric correlation measure that deals with the possibility of tied scores. The correlation between the religiosity index and the VTFI (Figure 3) was statistically significant in both testing periods: before ($N = 497$), $\tau b = -.38$, $p < .001$, and during the pandemic ($N = 497$), $\tau b = -.35$, $p < .001$. According to Fisher's Z, the difference of those correlations in both testing periods was not statistically significant from each other, $Z = .36$, $p = .72$. Furthermore, age significantly and positively correlated with religiosity in both the pre-pandemic sample ($\tau b = .24$; $p < .001$) and in the pandemic sample ($\tau b = .11$; $p < .001$); and negatively with the VTFI in the pre-pandemic sample ($\tau b = -.13$; $p < .001$), but not in the pandemic sample.

Figure 3

Correlations Between the Religiosity Index and the VTFI in the Samples Collected Before and During the COVID-19 Pandemic



Note. Each dot represents the score of a subject in the studied variables, with scores from the pre-pandemic sample shown in yellow and those from during the pandemic sample in blue. The regression line and its standard error are shown for each testing period. The distribution density of each variable is shown in the margins.

Study 2

Study 2 was designed to complement Study 1 by addressing the possibility that factors other than the pandemic influenced the differences observed in the matched subsamples. For this purpose, we analyzed the full dataset of young participants collected during the pandemic, including their psychological and behavioral responses to the crisis. Based on Study 1's findings,

we hypothesized that during the pandemic, individuals more concerned about COVID-19 and those who adhered more strictly to social regulations would exhibit reduced religiosity, increased future-focused cultural values, and a tendency to represent the future in front. Since participants from different cultures displayed similar patterns in Study 1, Study 2 focused on overall relationships between pandemic concerns and the variables studied rather than on intercultural differences.

Methods

Participants

In Study 1, we analyzed data from a subsample of 497 participants collected during the pandemic, matched with an equal number of pre-pandemic participants. Study 2 expanded the analysis to include the entire sample of young participants (ages 18–28) collected during the pandemic. Participants completed the questionnaire in their assigned cultural group's location, adhering to the same cultural inclusion criteria as Study 1: being born in, being a long-term resident of, or speaking the native language of the associated country/region. Those who did not meet at least two of these criteria were excluded (N = 70), resulting in a final sample of 893 participants: 22 Bosniaks, 156 Chinese, 76 Croats, 45 Moroccans, 80 Serbs, 384 Spaniards, 46 Turks, and 84 U.S. Americans. The mean age was 21.94, with 77% women and 80% students. Only 1% were infected with COVID-19 during the survey, and 3% experienced complete social isolation during the first lockdown. Participants scored highly on cultural identity variables, with group assignments matching self-reported identity in 99% of cases, native language in 100%, country of birth in 98%, and residence in 100%. Religious affiliations, overall and per cultural group, are illustrated in Figure S7 (supplementary materials), and Table S19 provides detailed demographic information (cultural identity, birth, residence, language, sex, and age) for each culture.

Materials and Procedure

Study 2 analyzes data collected during or shortly after the first COVID-19 confinement, using the same materials and procedures as Study 1 for the pandemic group. The TFQ showed acceptable internal consistency (ω = .88 for past-related items, ω = .76 for future-related items), but a CFA indicated its theoretical structure was not supported. The Religiosity Questionnaire demonstrated strong internal consistency (ω = .94 for belief, ω = .91 for practice, ω = .95 for

knowledge, ω = .97 overall), and its theoretical structure and configurational invariance were confirmed (*CFI* = .90). Participants who placed past and future events in the same box in the Temporal Diagram Task (N = 38) were excluded. The online format required all questionnaire items to be completed before continuing, so no responses were left blank. However, 91 participants exited before completing the TFQ, and five exited before the Religiosity Questionnaire, resulting in 96 dropouts.

In Study 2, we also included seven items (COVID-19 items) to assess concerns about the pandemic and awareness of restrictions. These items addressed personal and social concerns, including mood, boredom, changes in daily activities, social concern about the pandemic, strict compliance with regulations, the estimated timeline for a return to normalcy, and perceptions of changes in personal and societal life (see Table S20, supplementary materials). All participants completed the COVID-19 items, but 4% of responses to the item on returning to regular life were excluded due to a mistakenly included open-response option.

