



Longitudinal attenuation in political polarization: Evidence from COVID-19 vaccination adherence in Brazil

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ABSTRACT

Background: While political polarization in policy opinions, preferences, and observance is well established, little is known about whether and how such divisions evolve, and possibly attenuate, over time. Using the COVID-19 pandemic in Brazil as the backdrop, we examine the longitudinal evolution of a highly relevant and polarizing policy: adherence to the COVID-19 vaccination.

Methods: Studies 1 (N = 3346) and 2 (N = 10,214) use nationwide surveys to document initial differences and subsequent changes in vaccination adherence between conservatives ("Bolsonaristas") and non-conservatives ("non-Bolsonaristas"). Study 3 (N = 742) uses an original dataset to investigate belief changes among conservatives and their association with asymmetric changes in vaccination adherence.

Results: Despite substantial differences at the early stages of rollout, the gap in vaccination adherence between conservatives and non-conservatives significantly decreased with the passage of time, driven essentially by a much faster uptake among the initially most skeptic—the conservatives. Study 3 demonstrates that the asymmetric changes in vaccination adherence were associated with meaningful belief changes among the conservatives, especially about the perceived effectiveness of the COVID-19 vaccines and the expected adherence of peers to the vaccination campaign.

Conclusions: Together, these studies show that, in a context where the superiority of the promoted policy becomes clear over time and individuals have the opportunity to revisit prior beliefs, even intense political polarization can be attenuated.

1. Introduction

Political orientation exerts strong influence over people's attitudes and behaviors (Van Bavel and Pereira, 2018; Iyengar et al., 2019). Ideological differences have been reported in several life domains, including consumption preferences (Khan et al., 2013; Fernandes and Mandel, 2014), lifestyle activities (Jost et al., 2008), and everyday social interactions (Huber and Malhotra, 2017; Shafranek, 2021). Political cleavages manifest particularly pronouncedly in people's attitudes towards public policies and compliance with policy guidelines (Doherty, 2017). For example, as it became blatantly apparent in the early months

of the COVID-19 pandemic, political ideology stood out as one of the strongest predictors of adherence to self-protective behaviors, with conservatives being much less inclined to support and adhere to the public health recommendations than liberals (Grossman et al., 2020; Gadarian et al., 2021).

Although extensive research has documented the intimate connection between political ideology and policy opinions, preferences, and compliance, it is unclear how this association evolves over time—particularly in the context of the COVID-19 pandemic. The few longitudinal studies involving political polarization have documented an acute and growing partisan sorting (Garner and Palmer, 2011; Webster and

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Abramowitz, 2017), such that people increasingly align their political identities to preferences over issues like job guarantees and defense spending, to name a few (Bougher, 2017). These policies, however, are arguably infrequent topics of discussion in social circles and not necessarily intelligible to laypeople. Further, the policies have no clear scientific consensus guiding normative behavior. Conversely, in the context of the COVID-19 pandemic, vaccination is indisputably relevant to people, salient in their minds, and growingly supported by upcoming evidence. This context, thus, affords individuals the opportunity to revisit prior beliefs over this important and originally highly polarized issue.

In this research, we examine whether the association between political orientation and COVID-19 vaccination adherence varied over the course of the pandemic, and, if so, which psychological mechanisms could help account for the changes. In a shifting pandemic landscape, little is known about how the impact of such ideological divisions evolved over time. Did the gap persist, intensify, or attenuate? If changes were observed, what could explain them? Did they happen because conservatives updated their beliefs about the severity of the disease, the efficacy of the vaccines, or the expected behavior of peers? As it will be later discussed, understanding how polarization involving COVID-19 vaccination evolved over time and shedding light on its underlying mechanisms can help devise strategies to promote broader compliance in future vaccination efforts.

Previous research has identified several sets of beliefs relevant to health decision making. First, leading models of health psychology (e.g., Health Belief Model [Rosenstock, 1974] and Protection Motivation Theory [Rogers and Prentice-Dunn, 1997]) predict that people will engage in protective behaviors (e.g., taking the vaccine) if the perceived severity and susceptibility of the disease are high, and the perceived benefits of the preventive behavior outweigh its costs. In the context of the COVID-19 pandemic, differences between political groups in beliefs about the severity and susceptibility to the virus soon emerged worldwide (Barrios and Hochberg, 2021; Kerr et al., 2021; Vieites et al., 2021; Ju and You, 2022) and surveys showed that trust in the vaccines was much lower among conservatives when the rollout was about to start (Latkin et al., 2021a). Brazil was no different. Since the onset of the pandemic, liberals and conservatives held divergent risk perceptions (Vieites et al., 2021) about the new coronavirus and discrepant attitudes towards social distancing policies (Ramos et al., 2020). These differences resonated with President Bolsonaro's own claims that the COVID-19 was no more than a "little flu" (Walsh, 2020). The underestimation of the health-related costs of the pandemic was also implied in the discourse of some conservative leaders, who referred to the reactions to the pandemic as exaggerated and even "hysterical" (Mazui, 2020). Further, the efficacy of the vaccine was also called into question. For example, President Bolsonaro repeatedly discouraged vaccination emphasizing its purportedly serious side effects (UOL, 2023) and the questionable effectiveness.

Relatedly, a second set of beliefs refers to social norms and social pressure (Reid et al., 2010). People tend to adopt policy preferences and behaviors that are perceived to be adopted or socially accepted by in-group members (Ehret et al., 2018; Van Boven et al., 2018). Interestingly, people exaggerate how cohesive in-group preferences are and how much they differ from the preferences of out-groups (Ferbach and Van Boven, 2022). In the context of the COVID-19 pandemic, individuals held the belief that conservatives in general would/should not take the jab, which in turn influenced their own likelihood of doing so (Latkin et al., 2021b; Rabb et al., 2022). In Brazil, President Bolsonaro repeatedly stated that he did not get vaccinated (Pedroso, 2021), setting social norms among conservatives that they could/should not get the shot. In sum, beliefs about low susceptibility and severity of the disease, unfavorable cost-benefit analyses concerning vaccination, and perceived group norms explained, at least in part, the conservatives' lower likelihood of vaccinating at the onset of the rollout.

Critically, these same mechanisms could lead one to predict either the persistence/exacerbation or the attenuation of the effect over time.

On the one hand, research in COVID-unrelated contexts has documented that people's preferences have become increasingly aligned with their political identities. This phenomenon has risen in parallel to an affective polarization in society, where people cultivate positive sentiment towards political in-group members and negative feelings towards out-group members (Iyengar et al., 2019; Lelkes, 2018). As feelings strengthen, so do incentives for inter-group differentiation. When people are motivated to defend their identity, they tend to interpret information in light of extant beliefs. For example, people often seek out information that confirms prior beliefs (i.e., confirmation bias) and focus disproportionate effort on dismissing evidence inconsistent with prior beliefs (i.e., disconfirmation bias [Lord et al., 1979; Taber and Lodge, 2006]). Thus, directional reasoning suggests a limited predisposition to change beliefs about COVID-19 policies, which could help perpetuate, and possibly even exacerbate polarization over the vaccine.

On the other hand, beliefs have a dynamic nature and, as such, are subject to change (Vlasceanu and Coman, 2021). High quality and salient information can and often do overcome the power of psychological defense mechanisms (Ahluwalia, 2000). As the pandemic unfolded in Brazil and elsewhere, the reality confronted the beliefs of the initially skeptical. The images of overwhelmed hospitals and the spike in the number of deaths all over the world made it virtually impossible to question the severity of the disease (Hu et al., 2021). Along the same lines, the quality and quantity of information about the safety and effectiveness of the vaccines flooded traditional and social media (Wang and Lu, 2022). Finally, the presence of long queues to take the most-awaited jabs revealed to all the preference and behavior of an apparent majority. Thus, as the pandemic evolved and information about the disease, the vaccines, and behavioral norms became more readily available and harder to dispute, the initial beliefs of the most skeptic (i.e., conservatives, or "Bolsonaristas") may have been updated. In line with the changes in beliefs, the attenuation in polarization over COVID-19 vaccination may have emerged as more and more conservatives decided to get the shot over time.

2. Overview of the studies

We tested the possibility that polarization concerning COVID-19 vaccination attenuated over time and examined its underlying mechanisms across three longitudinal studies conducted in Brazil. Studies 1 and 2 use nationwide surveys ($N = 3346$ and $10,214$, respectively) to assess the vaccine polarization attenuation with different datasets and different measures of political ideology. In Study 1, we retrieved a two-wave, nationwide online panel from the World Values Survey (WVS), and then incorporated primary data from a quota-matched representative study as Study 1's third wave. Similar to the WVS panel, our primary data was collected online and designed to maintain the quota-based representation of the general population with respect to gender, age, region, and income level (the WVS used education level instead of income). The rationale behind merging these two datasets was to delve into the dynamic changes in vaccination adherence from February 2021 to April/May 2022, allowing us to investigate any potential shifts in vaccination adherence patterns within a broader timeframe.

