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Rainy Friday:
Religious Participation and Protests

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Abstract

What are the effects of religious participation on collective action such as protests? Until recently, conflict scholars have focused on macro-level characteristics of religion, while assuming, but rarely analyzing, individual-level mechanisms. I fill the gap by incorporating the insights from the literature of American Politics, which has long emphasized the roles of individual-level mechanisms such as attendance at religious gatherings. Borrowing from those insights, I argue that attendance at religious gatherings can address collective action problems and thus lead to protests. I test the hypotheses by exploiting an exogenous variation in the attendance at Islamic religious gatherings: rainfall on the day of Friday Prayer. I apply the design both to macro-level event data and an individual-level survey. The analyses indicate that rainy Fridays decrease the frequency of Muslim religious attendance and lower the likelihood of Muslim protests in Africa. These results imply a core role of communal gatherings in religious mobilization.

Keywords: Religion, Protest, Islam, Rainfall

JEL classification: D71, D74, Z12

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After the 2002 Israeli military incursion in the West Bank, an imam gave a sermon at a mosque in Fez, Morocco:

> Didn't you hear the shriek of that Muslim baby who cried his heart out for a sip of milk that the Jews refused to let him have? You are right God; you are right God when you said: 'we have cursed them for their hearts are cruel', 'we have cursed them for their hearts are cruel' (*Laalnahum wa jaalna qulubahum kasiah*). These are the Jews; these are the Jews (the pitch of the imam's voice goes higher when he repeats the 'Jews'); their evil ways should not come as a surprise to us. But what hurts the most, what hurts the most is this despicable reluctance to support our brothers on the land of *Isra'* and *Mi'raj*. Where are you, you spies, you traitors, you the scum of the Arabs (reference to Arab rulers)? You have sold your people; you have sold all the causes of the Muslim community (*umma*), even the Palestinian cause (Errihani 2011, 387).

Combined with the rhetorical tone of the Arabic language and the imam's oratory skills, the sermon sounded quite emotional. This speech is not particularly special to the 2002 Israeli incursion (Errihani 2011); imams routinely give similar sermons at Friday Prayer, a communal gathering of Muslims every Friday. It is easy to imagine how regular exposure to such indoctrinating speech gradually erodes the minds of the attendees.

What are the effects of attendance at communal religious gatherings on collective action, such as protests? As illustrated by the example above, regular attendance at religious gatherings can change people's religious and political beliefs, which in turn can constitute a key motivation for joining religious protests. In fact, previous literature on American politics has long emphasized the roles of religious communal gatherings, including church attendance, in collective action

(Verba, Schlozman, and Brady 1995; Putnam 2000). However, these insights have not been extended to conflict studies, with only a few exceptions from recent studies (Brooke, Chouhoud, and Hoffman forthcoming; Hoffman 2020a; 2020b; Hoffman and Nugent 2017). Conflict scholars tend to focus on the macro-level characteristics of religion, assuming but rarely analyzing individual-level behaviors (see Grzymala-Busse 2012; Philpott 2009; Gill 2001 for an overview).

In this paper, I fill those gaps by analyzing the effects of Friday Prayer attendance on protests. Borrowing insights from the field of American Politics (Verba, Schlozman, and Brady 1995; Putnam 2000), as well as resource mobilization theories (Wald, Silverman, and Fridy 2005; McCarthy and Zald 1977), I hypothesize that communal religious gatherings can address collective actions problems and thus provide opportunities for protests. Communal gathering can allow religious leaders to cultivate the trust of the attendees and thus mobilize the masses in protests (leadership mechanism). Communal gathering can also foster increased social capital thus helping horizontal coordination among attendees (social capital mechanism). Finally, Friday Prayer can also change people's religious and political beliefs and thus provide non-material motivations for joining protests (motivation mechanism).

Analyzing the causal effects of Friday Prayer on protests, however, poses empirical challenges. As previous studies show, religious participation is endogenous to protest participation (Brooke, Chouhoud, and Hoffman forthcoming; Eisenstein 2006). Recent studies have addressed the problem by using survey and natural experiments (Brooke, Chouhoud, and Hoffman forthcoming; Butcher and Pinckney 2022; Hoffman 2020a; 2020b; Iyer and Shrivastava 2018; Hoffman and Nugent 2017), but they tend to focus on the immediate effects of religious gatherings. However, it is *regular, habitual* attendance at religious gatherings that can nurture human

relationships and change personal beliefs (Verba, Schlozman, and Brady 1995; Putnam 2000). The core parameter of interest has not been analyzed due to endogeneity.