We submitted the COVID-19 items to a principal component analysis to assess their two main dimensions, using the 'oblimin' rotation and the pattern matrix. This analysis revealed two main components (see supplementary materials, Table S21): 1) a personal concern component, including measures of mood, boredom, and changes in the frequency of daily events (all factors loaded with a minimum weight of 0.52); and 2) a social concern component, which includes measures of concern on social situation, strict compliance of regulations, and estimations of baking to a regular life (all components loaded with a minimum weight of 0.48). The 'change perception' item was loaded on both components. Two indexes were created by averaging the items of each component, along with an overall COVID-19 concern index calculated by averaging all COVID-19 items. The mood and changes in the frequency of daily events items, which negatively correlated with the rest, were reversed before computing the indexes.

Analysis plan

The Lilliefors test indicated significant deviations from normality for the VTFI and religiosity index in the overall sample and across cultural clusters ($p < .001$ in all cases; see Table S22, supplementary materials). Skewness, kurtosis, and visual assessments (histograms

and Q-Q plots) confirmed the findings. The progressive cluster's religiosity index showed notable deviations (skewness = 1.20, kurtosis = 0.97), while the traditional cluster's VTFI indicated heavier tails (skewness = 0.20, kurtosis = 0.63). Visual assessments supported these results (Figure S8, supplementary materials), leading to the use of non-parametric analyses in Study 2.

We reported analyses describing relations (using Kendall's *Tau-B* Correlation Coefficients and binary logistic regressions) between the psychological concern of the pandemic, as measured by the COVID-19 Overall Concern Index and the two COVID-19 factors (personal and social concern), with VTFI, religiosity index, and temporal spatialization in the overall sample (see Figure S9 and S10, supplementary materials, for a detailed item-wise analysis).

Results

We correlated**,** using Kendall's Tau-B correlation coefficients, the three indexes measuring the COVID-19 psychological concern (i.e., the overall, personal, and social concern indexes) with the religiosity index, VTFI, and the proportion of future in front. The results are shown in Table 1. First, as in the smaller subsample of Study 1, the religiosity index and VTFI correlated negatively. Centrally, all three COVID-19 indexes were negatively correlated with the religiosity index and positively correlated with the VTFI: participants reporting greater psychological concern and awareness about the pandemic and engaging in more behaviors aimed at its resolution had lower religiosity and were more future-oriented. The effect sizes of all these correlations were small, except for the correlation between religiosity and VTFI, which was large (note that Kendall's Tau-B effect size corresponds to larger effect sizes when converted to Pearson's *r* or Spearman's *r*, see Gilpin, 1993). There were no significant differences between the size of the correlations between the personal and social concern indexes with the religiosity index, $Z = .84$, $p = .40$, and the VTFI, $Z = -.35$, $p = .73$. Thus, both the personal and social-concern pandemic's dimensions were related to religiosity and value temporal focus to a similar extent. Furthermore, age correlated positively with religiosity ($\tau b = .06$; $p = .02$), but not with VTFI.

Table 1

Kendall's Tau-B Correlation Coefficients Between the COVID-19 Overall, Personal, and Social Concern Indexes With the Religiosity Index, the VTFI, and the Proportion of Future in Front

	Religiosity Index	**Value Temporal Focus Index**	**Proportion Future in Front**
Personal Concern Index	-.06* *N*= 797	.08** *N*= 802	.08*** *N*= 855
Social Concern Index	-.08*** *N*= 797	.09*** *N*= 802	.05 *N*= 855
Overall Concern Index	-.07** *N*= 797	.09*** *N*= 802	.07* *N*= 855

Note. *Statistically significant results are marked with asterisks: *$p < .05$, ** $p < .01$, *** $p < .001$.

We also assessed the relationship between time spatialization and the rest of the variables using binary logistic regressions. Placing the future in front was predicted by both the COVID-19 overall concern index, Wald $\chi 2 = 6.64$, $p = .01$, $OR = 1.42$, 95% CI = [1.09, 1.86], and the personal concern index, Wald $\chi 2 = 8.55$, $p < .01$, $OR = 1.30$, 95% CI = [1.12, 1.72], but not by the social concern index, Wald $\chi 2 = 2.02$, $p = .16$, $OR = 1.20$, 95% CI = [0.94, 1.44].