In Study 2, we retrieved a five-wave repeated cross-sectional survey conducted by the Datafolha Institute (December 2020 to July 2021), a large and reputable polling institute in Brazil. In contrast to Study 1, where we assessed political orientation through a self-reported left-right scale, Study 2 relied on the approval rating of the at the time President Bolsonaro as a proxy for political identification.

Finally, Study 3 was a two-wave, repeated cross-section study conducted in the city of Rio de Janeiro, Brazil (June/July 2021; February/March 2022; $N = 742$). As Studies 1 and 2, it assessed the polarization attenuation over COVID-19 vaccination. Critically, it also examined the role of different belief-based mechanisms—i.e., beliefs about the susceptibility and severity of the COVID-19 disease, the efficacy of the vaccine, and perceived social norms—in driving the relationship between

political orientation and vaccination adherence. *SI Appendix, Table S1* provides a comprehensive overview of the empirical package.

Across all studies, we considered that participants adhered to vaccination if they either took the COVID-19 vaccine or intended to do so and that participants did not adhere to the vaccination if they had not taken the COVID-19 vaccine and were unsure as to whether they would eventually take it. We used the approach of combining uptake and intention for several reasons. First, had we focused solely on the decision to take the vaccine, cross-wave comparability would have been compromised due to vaccine supply issues. For example, in the first stages of the vaccine rollout, when only a small group could take the jab (e.g., elderly people and individuals with comorbidities), many individuals were arguably willing to get vaccinated but could not because the vaccine was not yet available to them. Conversely, had we focused exclusively on intention measures, our data would suffer from selection bias, as participants who reported getting vaccinated were not asked about their vaccination intentions. As a result, participants with positive attitudes about the vaccine—who presumably got vaccinated when they had the chance—would be systematically excluded from the analyses. Finally, previous research investigating vaccination adherence has consistently used a similar approach (Schmelz and Bowles, 2022; Shaw et al., 2022). By aligning with existing methodologies, we ensure that our findings are not only comparable with previous research, but also leverage the collective insights gained from this body of research.

3. Study 1: The first panel

3.1. Materials and methods

Data for Study 1 come from two sources. First, we gathered representative samples of Brazilian adults interviewed as part of the Values in Crisis Survey (VICS) coordinated by the WVVS Association (Sivis, 2021). In the VICS, participants were recruited to join a three-wave online panel survey, with the requirement of being quota representative of the general population with respect to gender, age, region, and education. Because questions about vaccination were only included from the second wave onwards, we used the last two VICS waves only. Of the 3543 individuals who completed the first wave of the VICS, which is not included in our study, 1929 participated in the second wave (corresponding to our Study 1's first wave) in February 2021, and 1301 partook in the third wave (corresponding to our Study 1's second wave) in September 2021, yielding a retention rate of 55% and 37% from VICS's wave 1 to wave 2 and wave 3, respectively. In our analysis, we focused exclusively on those 1301 participants who completed all three rounds of data collection, as the VICS has only made these responses available for examination.

Further, in order to explore the evolution of vaccination adherence from early 2021 to mid-2022, we then fielded an additional nationally quota-representative online cross-sectional survey of Brazilian adults from all 27 states based on gender, age, and income level, comparable to those administered by the VICS in terms of methodology, leaving us with a total of three waves, two from the VICS online panel (Waves 2 and 3 of the VICS, which corresponds respectively to Waves 1 and 2 in our study) and one from primary data (Wave 3): Wave 1: February 2021 ($N = 1301$); Wave 2: September 2021 ($N = 1301$); Wave 3: April/May 2022 ($N = 2045$). Descriptive statistics by wave can be found in the *SI Appendix, Table S2*.

Measures. *Dependent variable: vaccination adherence.* Vaccination adherence was measured by asking whether participants took the COVID-19 shot or whether they would take it if they had the chance. Because the three surveys were conducted at different stages of the vaccination campaign, we operationalized the dependent variable to ensure cross-wave comparability. We incorporated both intention and reported behavior as our measure of vaccination adherence. Specifically, in Wave 1, participants were asked “When a COVID-19 vaccine is approved by the Brazilian Health Regulatory Agency (ANVISA) and

becomes available, would you take it?”. Answers were coded as 1 if respondents indicated “Yes” and 0 if they indicated “No” or “It depends on the type of the vaccine”. In Wave 2, participants were asked “When a COVID-19 vaccine becomes available to you, how likely would you be to get vaccinated?”. Answers were coded as 1 if respondents indicated “I have already been vaccinated” or “I will (probably/definitely) get vaccinated” and 0 if they indicated “I will (probably/definitely) not get vaccinated”. Finally, in wave 3, participants were asked “Have you received the first dose of the COVID-19 vaccine?”. Answers were coded as 1 if respondents indicated “Yes” and 0 if they indicated “No”.

Independent variable: political orientation. We assessed our main independent variable of interest using a single-item measure. On a 10-point scale, participants were asked to place themselves on the left-right political spectrum (1 = “left” and 10 = “right”). Responses were rescaled to range between 1 = “left” and 5 = “right” to match responses in the third wave which presented a 5-point scale (1 = “clearly to the left”, 2 = “left”, 3 = “center”, 4 = “right”, 5 = “clearly to the right”), plus an “I don't know” option. For the main analysis, we computed political orientation as a dummy variable indicating whether the participant self-identified as right-wing or else. Scores greater than 3 were coded as (1 = “conservative”), while scores below 4 and “I don't know” responses were coded as (0 = “liberal”, “center”, or “I don't know”). As robustness checks, we considered two alternative specifications where we excluded those not able to place themselves in the political spectrum in the third wave. In one of the specifications, we used a dummy variable indicating whether the participant was at the right of the political spectrum or at the center or left (1 = “conservative”, 0 = “center” or “liberal”). In the other specification, we treated political orientation as an ordinal variable, ranging from 1 (“clearly left”) to 5 (“clearly right”).

Controls. Our analysis controlled for individual-level variables that could be confounded with our measures of political orientation and vaccination adherence. Namely, we controlled for the participants' gender, age, educational attainment (primary, middle, higher education), and household income (less than 1, from 1 to 2, from 2 to 5, from 5 to 10, more than 10 minimum wages).

Analytical approach. To evaluate the attenuation over time of COVID-19 vaccination polarization, we performed linear probability models with political orientation (1 = conservatives, 0 = all others), time (survey waves 1 to 3), and their interaction as independent variables, using vaccination adherence as the dependent variable (1 = vaccinated or willing to vaccinate, 0 = unvaccinated and unwilling to vaccinate), and controlling for all of the aforementioned sociodemographics. To account for attrition and ensure the representativeness of the surveys, we used a stepwise adjustment of survey sampling weights (based on age, sex, and educational attainment) to retrieve the known population margins of the first VICS wave.

3.2. Results

As expected, at the early stages of the vaccination rollout in Brazil, adherence was much lower among conservatives (51.51% vs. 72.22%; $t(1,299) = 7.65, P < 0.01, d = 0.44$). Importantly, from February 2021 to May 2022, we observed a larger uptake in vaccination among conservatives (from 51.51% to 92.74%; $t(1,011) = 16.83, P < 0.01, d = 1.06$) than among their non-conservative peers (from 72.22% to 96.99%; $t(2,331) = 19.03, P < 0.01, d = 0.82$). In other words, the difference in vaccination adherence between conservatives and non-conservatives decreased from 20.71 in February 2021 to only 4.25 percentage points in May 2022; $\beta = 0.16, P < 0.01$; see Fig. 1, panel a; *SI Appendix, Table S3*). Robustness checks using (a) logistic regressions, (b) alternative measures of political orientation, and (c) inverse probability weighting on important covariates to account for attrition yield similar results.