Discussion

In the present work, we studied the relationship between the arrival of the COVID-19 pandemic and its associated social restrictions (mainly total lockdown) and the changes in religiosity, value temporal focus, and time spatialization in young people across cultures. These cultures were divided into two cultural clusters: the traditional cluster (with cultures prioritizing past cultural values and being highly religious) and the progressive cluster (with cultures emphasizing future-oriented values and being less religious). To this end, we conducted two studies.

Study 1 confirmed the strong negative relationship between religiosity and value temporal focus and showed that young people tested during the first period of severe social restrictions were

less religious (hypothesis 1), more future-focused in cultural values— i.e., more oriented to progress than tradition — (hypothesis 2), and represented the future in front of them in a greater proportion (hypothesis 3) than young people tested before the arrival of the pandemic. Although these results are consistent with the effect of the pandemic, there are at least two alternative potential causes for those differences between the samples collected before and during the pandemic, as shown below.

First, the pre-COVID-19 group was tested in the lab using paper and pencil, whereas the COVID-19 group was tested using an online survey. One possible cause of the findings in Study 1 might be that less religious and more future-focused individuals were more likely to take online surveys during confinement because of their greater use of technologies than the more religious and past-focused individuals. We call this possibility the *online-preference hypothesis*. Second, the pre-pandemic samples were collected four or five years (except the Chinese sample, which was collected only one year) before the pandemic. This opens the possibility that the effects we have found are just the result of the mere passage of time, perhaps due to the ongoing secularization process, which makes people (especially young adults) become less religious and traditional in many cultures (Inglehart, 2021; Norris & Inglehart, 2011; Pew Research Center, 2018). We call this possibility the *secularization-drift hypothesis*.

To rule out these alternative accounts, we conducted Study 2 using the total pandemic sample. Since both explanations suggest changes unrelated to the pandemic, we examined their relationship with individuals' psychological concerns about the pandemic. Two components emerged: personal and social concern, for which we created separate indices and an overall concern index averaging all items. Against predictions from both the online-preference and the secularization-drift hypotheses, all three indexes were negatively associated with religiosity (hypothesis 4) and positively associated with value temporal focus (hypothesis 5). Moreover, both the overall and the personal indexes correlated positively with placing the future in front (hypothesis 6).

While correlational designs cannot establish causation, the combined results of Study 1 and Study 2 strengthen the case for the pandemic influencing changes in religiosity, temporal values,

and time spatialization. The findings suggest that during the pandemic, young people across cultures may have reduced their religiosity, shifted focus toward future-related values, and increasingly represented the future as being in front, consistent with the TFH (Callizo-Romero et al., 2020; de la Fuente et al., 2014). Regarding cross-cultural differences, the data showed that changes in religiosity, value temporal focus, and time spatialization occurred in the same direction across both highly religious and less religious cultural clusters, with no significant differences in effect sizes. However, caution is warranted due to differences in baseline levels of religiosity and value temporal focus, which could amplify minor changes and introduce measurement bias (McGrath & Meyer, 2006). Thus, while effect sizes appear consistent across clusters, differing baselines may impact their equivalence.

Why would young adults shift their focus toward progress and technology while moving away from religion and tradition during the pandemic? This question remains open, as the present study did not investigate underlying mechanisms. However, speculative explanations suggest that young adults may have adopted a negative coping strategy (Ahmadi & Ahmadi, 2015; Prati & Pietrantoni, 2009), reducing reliance on religion while strengthening secular approaches. These include greater dependence on future-oriented solutions, such as medical, technological, and epidemiological developments (e.g., vaccines, diagnostic tests, and social restrictions) as means to overcome the pandemic (Galang, 2021; Schnabel & Schieman, 2021). Trust in scientific advancements has been negatively associated with religiosity and conservatism during the pandemic (Plohl & Musil, 2021), while skepticism toward science has been linked to reduced compliance with COVID-19 policies (Brzezinski et al., 2021). Supporting this, Study 2 found that higher concern for the pandemic and adherence to social restrictions correlated with decreased religiosity, increased emphasis on progressive values over traditional ones, and a stronger tendency to represent the future in front. In the next section, we compare these findings with other research on changes in religiosity, temporal focus, and time spatialization during the pandemic.

Comparison with Other Studies on Religiosity During the COVID-19 Pandemic

While other studies suggested that the arrival of the pandemic boosted the religiosity of older and more religious people (e.g., Ganiel, 2021; Meza, 2020; Molteni, 2021; Pew Research

Center, 2020b; Thomas & Barbato, 2020), present results suggested that it may have had the opposite effect on young people. In this line, a study has also shown that contrary to what was shown in the general population by other studies, young people in Poland (a country with a high religiosity level) considered themselves to be less religious because of the pandemic (Dobosz et al., 2022). Also, when analyzing the data pool collected by the Pew Research Center (2020b) in March 2020, we observed that among non-religious U.S. Americans, young adults (18-29 years old), compared to older people, were the least likely to associate the arrival of the pandemic with becoming religious; and among religious U.S. Americans, young adults were the group that least felt that the pandemic strengthened their faith. They were also the least likely to pray for the end to the spread of coronavirus and to engage with religious services during the coronavirus outbreak.

Why did these changes occur? Since this study does not examine the mechanisms underlying the observed changes during the pandemic, we cannot draw definitive conclusions. However, age and generational factors may help explain these findings (Bengtson et al., 2015). When compared with studies on older populations, our data reveal different patterns, suggesting that younger participants may favor secular coping strategies over religious ones. This is supported by the positive correlation between age and religiosity observed in both studies. Moreover, the generational cohort of the participants is crucial to understanding their responses to significant sociohistorical events like the pandemic (Bengtson et al., 2015). Most of our participants belong to late Millennial and early Gen Z cohorts, which are characterized by lower religiosity and a stronger reliance on secular strategies. These generational traits may explain the shift toward progressive values and greater trust in scientific and technological advancements. So, age and generational factors could shape how individuals respond to sociohistorical events such as the pandemic, highlighting the need for further research on these impacts across different generations.

Comparison with Other Studies on Temporal Focus and Time Spatialization During the COVID-19 Pandemic

Our findings contrasted with Li and Cao's (2021) findings, who observed that a reminder of the COVID-19 threat increased both having a past temporal focus (pattern also suggested by Yeung et al., 2020) and representing the past in front of self among Chinese participants. At least

two main explanations for this contrast are possible. The first possibility is that Li and Cao (2021) operationalized temporal focus as personal temporal focus (i.e., the attention and thought given to the personal past vs. future) using the Temporal Focus Scale developed by Shipp et al. (2009) instead of the Temporal Focus Questionnaire that was used here to measure value temporal focus. As shown by Callizo-Romero et al. (2022), both measures may dissociate.

Conveniently, the COVID-19 Time Project, in which the present work was carried out, collected data on personal temporal focus (using the Temporal Focus Scale) for a different research goal (see Methods section). Correlation matrices in the supplementary materials (Tables S23 and S24) examined relationships between the three COVID-19 indexes, a personal temporal focus index (computed similarly to the VTFI), and the proportion of future-in-front responses in the Chinese (Table S23) and overall samples (Table S24). Contrary to Li and Cao (2021), we found a significant positive correlation between the COVID-19 social and overall concern indexes and personal temporal focus in the Chinese sample ($p < .03$, $N = 130$; see Table S23), but no other significant correlations. In the overall sample, no correlations were significant (see Table S24). These results indicated that greater pandemic concern was linked to a stronger personal future focus in Chinese participants (only), inconsistent with Li and Cao (2021), ruling out this first possibility.

The second possibility is that the Chinese participants in Li and Cao (2021) were older (median age: 38.2) than in our study (mean age: 19.96). Because older individuals are more likely to focus on the past and to represent the past in front of them (de la Fuente et al., 2014), and given that age seems to be a key factor in how individuals respond to the onset of the pandemic, this might contribute to differences between their findings and ours.

Limitations

Our study faced two main limitations: data representativeness and the validity of the temporal focus measure. Regarding representativeness, our findings allow inferences at the cultural cluster level but lack precision for individual cultures due to small sample sizes in some groups (e.g., Moroccans and Bosniaks), constrained by pandemic-related data collection challenges. This reduced statistical power for single-culture analyses: In Study 1, sufficient power (80%) was

achieved only for cross-cultural comparisons between large groups ($N > 307$), specifically the traditional and progressive clusters, while single-culture analyses required larger samples to detect effects reliably. In Study 2, detecting the largest observed effect size (Kendall's *Tau-B* = .09) required at least 313 participants per culture for 80% power. Thus, our inferences are restricted to cultural clusters and general patterns rather than individual cultures.