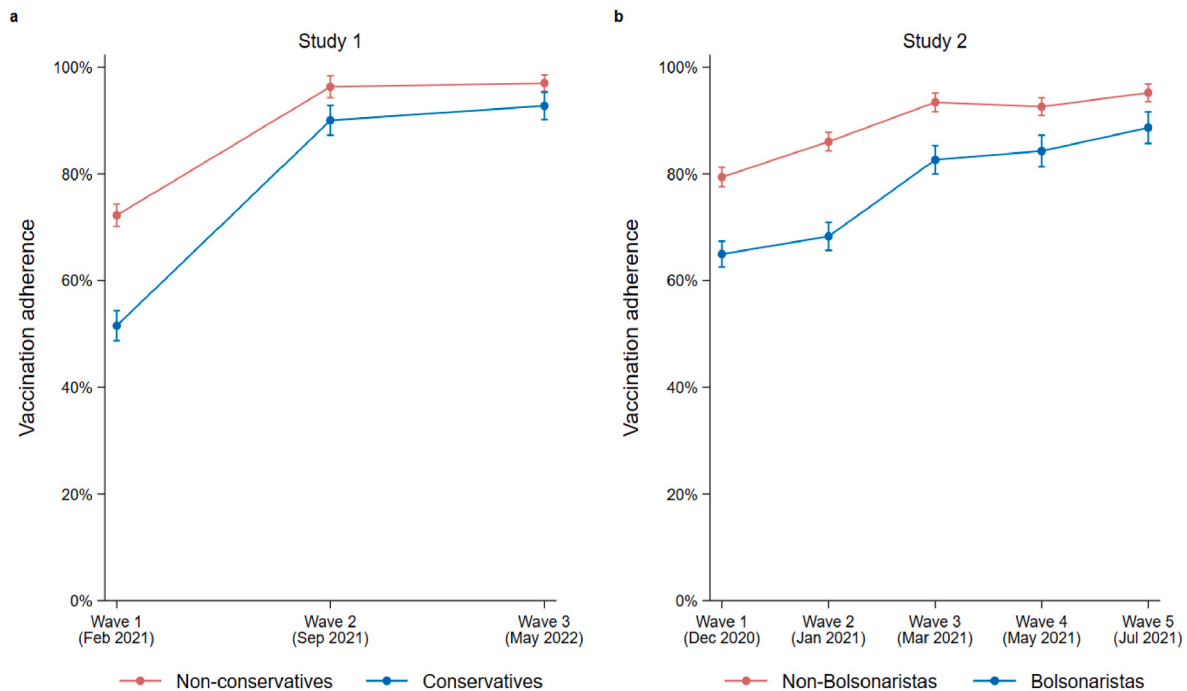


Fig. 1. Change in vaccination adherence estimates (Studies 1 and 2). Panel a depicts average marginal effects of time on vaccination adherence over the three-wave period by political orientation. Panel b depicts equivalent coefficients for presidential job approval over the five-wave period. These effects were estimated using linear probability models. Error bars indicate 95% confidence intervals. Results with alternative specifications and sets of control variables can be found in the *SI Appendix*, Figs. S2a–e.

4. Study 2: The second panel

To provide further evidence for the findings of Study 1, we relied on another nationwide survey of repeated cross-sections ($N = 10,214$), collected from December 2020 to July 2021. We also considered an alternative measure of political orientation (i.e., people's approval rating of President Bolsonaro: 1 = the Bolsonaro Administration has done an excellent/good job; 0 = else).

4.1. Materials and methods

Study 2 relies on data samples of repeated population cross-sections from the Opinions about the Coronavirus Study (OCS), conducted by the Datafolha Institute (DataFolha, 2021). In the OCS, samples of Brazilian adults from each of the 27 states of Brazil were recruited via mobile phone (which is currently used by approximately 90% of the Brazilian population) with the requirement of being quota representative of the general macro-region population with respect to gender and age. As in the VICS, the first wave of the OCS was fielded at the onset of the pandemic, in March 2020, but questions about vaccination were only included in the eighth wave, in December 2020; hence, here we used data from the eighth wave onwards, leaving us with a total of five waves: Wave 1: 8–10 December 2020 ($N = 2016$); Wave 2: 20–21 January 2021 ($N = 2030$); Wave 3: March 2021 ($n = 2023$); Wave 4: May 2021 ($N = 2071$); Wave 5: July 2021 ($N = 2074$). Descriptive statistics by wave can be found in the *SI Appendix*, Table S4.

Measures. *Dependent variable: vaccination adherence.* As in Study 1, to ensure cross-wave comparability and to incorporate intention and reported behavior, we operationalized our measure of vaccination adherence as a dummy variable. Specifically, in Wave 1, participants were asked “When a COVID-19 vaccine becomes available, will you get vaccinated?”. Answers were coded as 1 if respondents indicated “Yes” and 0 if they indicated “No” or “I don’t know”. In Wave 2, participants were asked “Last Sunday, the Brazilian Health Regulatory Agency

(ANVISA) approved two COVID-19 vaccines for emergency use. Will you get vaccinated?”. Answers were coded as 1 if respondents indicated “Yes” and 0 if they indicated “No” or “I don’t know”. Finally, in waves 3 to 5, participants were asked “Have you received the COVID-19 vaccine? Will you get vaccinated?”. Answers were coded as 1 if respondents indicated “I have already been vaccinated” or “I haven’t been vaccinated but I will” and 0 if they indicated “I haven’t been vaccinated and I won’t get the shot” or “I don’t know”.

Independent variable: presidential job approval. We assessed the main independent variable of interest using a single-item measure of presidential approval (“In your opinion, the [performance of] President Jair Bolsonaro’s Administration has been excellent, good, regular, bad, or terrible?”). We then coded this measure as 1 if the respondent indicated that it was either “excellent” or “good” and 0 if the respondent indicated “regular”, “bad”, “terrible”, or “I don’t know”. As robustness checks, we considered two alternative specifications. First, we excluded those not able to evaluate the administration of President Bolsonaro, using a dummy variable indicating whether the participant approves or disapproves the way that the president handled his job as president (1 = “Bolsonaristas” 0 = “non-Bolsonaristas”). Second, we treated the political orientation variable as an ordinal variable, ranging from 1 “terrible” to 5 “excellent”.

Controls. Our analysis controlled for individual-level variables that could be confounded with our measures of political orientation and vaccination adherence. Namely, we controlled for the participants’ gender, age, educational attainment (primary, middle, higher education), household income (less than 1, from 1 to 2, from 2 to 3, from 3 to 5, from 5 to 10, more than 10 minimum wages), and race/ethnicity (white, black, mixed race, yellow, indigenous).

Analytical approach. To evaluate the attenuation over time of COVID-19 vaccine polarization, we performed linear probability models with political orientation (1 = approved Bolsonaro’s right-wing government performance, 0 = disapproved or did not know about Bolsonaro’s right-wing government performance), time (survey waves 1 to 5),

and their interaction as independent variables, using vaccination adherence as dependent variable (1 = vaccinated or willing to vaccinate, 0 = unvaccinated and unwilling to vaccinate), and controlling for all of the aforementioned sociodemographics. To account for missing observations on household income, we perform multiple imputations based on age, sex, race, and educational attainment (Lee and Shi, 2021).

4.2. Results

As in Study 1, Study 2 shows that by December 2020 intention to adhere to the to-be-launched vaccination program was lower among those who approved President Bolsonaro (64.93%) than among those who did not approve him (79.93%; $t(2,014) = 7.22, P < 0.01, d = 0.33$). Importantly, the difference in intention-to-adhere or adherence to the vaccination program between Bolsonaro's "fans" and "foes" significantly decreased from December 2020 to July 2021 (from 14.46 to 6.55 percentage points; $\beta = 0.08, P < 0.01$; see Fig. 1, panel b; SI Appendix, Table S5), mainly driven by a larger vaccination observance over the months by Bolsonaro supporters. As in Study 1, robustness checks using (i) logistic regressions, (ii) alternative measures of political orientation, and (iii) multiple imputations on household income yield similar results.

After months of delay and political disputes over the immunization program, vaccination rollout started in January 2021 in Brazil, with the first person being vaccinated on January 17. Our first two studies show that irrespective of dataset, exact period of analysis, and type of measurement of political ideology, there was a sizeable difference in vaccination adherence between political groups at the early stages of the vaccination rollout. Critically, the increased overall vaccination adherence occurred in tandem with an average attenuation of the political ideology gap driven essentially by a larger uptake among the most skeptic—conservatives/Bolsonaro supporters (see also SI Appendix, Fig. S1). The next study provides a more nuanced understanding of this shift by exploring proximal belief-based mechanisms that could account for the changes in the association between political ideology and vaccination adherence.

5. Study 3: Belief-based mechanisms

Study 3 was conducted in the city of Rio de Janeiro, Brazil. We recruited 307 participants between 11 June and 13 July 2021 (Wave 1) and 435 participants between 10 February and 28 March 2022 (Wave 2) as part of a two-wave, repeated cross-sectional study designed to measure the changes in vaccination adherence across political orientation over time, and most importantly to assess the extent to which possible belief updates could be associated with such behavioral changes.

Additionally, in both waves, three groups of belief-based mechanisms were measured: (a) beliefs about the disease, as measured by participants' perceived susceptibility to infection, perceived severity of the disease, perceived susceptibility to infection toward relevant others, and perceived severity of the disease toward relevant others; (b) beliefs about the vaccine, as measured by participants' perceived vaccine effectiveness in minimizing susceptibility to infection and in reducing the severity of the disease; and (c) beliefs about peers' behaviors toward vaccination, as measured by participants' perceived social norms and perceived social pressure to get vaccinated.

5.1. Materials and methods

Residents of the city of Rio de Janeiro were approached on the streets by trained field researchers and asked whether they would be willing to voluntarily take part in a 10-min survey about vaccination against COVID-19. The survey was conducted in both wealthy and poor neighborhoods of the city to assure socioeconomic variability in the sample. Descriptive statistics by wave can be found in the SI Appendix, Table S6. The study followed all ethical guidelines and was approved by the Committee for Ethical Compliance in Research Involving Human Beings

of Fundação Getúlio Vargas (n. 023/2022). Informed consent was obtained from all participants. For details and questions asked, see SI Appendix, Survey questions.

Measures. Dependent variable: vaccination adherence. As in the previous studies, we combined vaccine intention and reported behavior as the main dependent variable. In the first wave, we asked participants to indicate whether they had taken the first COVID-19 shot and, for those who did not, whether they would take it if one was available (when the first wave was conducted, vaccine rollouts followed eligibility rules, such as age and priority groups). Participants in the second wave, in turn, were asked to indicate whether they had taken the first dose of the COVID-19 vaccine. At the time of the second wave, all Brazilian adults were eligible for both first and second doses, while some were still not eligible for booster shots. Participants who reported not having taken the first dose of the vaccine were asked to indicate their willingness to take the missed shot. Reported vaccination behavior was assessed by a yes/no question, while intention to vaccinate was assessed on a 4-point scale ranging from 1 = "definitely not" to 4 = "definitely yes". As in studies 1 and 2, we operationalized our measure of vaccination adherence as a dummy variable (1 if the respondent indicated "Yes, I have already been vaccinated" or "Yes, I will [probably/definitely] get vaccinated" and 0 if the respondent indicated "No, I have not been vaccinated" or "No, I will [probably/definitely] not get vaccinated" or "I don't know").

Independent variable: Political orientation. We assessed our main independent variable of interest using a single-item measure. Similar to the third wave in Study 1, participants were asked to place themselves on the left-right political scale (1 = "clearly to the left", 2 = "left", 3 = "center", 4 = "right", 5 = "clearly to the right"), plus an "I don't know" option. Scores greater than 3 were coded as (1 = "conservative"), while scores below 4 and "I don't know" responses were coded as (0 = "liberal", "center", or "I don't know"). To avoid consistency effects, this question was displayed at the end of the questionnaire, after participants had answered about their vaccination status and various questions about their perceptions of issues related to the COVID-19 pandemic. We considered the same set of alternative specifications described in Study 1.

Belief-based measures: Beliefs about the disease. Two 5-point scale items (1 = "extremely unlikely" to 5 = "extremely likely") measured participants' perceived susceptibility to infection ("In your opinion, what do you consider to be your own probability of getting infected [or reinfected] with COVID-19?") and severity of the disease ("In your opinion, what do you consider to be your own probability of getting seriously ill if infected [or reinfected] with COVID-19?"). To capture beliefs about the susceptibility to infection and severity of the disease toward relevant others, we also included two 5-point agreement-phrased items (1 = "strongly disagree"; 5 = "strongly agree") directed to participants' perception of the impact of COVID-19 on their family members (susceptibility: "I worry about the possibility of someone from my family getting COVID-19"; severity: "I worry about the possibility of someone from my family getting seriously ill if infected with COVID-19").

Beliefs about the vaccine. To measure perceived vaccine effectiveness, two items were used: one focusing on minimizing susceptibility to infections ("In your opinion, how effective are the vaccines at reducing COVID-19 transmission?") and the other directed at reducing the severity of the disease ("In your opinion, how effective are the vaccines at reducing the number of COVID-19-associated hospitalizations and deaths?"). Answers were given on a 5-point scale ranging from 1 "not at all effective" to 5 "extremely effective".

Beliefs about social norms/pressure. Finally, two items measured perceptions about peers' behaviors toward vaccination. One item measured the perceived social norms ("In general, do you think that your friends and family would take [or took] the COVID-19 vaccine?") and the other item measured the perceived social pressure to get vaccinated ("In general, how do you think friends and family would react if you told

them that you did not [or would not] take the COVID-19 vaccine?”). The answer to the first item was given on a 4-point scale ranging from 1 “definitely no” to 4 “definitely yes”. The answer to the second item was given on a 5-point scale ranging from 1 “openly support” to 5 “openly criticize”. Sixty-four participants were not able to indicate how others would react and were excluded from the analyses involving social pressure.

Control variables. As in the previous studies, our analysis controlled for a set of individual-level variables that could be confounded with our measures of political orientation and vaccination adherence. Namely, we controlled for participants’ gender, age, education level (primary, middle, higher education), household income (less than 1, from 1 to 2, from 2 to 3, from 3 to 5, from 5 to 10, more than 10 minimum wages), and race/ethnicity (white, black, mixed race), and marital status (single, married, divorced, widowed).

Analytical approach. To evaluate the attenuation over time of COVID-19 vaccine polarization, we performed linear probability models with political orientation (1 = right-wing, 0 = all others), time (survey waves 1 and 2), and their interaction as independent variables, using vaccination adherence as dependent variable (1 = vaccinated or willing to vaccinate, 0 = unvaccinated and unwilling to vaccinate), and controlling for all of the aforementioned sociodemographics.

To assess changes in beliefs across time and political orientation, we performed a series of 2 (Time: first vs. second wave) x 2 (Political orientation: conservatives vs. non-conservatives) factorial ANOVA models. Specifically, we exploratorily assessed the interacting influence of the two independent variables on each of the eight belief-based measures collected.

To investigate the possibility that changes in beliefs could be a driver of patterns of changes in vaccination adherence, we used seemingly unrelated models, which allow for parallel mediation analysis and comparison of indirect effects through different mediators. Specifically, we simultaneously estimated nine models: one for the association of each of the belief-based mediators with political orientation, and another regressing political orientation and all the mediators on

vaccination adherence. All models include our set of control variables and the interactions of each of the covariates with a dummy variable representing the survey wave to mitigate omitted interaction bias (Blackwell and Olson, 2021). Further, to test for the conditional indirect associations at both waves and the difference in slopes between the two periods, we also interacted each of the mediators with the wave dummy. For the overall statistical inferences, a bootstrapping procedure with 1000 replications was used to perform joint significance tests.

5.2. Results

Asymmetric changes in vaccination adherence. Similar to what we observed in the previous studies with representative samples, vaccination adherence was also lower among conservatives (38.64% vs. 96.96%; $t(305) = 14.66, P < 0.01, d = 2.39$) at the earlier stages of the vaccination program (first wave). However, the gap in vaccination adherence across the political spectrum fell substantially about eight months later (86.66% vs. 97.77%), as evidenced by the significant interaction between our political ideology variable and survey wave ($\beta = 0.47, P < 0.01$; see *SI Appendix, Table S7*). Again, the effect was mainly driven by a spike in vaccination adherence among conservatives over time (see Fig. 2). Robustness checks using logistic regressions and alternative measures of political orientation yield similar results.

Asymmetric changes in beliefs. Our results allow us to draw two main conclusions. First, beliefs changed significantly for many issues over time. Second, when belief updates took place, they did so in an asymmetric fashion, akin to the pattern observed in vaccination adherence. For instance, by mid-2021, conservatives were much less likely to believe in the effectiveness of the vaccines than non-conservatives. Eight months later, this gap significantly attenuated, driven mainly by an increase in perceived vaccination effectiveness among conservatives (susceptibility: $F(1, 738) = 6.82, P < 0.01, \eta^2 = 0.009$; severity: $F(1, 738) = 30.96, P < 0.01, \eta^2 = 0.036$; see Fig. 3). The same was true for social norms. During the first wave of the survey, conservatives were less likely than non-conservatives to believe that their peers would take the