Secondly, as the participants were primarily university students or graduates, the findings may not fully generalize to the broader youth population. Education level, which is negatively correlated with religiosity across cultures (Schwadel, 2015), could influence the dimensions examined in this study. Educational attainment also varies across cultures, potentially affecting the representativeness of some countries more than others. For example, World Bank (2024) data from 2018–2020 show disparities in the percentage of the population aged 25+ with at least short-cycle tertiary education: 13% in Bosnia and Herzegovina, 24% in China, 33% in Spain, 21% in Turkey, and 48% in the U.S., with no data available for Morocco. Thus, our findings are generalizable to young, educated populations in the traditional and progressive cultural clusters but may not apply to less-educated groups or specific national contexts.

Lastly, the lack of support for the theoretical factorial structure of the TFQ, which assesses value temporal focus, highlights a psychometric limitation that must be considered when interpreting the findings. However, despite this issue, the TFQ effectively supported our hypothesis and aligns with prior research employing this measure. While the absence of a clear factorial structure introduces noise, the TFQ still seems to capture relevant aspects of value temporal focus across clusters, suggesting it retains sufficient sensitivity to detect meaningful variance in this construct. In contrast, the Religiosity Questionnaire and COVID scale showed strong factorial validity, limiting concerns to the TFQ. Thus, only TFQ-related results should be interpreted with caution.

Conclusion

In conclusion, the present findings advanced knowledge about the changes that could occur in young people's religiosity, temporal values, and time spatialization during the COVID-19

pandemic and its consequent social restrictions. During the first stage of pandemic social restrictions (mainly total lockdowns), young educated adults from cultures that varied widely in their pre-pandemic religiosity and temporal values were less religious, more focused on future-related than past-related values, and represented the future in front of them to a greater extent than matched young adults collected before the pandemic. Moreover, during the pandemic, young adults who were more psychologically concerned about the social situation also showed less religiosity, a stronger future focus on their temporal values, and a greater tendency to represent the future in front of them.

Our findings have theoretical implications for the psychology of religion. Firstly, our results suggest that age and generational differences may influence religious coping strategies among young people from diverse cultures with varying socio-religious contexts, although this was not measured and remains a possible interpretation. Secondly, shifts in religiosity during crises may reflect broader cultural responses, including the emphasis on specific time-related cultural values and their association with cognitive aspects such as time spatialization.

The COVID-19 crisis appeared *deus ex machina*, which literally means “god from the machine.” While other studies that focused on older populations have shown an increase in the number of participants who sought god in facing the pandemic, our results suggest that young, educated individuals across cultures paid more attention to the *machina* than to *deus*.

References

Ahmadi, N., & Ahmadi, F. (2015). The use of religious coping methods in a secular society: A survey study among cancer patients in Sweden. *Illness, Crisis & Loss, 25*(3), 171–199. https://doi.org/10.1177/1054137315614513

Ano, G. G., & Vasconcelles, E. B. (2005). Religious coping and psychological adjustment to stress: A meta-analysis. *Journal of Clinical Psychology, 61*(4), 461-480. https://doi.org/10.1002/jclp.20049

Areba, E. M., Duckett, L., Robertson, C., & Savik, K. (2018). Religious coping, symptoms of depression and anxiety, and well-being among Somali college students. *Journal of Religion and Health, 57*, 94–109. https://doi.org/10.1007/s10943-017-0359-3

Bengtson, V. L., Silverstein, M., Putney, N. M., & Harris, S. C. (2015). Does religiousness increase with age? Age changes and generational differences over 35 years. *Journal for the Scientific Study of Religion, 54*(2), 363-379. https://doi.org/10.1111/jssr.12183

Bentzen, J. S. (2021). In crisis, we pray: Religiosity and the COVID-19 pandemic. *Journal of Economic Behavior & Organization, 192*, 541-583. https://doi.org/10.1016/j.jebo.2021.10.014

Brzezinski, A., Kecht, V., Van Dijcke, D., & Wright, A. L. (2021). Science skepticism reduced compliance with COVID-19 shelter-in-place policies in the United States. *Nature Human Behaviour, 5*(11), 1519-1527.