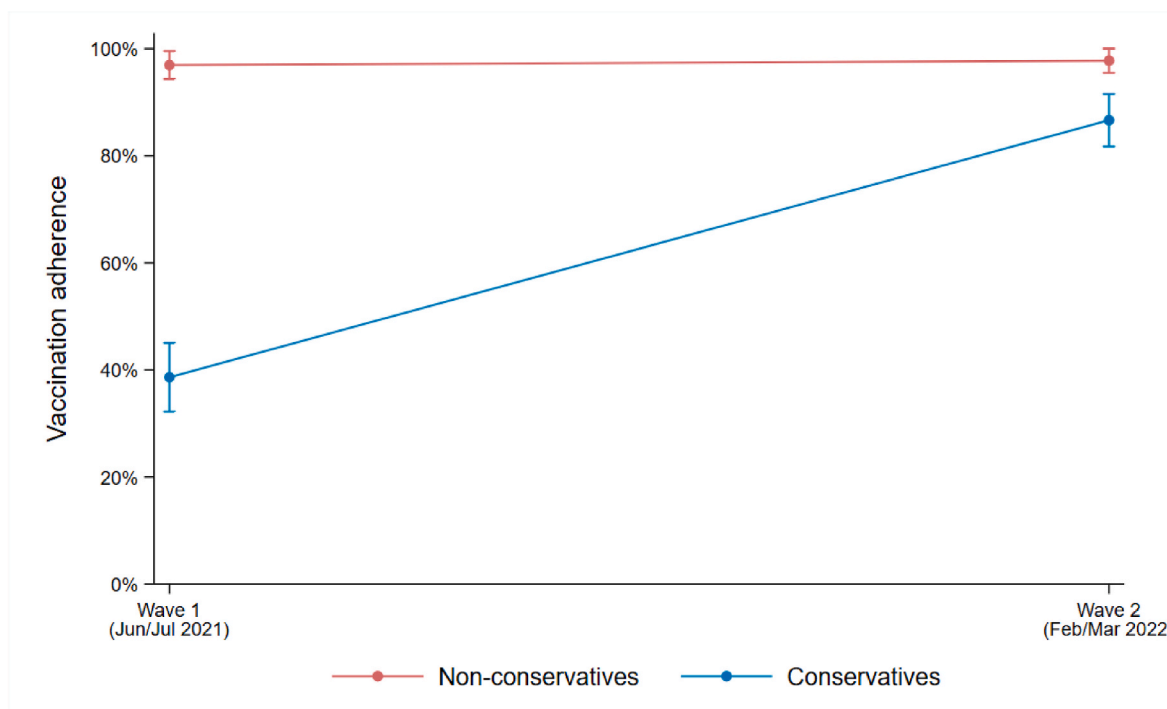


Fig. 2. Change in vaccination adherence estimates by political orientation (Study 3). This figure depicts average marginal effects of time on vaccination adherence over the two-wave period by political orientation. These were estimated using a linear probability model. Error bars indicate 95% confidence intervals. Results with alternative specifications and a set of control variables can be found in the *SI Appendix, Figs. S3a–e*.

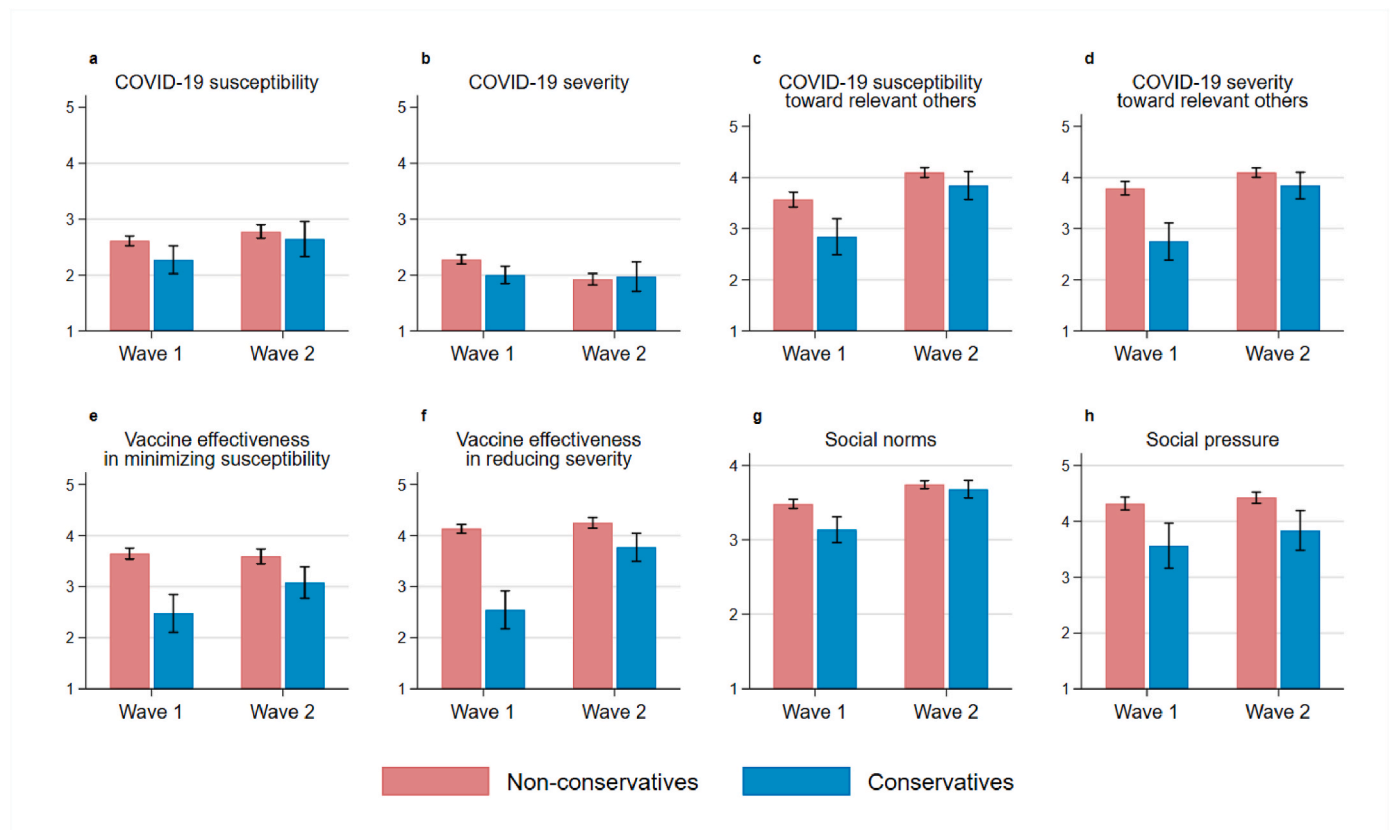


Fig. 3. Effects of political orientation and time on a series of belief-based mechanisms (Study 3). This figure depicts the mean values of each of the belief-based measures by political ideology group and wave. These were estimated by 2 (Time: first vs. second wave) x 2 (Political orientation: conservatives vs. non-conservatives) factorial ANOVA models (for the ANOVA table, see *SI Appendix*, Table S8). Panels depict the results from the ANOVA model with each of the belief-based measures as the dependent variable; namely, COVID-19 susceptibility (panel a), COVID-19 severity (panel b), COVID-19 susceptibility toward relevant others (panel c), COVID-19 severity toward relevant others (panel d), vaccine effectiveness in minimizing susceptibility (panel e), vaccine effectiveness in reducing severity (panel f), social norms (panel g), and social pressure (panel h). Error bars indicate 95% confidence intervals.

jab. By the second wave, the difference vanished ($F(1, 738) = 7.39, P < 0.01, \eta^2 = 0.009$; see Fig. 3). Although it did not reach significance, a similar trend appeared for social pressure (i.e., being criticized for not taking the vaccine). Finally, we also observed that conservatives believed their family to be less at risk than non-conservatives in June–July 2021, but the difference disappeared in the 2022 survey, again driven by a spike in concern among conservatives (susceptibility: $F(1, 738) = 4.45, P < 0.05, \eta^2 = 0.005$; severity: $F(1, 738) = 14.03, P < 0.01, \eta^2 = 0.017$; see Fig. 3). Null effects emerged when we asked participants about their own susceptibility to infection and probability of being severely harmed by it. Interestingly, across groups and survey waves, participants reported very low perceived risks, which may reflect the well-established unrealistic optimism in people's response to uncommon negative events (Vieites et al., 2021).

Mediating roles. Mediation results show significant indirect associations between political orientation and vaccination adherence through perceived vaccination effectiveness (susceptibility: indirect effect = $-0.03, P < 0.05$; severity: indirect effect = $-0.21, P < 0.01$) and the social norms (indirect effect = $-0.06, P < 0.05$; see Table 1) in the first wave, while none of them reached significance in the second (all P s > 0.05). As presented in Table 1, the association between political orientation and perceived vaccine efficacy significantly lessened in magnitude from the first to the second wave (susceptibility: $\beta = -0.69, P < 0.05$; severity: $\beta = -0.90, P < 0.01$), as well as the association between political orientation and the perceived social norms ($\beta = -0.44, P < 0.01$), suggesting that the gap between the two groups narrowed markedly over time. See *SI Appendix*, Fig. S4 for bivariate correlations

between the belief-based mechanisms, dependent, and independent variables in each wave.

Taken together, these results suggest that part of the lower vaccination adherence among conservatives was driven by weaker perceptions of vaccine efficacy and how others adhere to the vaccine. Further, our results indicate that the observed attenuation of the association between political ideology and vaccination adherence occurred in part because these indirect associations faded as the two groups converged on their beliefs. Importantly, we observe that changes were much more pronounced in the ideology-belief than in the belief-vaccination path, implying that asymmetric changes in vaccination adherence were indeed driven by conservatives updating their beliefs. Since the key variables in the analyses were not randomly assigned, there is always the possibility that the observed associations could be attributed to an unmeasured confounder. As such, we conducted sensitivity analyses to estimate how large the correlation between the two error terms for the models fitting the belief-based mediator and outcome variable has to be for the mediation effect to disappear. Indirect associations through perceived vaccine effectiveness are particularly robust as the sensitivity analysis shows that for the mediation effect to be zero, the correlation between the two error terms must be approximately 0.58 and 0.45 for severity and susceptibility, respectively. See *SI Appendix*, Fig. S5 for complete sensitivity results.

Table 1
Indirect associations between political orientation and vaccination adherence at waves 1 and 2 through different belief-based mediators (Study 3).

Path	Stage		Indirect Association ($P_{MX}P_{YM}$)
	First	Second	
	P_{MX}	P_{YM}	
COVID-19 susceptibility			
Wave 1	-0.287*	-0.005	0.001
Wave 2	-0.118	0.005	-0.001
Difference	-0.169	-0.010	0.002
COVID-19 severity			
Wave 1	-0.179	-0.032*	0.006
Wave 2	-0.034	-0.026*	0.001
Difference	-0.145	-0.006	0.005
COVID-19 susceptibility toward others			
Wave 1	-0.701***	0.034**	-0.024*
Wave 2	-0.285*	0.008	-0.002
Difference	-0.416	0.026	-0.022
COVID-19 severity toward others			
Wave 1	-1.070***	-0.001	0.001
Wave 2	-0.291*	0.015	-0.004
Difference	-0.779***	-0.016	0.005
Vaccine efficacy in minimizing susceptibility			
Wave 1	-1.044***	0.030***	-0.031**
Wave 2	-0.352*	0.018**	-0.006
Difference	-0.692**	0.012	-0.025*
Vaccine efficacy in reducing severity			
Wave 1	-1.411***	0.147***	-0.208***
Wave 2	-0.515***	0.018	-0.009
Difference	-0.896***	0.129***	-0.198***
Social norms			
Wave 1	-0.451***	0.141**	-0.064**
Wave 2	-0.011	0.052*	-0.001
Difference	-0.440***	0.089	-0.063**
Social pressure			
Wave 1	-0.895***	-0.003	0.003
Wave 2	-0.675***	0.010	-0.007
Difference	-0.220	-0.013	0.010

Note: P_{MX} , path from political orientation to the mediator; P_{YM} , path from the mediator to vaccination adherence; ($P_{MX}P_{YM}$), path from political orientation to vaccination adherence through the mediator. Path coefficients were estimated by simultaneously entering mediator variables, together with political orientation and our set of control variables, into a parallel mediation model. P_{MX} coefficients were estimated by OLS linear regression models and P_{YM} coefficients were estimated by linear probability models. To account for multiple hypothesis testing and control for the false discovery rate in multiple comparisons, we adjust critical P -values via the Benjamini-Hochberg correction. The significance of each coefficient following this adjustment is presented in *SI Appendix, Table S9*. Bootstrap replications = 1000. Sample size = 742.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

6. Discussion

6.1. Summary of results

How and why does political polarization concerning COVID-19 vaccination evolve over time? We address these questions across three studies conducted in Brazil using both primary and secondary data sources and relying on different measures of political orientation. Studies 1 and 2 showed that, despite the originally polarized vaccination adherence, where conservative citizens were much less inclined to vaccinate than their liberal peers, the pattern of vaccination adherence converged over time as conservatives became more inclined to get the shot. In the same vein, Study 3 showed that beliefs about the COVID-19 vaccine effectiveness and perceived social norms helped explain the increase in the vaccination rate among conservatives and the ensuing polarization attenuation.

6.2. Implications

This research has several important implications. First, it contributes to the literature on COVID-19 and vaccination by showing that the observed differences across political groups can be temporally specific. Although prior studies documented a lower vaccination adherence among conservatives (Allcott et al., 2020), our findings reveal that such differences should not be treated as static or inevitable. While political divisions over vaccination emerged early in the pandemic and during the first months of rollout (Fridman et al., 2021; Latkin et al., 2021a), evidence concerning how these effects changed over the course of the implementation of immunization programs is lacking. Further, our research joins an incipient body of work (Conway et al., 2016; Federico and Malka, 2018) showing that conservatives are not necessarily particularly close-minded, averse to novelty, and less tolerant of complex thinking, as proposed by the rigidity-of-the-right model (Adorno et al., 1950; Jost et al., 2003; Jost, 2017). While the suggested cognitive rigidity among right-wing people implies that conservatives would be unlikely to update their beliefs given new information, especially when the updated beliefs are inconsistent with the normative group beliefs, our results show that conservatives in fact adjusted their perceptions about the COVID-19 vaccines and social norms, which in turn led them to vaccinate.

Our findings also have relevant policy implications. Just like the COVID-19 pandemic, future health-related crises might also be met with politically polarized responses, which would limit the effectiveness of governmental efforts (e.g., vaccination). As policymakers develop strategies to prepare for future pandemics (WHO, 2023), our results show that political polarization over vaccination adherence is not insurmountable. Indeed, while conservatives were initially skeptic of the vaccines in Brazil, changes in vaccine risk perceptions and perceived social norms prompted them to get the shot. By showing that threat perception and social norms are critical drivers of vaccination behavior, these findings join a fast-growing body of work on how the behavioral sciences can be used to help address health-related challenges (Van Bavel et al., 2020). More specifically, our findings suggest that policymakers might promote broader compliance through messages that leverage on conservatives' behaviors and opinions to convey pro-vaccine social norms and highlight vaccine effectiveness.

6.3. Limitations and future research

This work has limitations that offer opportunities for future investigation. First, although our results are contrived to the context of the COVID-19 pandemic, it speaks to the incipient body of work investigating the longitudinal effects of political ideology on policy preferences and behavior. While previous studies have focused on the debate about the relationships between policy polarization, partisan sorting, and affective polarization (Garner and Palmer, 2011; Mason, 2015; Webster and Abramowitz, 2017), these studies have generally found an increase in policy polarization over time. In contrast, our results reveal that in a context where high quality and quantity of relevant information allows individuals to revisit prior beliefs, policy polarization can in fact be attenuated. Future work investigating how attitudes towards different parties, politicians, and a variety of policies evolve over time would help determine when political polarization is likely to persist or attenuate.

Further, our research is contrived to the Brazilian context. It is an open question whether these findings would emerge in other corners of the world, and, if not, what could account for the differences. Indeed, Brazil combined two distinctive features: a highly polarized society and a history of broad vaccination compliance (Kirby, 2022). In this unique context, although vaccine take-up rates were initially highly polarized, once the political barriers were overcome through shifting perceptions about vaccine effectiveness and group social norms, people reestablished their typical behavior—in this case, taking the shot. In many other countries, however, there is not only a strong political polarization;

non-negligible segments of the population are also hesitant to vaccinate for reasons not necessarily related to political identification (e.g., religiosity [Blume, 2006], fear of side effects [Kumar et al., 2022]). A global assessment of the trajectory of COVID-19 vaccination across political groups and its regional nuances in terms of behavioral patterns and psychological mechanisms would advance our understanding of the subject.

Future work could also explore the specific traits or factors that made conservatives susceptible to change their beliefs about COVID-19 vaccination. Our findings suggest that across the three studies, the individuals who identified more strongly as conservative were notably those who exhibited a more pronounced shift in their attitudes over time (see *SI Appendix*, Figs. S2e and S3e, and Model 6 in *SI Appendix*, Tables S3, S5, and S7). While our Studies 1 and 2 were designed to represent the general Brazilian population, as determined through quota sampling, this approach limits our ability to thoroughly evaluate the evolution of polarization over the COVID-19 vaccine among conservatives from different population subgroups as they are not precisely represented within our studies. Nevertheless, we made an exploratory effort to examine the evolution of vaccination adherence among conservatives from different genders, age groups, income levels, and educational attainment, but no clear and consistent pattern emerged (see *SI Appendix*, Figs. S6a–b and *SI Appendix*, Tables S10–12). Future work could further investigate this issue.

Additionally, non-response might present a problem with respect to selection bias. Across our studies, it is empirically challenging to disentangle what political ideology and vaccination adherence differences exist among individuals who opted not to participate in our surveys. Because we do not have information about the participants who either refused to answer online and telephone surveys (in Studies 1 and 2) or to answer research assistants on the streets (in Study 3), we acknowledge this as a limitation. Future research using administrative secondary data might provide additional and unobtrusive evidence of this phenomenon, while also ruling out selection bias issues.