Callizo, C., Casasanto, D., Chahboun, Göksun, T., Gu, Y., Kranjec, A., Ouellet, M., S Tutnjević, S., Santiago, J. (October 2024). Deus ex machina: The COVID-19 pandemic and young adults' religiosity, value temporal focus, and time spatialization across cultures. https://doi.org/10.17605/OSF.IO/HTXCK

Callizo-Romero, C., Tutnjević, S., Pandza, M., Ouellet, M., Kranjec, A., Ilić, S., Gu, Y., Göksun, T., Chahboun, S., Casasanto, D., & Santiago, J. (2020). Temporal focus and time spatialization across cultures. *Psychonomic Bulletin and Review, 27*(6), 1247–1258. https://doi.org/10.3758/s13423-020-01760-5

Callizo-Romero, C., Tutnjević, S., Pandza, M., Ouellet, M., Kranjec, A., Ilić, S., Gu, Y., Göksun, T., Chahboun, S., Casasanto, D., & Santiago, J. (2022). Does time extend asymmetrically into the past and the future? A multitask cross-cultural study. *Language and Cognition*, *14*(2), 275-302. https://doi.org/10.1017/langcog.2022.5

Carver, C. S., Scheier, M. F., & Weintraub, J. K. (1989). Assessing coping strategies: A theoretically based approach. *Journal of Personality and Social Psychology, 56*(2), 267–283. https://doi.org/10.1037/0022-3514.56.2.267

Casasanto, D., & Jasmin, K. (2012). The hands of time: Temporal gestures in English speakers. *Cognitive Linguistics*, *23*(4), 643-674. https://doi.org/10.1515/cog-2012-0020

Cheng, C., & Ying, W. (2023). A meta-analytic review of the associations between dimensions of religious coping and psychological symptoms during the first wave of the COVID-19 pandemic. *Frontiers in Psychiatry*, *14*, 1097598. https://doi.org/10.3389/fpsyt.2023.1097598

Cohen, A. B., Siegel, J. I., & Rozin, P. (2003). Faith versus practice: Different bases for religiosity judgments by Jews and Protestants. *European Journal of Social Psychology*, *33*(2), 287–295. https://doi.org/10.1002/ejsp.148

Counted, V., Pargament, K. I., Bechara, A. O., Joynt, S., & Cowden, R. G. (2022). Hope and well-being in vulnerable contexts during the COVID-19 pandemic: Does religious coping matter? *The Journal of Positive Psychology*, *17*(1), 70-81. https://doi.org/10.1080/17439760.2020.1832247

de la Fuente, J., Santiago, J., Roman, A., Dumitrache, C., & Casasanto, D. (2014). When you think about it, your past is in front of you: How culture shapes spatial conceptions of time. *Psychological Science*, *25*(9), 1682-1690. https://doi.org/10.1177/0956797614534695

Dobosz, D., Gierczyk, M., Janiak, A., Piasecki, D., & Rajba, B. (2022). Transformations of Religiosity during the SARS-CoV-2 Pandemic—On the example of Catholic religious practices of Polish students. *Religions*, *13*(4), 308. https://doi.org/10.3390/rel13040308

Galang, J. R. F. (2021). Science and religion for COVID-19 vaccine promotion. *Journal of Public Health*, *43*(3), e513–e514. https://doi.org/10.1093/pubmed/fdab128

Ganiel, G. (2021). Online opportunities in secularizing societies? Clergy and the COVID-19 Pandemic in Ireland. *Religions*, *12*(6), 437. https://doi.org/10.3390/rel12060437

Gill, A., & Lundsgaarde, E. (2004). State welfare spending and religiosity: A cross-national analysis. *Rationality and Society*, *16*(4), 399-436. https://doi.org/10.1177/1043463104046694

Gilpin, A. (1993). Table for conversion of Kendall's tau to Spearman's rho within the context of measures of magnitude of effect for meta-analysis. *Educational and Psychological Measurement, 53*(1), 87–92. https://doi:10.1177/0013164493053001007

Haerpfer, C., Inglehart, R., Moreno, A., Welzel, C., Kizilova, K., Diez-Medrano J., M. Lagos, P. Norris, E. Ponarin & B. Puranen (eds.). 2022. *World Values Survey: Round seven – country-pooled datafile version 6.0*. Madrid, Spain & Vienna, Austria: JD Systems Institute & WVSA Secretariat. https://doi:10.14281/18241.24

Hayes, A. F., & Coutts, J. J. (2020). Use omega rather than Cronbach's alpha for estimating reliability. But… *Communication Methods and Measures*, *14*(1), 1–24. https://doi.org/10.1080/19312458.2020.1718629

Höllinger, F., & Makula, L. (2021). Religiosity in the major religious cultures of the world. *International Journal of Sociology*, *51*(5), 345-359. https://doi.org/10.1080/00207659.2021.1958181

Inglehart, R. (2021). *Religion's sudden decline: What's causing it, and what comes next?* Oxford University Press.

Inglehart, R., C. Haerpfer, A. Moreno, C. Welzel, K. Kizilova, J. Diez-Medrano, M. Lagos, P. Norris, E. Ponarin & B. Puranen et al. (eds.). 2014. *World Values Survey: Round six - country-pooled datafile version*: https://www.worldvaluessurvey.org/WVSDocumentationWV6.jsp. Madrid: JD Systems Institute.

Koenig, H. G., King, D., & Carson, V. B. (2012). *Handbook of religion and health*. Oup Usa.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. University of Chicago Press.

Li, H., & Cao, Y. (2021). In times of illness: COVID-19 threat influences temporal focus and implicit space-time mappings. *Personality and Individual Differences, 171,* 110561. https://doi:10.1016/j.paid.2020.110561

Lowicki, P., Witowska, J., Zajenkowski, M., & Stolarski, M. (2018). Time to believe: Disentangling the complex associations between time perspective and religiosity. *Personality and Individual Differences*, 134, 97-106. https://doi.org/10.1016/j.paid.2018.06.001

McDougle, L., Konrath, S., Walk, M., & Handy, F. (2016). Religious and secular coping strategies and mortality risk among older adults. *Social Indicators Research, 125*, 677-694. https://doi.org/10.1007/s11205-014-0852-y

McGrath, R. E., & Meyer, G. J. (2006). When effect sizes disagree: The case of r and d. *Psychological Methods, 11*(4), 386–401. https://doi.org/10.1037/1082-989X.11.4.386

Meza, D. (2020). In a pandemic are we more religious? Traditional practices of Catholics and the COVID-19 in Southwestern Colombia. *International Journal of Latin American Religions*, *4*(2), 218–234. https://doi.org/10.1007/s41603-020-00108-0

Molteni, F., Ladini, R., Biolcati, F., Chiesi, A. M., Dotti Sani, G. M., Guglielmi, S., ... & Vezzoni, C. (2021). Searching for comfort in religion: Insecurity and religious behaviour during the COVID-19 pandemic in Italy. *European Societies*, *23*(sup1), S704-S720. https://doi.org/10.1080/14616696.2020.1836383

Norris, P., & Inglehart, R. (2011). *Sacred and secular: Religion and politics worldwide*. Cambridge University Press.

Ouellet, M., Santiago, J., Israeli, Z., & Gabay, S. (2010). Is the future the right time? *Experimental Psychology, 57* (4) https://doi.org/10.1027/1618-3169/a000036

Özer, Z., Aksoy, M., & Turan, G. B. (2023). The relationship between death anxiety and religious coping styles in patients diagnosed with COVID-19: A sample in the east of Turkey. *OMEGA-journal of Death and Dying, 87*(1), 299-311. https://doi.org/10.1177/00302228211065256

Pankowski, D., & Wytrychiewicz-Pankowska, K. (2023). Turning to religion during COVID-19 (Part I): A systematic review, meta-analysis and meta-regression of studies on the relationship between religious coping and mental health throughout COVID-19. *Journal of Religion and Health, 62*(1), 510-543.

Pargament, K (1997). *The psychology of religion and coping: Theory, research, practice*. Guilford.