In the current research, only respondents with a full set of indicator information were included in the analysis, minimizing concerns related to bias resulting from item non-response. Across our studies, individuals who indicated uncertainty regarding either their willingness to receive a COVID-19 vaccine or vaccination status were classified as non-adherent, given that such responses are at odds with a favorable stance toward vaccination. In a similar vein, participants who could not indicate their political orientation or express an evaluation of President Bolsonaro's administration were categorized as non-conservative or non-Bolsonarista, as their responses did not align with this particular political affiliation. Our results remain consistent when examining models restricted to individuals who positioned themselves along the left-right political spectrum or assessed President Bolsonaro's administration (see Model 5 in *SI Appendix*, Tables S3, S5, and S7). When considering the sociodemographic variables, we found that, among all survey waves in Study 2, household income displayed a noteworthy rate of participant refusal. Specifically, in Wave 1, 6.94% of participants chose not to disclose their household income (for detailed information on the overall count of missing observations across all studies, see *SI Appendix*, Table S13). To address this specific case of missing data, we employed a multiple imputation technique, ensuring the robustness and consistency of our results (see Model 7 in *SI Appendix*, Table S5).

Finally, one might argue that the observed increase in vaccine uptake among conservatives over time was due to changing attitudes towards Bolsonaro in advance of his electoral loss in 2022. Although possible, this explanation seems unlikely. Bolsonaro's defeat was not highly anticipated. In the history of Brazilian democracy, no elected President had ever lost a reelection campaign. The incumbent advantage would lead many, and certainly the supporters of Bolsonaro, to think that he, as previous presidents, would be reelected. In electoral contexts, political preferences often intertwine closely with expectations of the electoral outcome, driven by a phenomenon known as wishful thinking, where

individuals tend to anticipate success for their favored candidate (Krizan et al., 2010). Further, the 2022 election was decided only in the runoff by a very tight margin—while President Lula received 50.9% of the valid votes, Bolsonaro received the remaining 49.1% (UOL, 2022). Thus, it is unlikely that conservatives modulated their vaccination behavior between 2021 and early 2022—the data frame in our studies—in anticipation of Bolsonaro's loss in the October 2022 election.

7. Conclusion

In sum, using the context of COVID-19 vaccination in Brazil, this study demonstrates that the predictive power of political orientation on policy observance may attenuate over time. As people are exposed to high-quality information that confronts their existing beliefs, they update such priors and eventually change their behaviors. Party elites and divergent beliefs can create barriers to the coordinated action needed in the face of collective threats by polarizing public opinion and reducing overall compliance. Fortunately, as our findings demonstrate, political polarization over COVID-19 vaccination is neither a static nor an inevitable social phenomenon.

Data analysis

In the studies presented here, for the main analyses, linear probability models followed by Stata 17.0 margins postestimation command were used to estimate the percentage-point difference in the level of vaccination adherence between waves.

CRediT authorship contribution statement

Rodrigo Furst: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Rafael Goldszmidt:** Conceptualization, Methodology, Project administration, Resources, Supervision, Validation. **Eduardo B. Andrade:** Conceptualization, Supervision, Validation, Writing – review & editing. **Yan Vieites:** Conceptualization, Investigation, Project administration, Supervision, Validation, Writing – review & editing. **Bernardo Andretti:** Data curation, Formal analysis, Methodology, Validation, Writing – original draft, Writing – review & editing. **Guilherme A. Ramos:** Writing – original draft, Writing – review & editing.

Data availability

I have shared the link to my data/code at the Attach File step

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2024.116783>.

References

- Adorno, T.W., Frenkel-Brunswick, E., Levinson, D.J., Sanford, R.N., 1950. *The Authoritarian Personality*. Harper, New York.
- Ahluwalia, R., 2000. Examination of psychological processes underlying resistance to persuasion. *J. Consum. Res.* 27, 217–232. <https://doi.org/10.1086/314321>.
- Allcott, H., Boxell, L., Conway, J., Gentzkow, M., Thaler, M., Yang, D., 2020. Polarization and public health: partisan differences in social distancing during the coronavirus pandemic. *J. Publ. Econ.* 191, 104254 <https://doi.org/10.1016/j.jpubeco.2020.104254>.
- Barrios, J.M., Hochberg, Y.V., 2021. Risk perceptions and politics: evidence from the COVID-19 pandemic. *J. Financ. Econ.* 142, 862–879. <https://doi.org/10.1016/j.jfineco.2021.05.039>.
- Blackwell, M., Olson, M., 2021. Reducing model misspecification and bias in the estimation of interactions. *Polit. Anal.* <https://doi.org/10.1017/pan.2021.19>.
- Blume, S., 2006. Anti-vaccination movements and their interpretations. *Soc. Sci. Med.* 62, 628–642. <https://doi.org/10.1016/j.socscimed.2005.06.020>.