Pargament, K. I., Koenig, H. G., & Perez, L. M. (2000). The many methods of religious coping: Development and initial validation of the RCOPE. *Journal of Clinical Psychology, 56*(4), 519–543. https://doi.org/10.1002/(SICI)1097-4679(200004)56:4

Park, C. L., & Cohen, L. H. (1993). Religious and nonreligious coping with the death of a friend. *Cognitive Therapy and Research, 17*(6), 561–577. https://doi.org/10.1007/BF01176079

Pew Research Center (2018). June 13, 2018. *The age gap in religion around the world*. Retrieved from https://www.pewforum.org/2018/06/13/young-adults-around-the-world-are-less-religious-by-several-measures/

Pew Research Center (2020a). *The global God divide*. July 20, 2929. Retrieved from https://www.pewresearch.org/global/2020/07/20/the-global-god-divide/

Pew Research Center (2020b). *Few Americans say their house of worship is open, but a quarter say their faith has grown amid the pandemic.* Pew Research Center. April 30th, 2020. Retrieved from https://www.pewresearch.org/fact-tank/2020/04/30/few-americans-say-their-house-of-worship-is-open-but-a-quarter-say-their-religious-faith-has-grown-amid-pandemic/

Pew Research Center (2020c). Pew Research Center's American news pathways data tool. Retrieved from https://www.pewresearch.org/pathways-2020/COVID_ACT_R_c/age/us_adults

Pew Research Center (2021). *More Americans than people in other advanced economies say COVID-19 has strengthened religious faith*. January, 2021. Retrieved from

https://www.pewforum.org/2021/01/27/more-americans-than-people-in-other-advanced-economies-say-covid-19-has-strengthened-religious-faith/

Plohl, N., & Musil, B. (2021). Modeling compliance with COVID-19 prevention guidelines: The critical role of trust in science. *Psychology, Health & Medicine. 26*(1), 1–12. https://doi: 10.1080/13548506.2020.1772988

Prati, G., & Pietrantoni, L. (2009). Optimism, social support, and coping strategies as factors contributing to posttraumatic growth: A meta-analysis. *Journal of Loss and Trauma, 14*(5), 364-388. https://doi.org/10.1080/15325020902724271

R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Saroglou, V., Delpierre, V., & Dernelle, R. (2003). Values and religiosity: A meta-analysis of studies using Schwartz's model. *Personality and Individual Differences*, *37*(4), 721–734. https://doi.org/10.1016/j.paid.2003.10.005

Schnabel, L., & Schieman, S. (2021). Religion protected mental health but constrained crisis response during crucial early days of the COVID-19 pandemic. *Journal for the Scientific Study of Religion, 61*(2), 530-543. https://doi.org/10.1111/JSSR.12720

Schwadel, P. (2015). Explaining cross-national variation in the effect of higher education on religiosity. *Journal for the Scientific Study of Religion, 54*(2), 402–418. https://doi.org/10.1111/jssr.12187

Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. *Online readings in Psychology and Culture, 2*(1), 11. https://doi.org/10.9707/2307-0919.1116

Schwartz, S., & Huismans, S. (1995). Value priorities and religiosity in four Western religions. *Social Psychology Quarterly*, *58*(2), 88–107. https://doi.org/10.2307/2787148

Shipp, A. J., Edwards, J. R., & Lambert, L. S. (2009). Conceptualization and measurement of temporal focus: The subjective experience of the past, present, and future. Organizational *Behavior and Human Decision Processes*, *110*(1), 1–22. https://doi.org/10.1016/j.obhdp.2009.05.001

Stolarski, M., Fieulaine, N., & Van Beek, W. (Eds.). (2015). *Time perspective theory: Review, research, and application*. Cham, Switzerland: Springer International Publishing.

Taylor, D. B. (2021, March 17). A Timeline of the Coronavirus Pandemic. *The New York Times*. https://www.nytimes.com/article/coronavirus-timeline.html

Thomas, J., & Barbato, M. (2020). Positive religious coping and mental health among Christians and Muslims in response to the COVID-19 pandemic. *Religions, 11*(10), 498. https://doi.org/10.3390/REL11100498

World Bank. (2024, May 10). Educational attainment, at least completed short-cycle tertiary, population 25+, total (%). Retrieved from https://data.worldbank.org/indicator/SE.TER.CUAT.ST.ZS?end=2015&start=2015&view=map&year=2020

Zimbardo, P. G., & Boyd, J. N. (1999). Putting time in perspective: A valid, reliable individual-differences metric. *Journal of Personality and Social Psychology, 77*(6), 1271-1288. https://doi.org/10.1037/0022-3514.77.6.1271