- Bougher, L.D., 2017. The correlates of discord: identity, issue alignment, and political hostility in polarized America. *Polit. Behav.* 39, 731–762. <https://doi.org/10.1007/s11109-016-9377-1>.
- Conway III, L.G., Gornick, L.J., Houck, S.C., Anderson, C., Stockert, J., Sessoms, D., McCue, K., 2016. Are conservatives really more simple-minded than liberals? The domain specificity of complex thinking. *Polit. Psychol.* 37, 777–798. <https://doi.org/10.1111/pops.12304>.
- DataFolha, 2021. Data from “Opinião Sobre O Coronavírus”. https://www.cesop.unicamp.br/por/banco_de_dados.
- Doherty, C., 2017. Key Takeaways on Americans’ Growing Partisan Divide over Political Values. <https://www.pewresearch.org/fact-tank/2017/10/05/takeaways-on-americans-growing-partisan-divide-over-political-values/>. (Accessed 25 July 2022).
- Ehret, P.J., Van Boven, L., Sherman, D.K., 2018. Partisan barriers to Bipartisanship: understanding Climate policy polarization. *Soc. Psychol. Personal. Sci.* 9, 308–318. <https://doi.org/10.1177/1948550618758709>.
- Federico, C.M., Malka, A., 2018. The Contingent, Contextual nature of the relationship between needs for security and certainty and political preferences: evidence and implications. *Polit. Psychol.* 39, 3–48. <https://doi.org/10.1111/pops.12477>.
- Fernandes, D., Mandel, N., 2014. Political conservatism and variety-seeking. *J. Consum. Psychol.* 24, 79–86. <https://doi.org/10.1016/j.jcps.2013.05.003>.
- Fernbach, P.M., Van Boven, L., 2022. False polarization: cognitive mechanisms and potential solutions. *Curr Opin Psychol* 43, 1–6. <https://doi.org/10.1016/j.copsyc.2021.06.005>.
- Fridman, A., Gershon, R., Gneezy, A., 2021. COVID-19 and vaccine hesitancy: a longitudinal study. *PLoS One* 16, e0250123. <https://doi.org/10.1371/journal.pone.0250123>.
- Gadarian, S.K., Goodman, S.W., Pepinsky, T.B., 2021. Partisanship, health behavior, and policy attitudes in the early stages of the COVID-19 pandemic. *PLoS One* 16, e0249596. <https://doi.org/10.1371/journal.pone.0249596>.
- Garner, A., Palmer, H., 2011. Polarization and issue consistency over time. *Polit. Behav.* 33, 225–246. <https://doi.org/10.1007/s11109-010-9136-7>.
- Grossman, G., Kim, S., Rexer, J.M., Thirumurthy, H., 2020. Political partisanship influences behavioral responses to governors’ recommendations for COVID-19 prevention in the United States. *Proc. Natl. Acad. Sci. U.S.A.* 117, 24144–24153. <https://doi.org/10.1073/pnas.2007835117>.
- Hu, C., Rivers, M., Reverdosa, M., Pedroso, R., 2021. Brazil’s Covid-19 Resurgence Is Pushing Hospitals to Overflowing. <https://edition.cnn.com/2021/03/15/world/brazil-variant-icu-crisis-sao-paulo-intl-latam/index.html>. (Accessed 29 August 2022).
- Huber, G., Malhotra, N., 2017. Political homophily in social relationships: evidence from online dating behavior. *J. Polit.* 79, 269–283. <https://doi.org/10.1086/687533>.
- Iyengar, S., Lelkes, Y., Levendusky, M., Malhotra, N., Westwood, S.J., 2019. The origins and consequences of affective polarization in the United States. *Annu. Rev. Polit. Sci.* 22, 129–146. <https://doi.org/10.1146/annurev-polisci-051117-073034>.
- Jost, J.T., 2017. Ideological asymmetries and the essence of political psychology. *Polit. Psychol.* 38, 167–208. <https://doi.org/10.1111/pops.12407>.
- Jost, J.T., Glaser, J., Sulloway, A.W., Sulloway, F.J., 2003. Political conservatism as motivated social cognition. *Psychol. Bull.* 129, 339–375. <https://doi.org/10.1037/0033-2909.129.3.339>.
- Jost, J.T., Nosek, B.A., Gosling, S.D., 2008. Ideology: its resurgence in social, personality, and political psychology. *Perspect. Psychol. Sci.* 3, 126–136. <https://doi.org/10.1111/j.1745-6916.2008.00070.x>.
- Ju, Y., You, M., 2022. It’s politics, Isn’t it? Investigating Direct and indirect influences of political orientation on risk perception of COVID-19. *Risk Anal.* 42, 56–68. <https://doi.org/10.1111/risa.13801>.
- Kerr, J., Panagopoulos, C., van der Linden, S., 2021. Political polarization on COVID-19 pandemic response in the United States. *Pers. Individ. Differ.* 179, 110892. <https://doi.org/10.1016/j.paid.2021.110892>.
- Khan, R., Misra, K., Singh, V., 2013. Ideology and brand consumption. *Psychol. Sci.* 24, 326–333. <https://doi.org/10.1177/095679761245737>.
- Kirby, J., 2022. How Brazil Survived its President’s Vaccine Skepticism. <https://www.vox.com/22909351/brazil-vaccines-bolsonaro-covid-19-misinformation>. (Accessed 9 October 2023).
- Krizan, Z., Miller, J.C., Johar, O., 2010. Wishful thinking in the 2008 U.S. presidential election. *Psychol. Sci.* 21 (1), 140–146. <https://doi.org/10.1177/0956797609356421>.
- Kumar, S., Shah, Z., Garfield, S., 2022. Causes of vaccine hesitancy in adults for the Influenza and COVID-19 vaccines: a systematic literature review. *Vaccines (Basel)* 10 (9), 1518. <https://doi.org/10.3390/vaccines10091518>.
- Latkin, C.A., Dayton, L., Yi, G., Konstantopoulos, A., Boodram, B., 2021a. Trust in a COVID-19 vaccine in the U.S.: a social-ecological perspective. *Soc. Sci. Med.* 270, 113684. <https://doi.org/10.1016/j.socscimed.2021.113684>.
- Latkin, C., Dayton, L., Yi, G., Jaleel, A., Nwosu, C., Limaye, R., 2021b. COVID-19 vaccine delay: an examination of United States residents’ intention to delay vaccine uptake. *Hum. Vaccines Immunother.* 17, 2903–2913. <https://doi.org/10.1080/21645515.2021.1917234>.
- Lee, T., Shi, D., 2021. A comparison of full information maximum likelihood and multiple imputation in structural equation modeling with missing data. *Psychol. Methods* 26, 466–485. <https://doi.org/10.1037/met0000381>.
- Lelkes, Y., 2018. Affective polarization and ideological sorting: a reciprocal, albeit weak, relationship. *Forum* 16, 67–79. <https://doi.org/10.1515/for-2018-0005>.
- Lord, C.G., Ross, L., Lepper, M.R., 1979. Biased assimilation and attitude polarization: the effects of prior theories on subsequently considered evidence. *J. Pers. Soc. Psychol.* 37, 2098–2109. <https://doi.org/10.1037/0022-3514.37.11.2098>.
- Mason, L., 2015. “I Disrespectfully agree”: the Differential effects of partisan sorting on social and issue polarization. *Am. J. Polym. Sci.* 59, 128–145. <https://doi.org/10.1111/ajps.12089>.
- Mazui, G., 2020. Bolsonaro volta a falar em ‘histeria’ e diz que ações de governadores sobre isolamento prejudicam a economia. <https://g1.globo.com/politica/noticia/2020/03/17/bolsonaro-volta-a-falar-em-histeria-e-diz-que-acoes-de-governadores-so-bre-isolamento-prejudicam-a-economia.ghtml>. (Accessed 9 October 2023).
- Pedroso, R., 2021. Brazil’s Bolsonaro Says He Will Not Be Vaccinated against Covid-19. <https://edition.cnn.com/2021/10/13/americas/bolsonaro-no-vaccine-intl/index.html>. (Accessed 30 July 2022).
- Rabb, N., Bowers, J., Glick, D., Wilson, K.H., Yokum, D., 2022. The influence of social norms varies with “others” groups: evidence from COVID-19 vaccination intentions. *Proc. Natl. Acad. Sci. U.S.A.* 119, e2118770119. <https://doi.org/10.1073/pnas.2118770119>.
- Ramos, G.A., Vieites, Y., Jacob, J., Andrade, E.B., 2020. Political orientation and support for social distancing during the COVID-19 pandemic: evidence from Brazil. *Rev. Adm. Pública.* 54, 697–713. <https://doi.org/10.1590/0034-761220200162x>.
- Reid, A.E., Cialdini, R.B., Aiken, L.S., 2021. Social Norms and Health Behavior in Handbook of Behavioral Medicine, Steptoe, A. (Eds.), Springer, pp. 263–274.
- Rogers, R.W., Prentice-Dunn, S., 1997. In: Gochman, D.S. (Ed.), Handbook of Health Behavior Research 1: Personal and Social Determinants. Plenum Press.
- Rosenstock, I.M., 1974. Historical origins of the health belief model. *Health Educ. Q.* 2, 328–335. <https://doi.org/10.1177/109019817400200403>.
- Schmelz, K., Bowles, S., 2022. Opposition to voluntary and mandated COVID-19 vaccination as a dynamic process: evidence and policy implications of changing beliefs. *Proc. Natl. Acad. Sci. U.S.A.* 119 (13), e2118721119. <https://doi.org/10.1073/pnas.2118721119>.
- Shafranek, R.M., 2021. Political considerations in nonpolitical decisions: a conjoint analysis of roommate choice. *Polit. Behav.* 43, 271–300. <https://doi.org/10.1007/s11109-019-09554-9>.
- Shaw, J., Anderson, K.B., Fabi, R.E., et al., 2022. COVID-19 vaccination intention and behavior in a large, diverse, U.S. refugee population. *Vaccine* 40 (9), 1231–1237. <https://doi.org/10.1016/j.vaccine.2022.01.057>.
- Sivis, 2021. Data from “Valores em Crise, Base de Dados, Instituto Sivis”, Curitiba. <https://sivis.org.br/microdados/vic-2/>.
- Taber, C.S., Lodge, M., 2006. Motivated skepticism in the evaluation of political beliefs. *Am. J. Polym. Sci.* 50, 755–769. <https://doi.org/10.1111/j.1540-5907.2006.00214.x>.
- UOL, 2022. <https://noticias.uol.com.br/eleicoes/2022/apuracao/2turno/>. (Accessed 9 October 2023).
- UOL, 2023. ‘Se virar jacaré, é problema seu’: o que Bolsonaro já disse sobre vacinas. <https://noticias.uol.com.br/politica/ultimas-noticias/2023/05/03/jair-bolsonaro-vacina-covid-19.htm>. (Accessed 9 October 2023).
- Van Bavel, J.J., Pereira, A., 2018. The partisan brain: an identity-based model of political belief. *Trends Cognit. Sci.* 22, 213–224. <https://doi.org/10.1016/j.tics.2018.01.004>.
- Van Bavel, J.J., Baicker, K., Boggio, P.S., et al., 2020. Using social and behavioural science to support COVID-19 pandemic response. *Nat. Human Behav.* 5, 460–471. <https://doi.org/10.1038/s41562-020-0884-z>.
- Van Boven, L., Ehret, P.J., Sherman, D.K., 2018. Psychological barriers to Bipartisan public support for climate policy. *Perspect. Psychol. Sci.* 13, 492–507. <https://doi.org/10.1177/1745691617748966>.
- Vieites, Y., Ramos, G.A., Andrade, E.B., Pereira, C., Medeiros, A., 2021. Can self-protective behaviors increase unrealistic optimism? Evidence from the COVID-19 pandemic. *J. Exp. Psychol. Appl.* 27, 621–631. <https://doi.org/10.1037/xap0000379>.
- Vlasceanu, M., Coman, A., 2021. The effects of Dyadic conversations on coronavirus-related belief change. Proceedings of the Annual Meeting of the Cognitive Science Society 43. <https://escholarship.org/uc/item/1778c6kz>.
- Walsh, N.P., 2020. Bolsonaro Calls Coronavirus a ‘little flu.’ inside Brazil’s Hospitals, Doctors Know the Horrifying Reality. <https://edition.cnn.com/2020/05/23/america/brazil-coronavirus-hospitals-intl/index.html>. (Accessed 27 July 2022).
- Wang, D., Lu, J., 2022. How news agencies’ Twitter Posts on COVID-19 vaccines Attract audiences’ Twitter Engagement: a content analysis. *Int. J. Environ. Res. Publ. Health* 19, 2716. <https://doi.org/10.3390/ijerph19052716>.
- Webster, S.W., Abramowitz, A.I., 2017. The ideological foundations of affective polarization in the U.S. Electorate. *Am. Polit. Res.* 45, 621–647. <https://doi.org/10.1177/1532673X17703132>.
- WHO, 2023. A Checklist for Respiratory Pathogen Pandemic Preparedness Planning. World Health Organization, Geneva, 2023. Licence: CC BY-NC-SA 3.0 IGO.