I address those problems by exploiting a unique analytical opportunity in Islamic religious practices: rain on the day of Friday Prayer. Although Friday Prayer is one of the most important religious obligations for Muslims, attendance can be waived due to bad weather. While rain rarely poses challenges in the arid climate of the Middle East, it can be a real problem in other regions such as Africa. By using Friday rainfall as exogenous variation and carefully addressing other empirical issues related to rainfall (Mellon 2022; Betz, Cook, and Hollenbach 2020; Gallen 2020; Schultz and Mankin 2019; Sarsons 2015), I first show that if a year has more rainy Fridays, it significantly decreases the number of Muslim protests in Africa. I then apply a similar design to an individual-level survey and demonstrate that rainy Fridays indeed suppress attendance at religious practices. Combined with the extensive robustness checks and analyses on effect heterogeneities, the empirical analyses imply that Friday Prayer constitutes a key mechanism in religious mobilization.

These findings put forth a new research agenda in conflict studies: the micro-level dynamics of religion and conflict. This certainly does not deny the importance of macro-level factors, but they lead to conflict only through individual behaviors. Religious diversity, for instance, is reported to stimulate competition among religious groups and thus cause conflict (Isaacs 2017; Trejo 2009; Grim and Finke 2007). However, this macro-level relationship is mediated by individual behaviors; competition should increase the salience of religion and hence facilitate religious and political participation at an individual level. It is therefore critically important to unpack the micro-level dynamics of religion and conflict.

Religion and Collective Action

Two distant subfields in political science—American Politics and Conflict Studies—discuss religion and collective actions with different focuses and concepts. Although conflict studies put less emphasis on religion until the late 2000s (Grzymala-Busse 2012; Wald and Wilcox 2006), later studies started analyzing the topic with an emphasis on macro-level factors. For instance, they examine religious diversity and competition among religious groups (Gerring, Hoffman, and Zarecki 2018; Isaacs 2017; Basedau, Pfeiffer, and Vüllers 2016; Trejo 2009; Grim and Finke 2007; Toft 2007), grievances (Basedau et al. 2017; Basedau, Pfeiffer, and Vüllers 2016), political institutions (Muchlinski 2014), the organizational characteristics of religious groups (Hale 2015; Collins 2007; Fox 1999), and the personal characteristics of religious leaders (Basedau, Pfeiffer, and Vüllers 2016; Basedau and Koos 2015; Hauk and Muller 2015).

Importantly, these macro studies often assume individual-level behaviors. For instance, religion provides norms and beliefs as well as material resources, which in turn have various effects on individual behaviors such as participation in collective actions (Gerring, Hoffman, and Zarecki 2018; Basedau et al. 2017; Basedau, Pfeiffer, and Vüllers 2016; Basedau and Koos 2015). Previous studies tend to *assume* those individual-level behaviors and then analyze macro-level characteristics (e.g., religious diversity, institutions, and inequality). However, without understanding the underlying individual behaviors, the causal mechanisms remain untested.

This contrasts with the field of American Politics, in which religion constitutes a core concept in studies about "civic engagement," including participation in protests. Following the foundational studies in this field (Verba, Schlozman, and Brady 1995; Putnam 2000), many studies analyzed individual-level factors in conjunction with macro-level factors (Layman 1997). While several studies look at how religious beliefs relate to civic engagement (McVeigh and Sikkink

2001; Driskell, Embry, and Lyon 2008), more studies examined the roles of religious practices, such as church attendance (Lewis, Macgregor, and Putnam 2013; Eisenstein 2006; Djupe and Gilbert 2006; Jamal 2005; Scheufele, Nisbet, and Brossard 2003; Jones-Correa and Leal 2001; Calhoun-Brown 1996). Church attendance can allow participants to cultivate a relationship with religious leaders, form social relationships with other followers, and even change their own religious and political beliefs.

Several studies try to bridge the gap by incorporating the insights from American Politics into conflict studies and thus providing micro-foundations. Although a group of studies examines religious beliefs (Rink and Sharma 2018; Ginges et al. 2016; Canetti et al. 2010; Ginges, Hansen, and Norenzayan 2009; Ginges et al. 2007), recent studies have analyzed the effects of religious practices, including Muslim attendance at Friday Prayer (Brooke, Chouhoud, and Hoffman forthcoming; Butcher and Pinckney 2022; Hoffman 2020a; 2020b; Arikan and Bloom 2019; Iyer and Shrivastava 2018; Hoffman and Nugent 2017; Hoffman and Jamal 2014).

These studies are, however, not immune to problems. Although several studies look at the associations between religious and protest participation (Arikan and Bloom 2019; Hoffman and Jamal 2014), these two modes of participation are endogenous (Brooke, Chouhoud, and Hoffman forthcoming; Eisenstein 2006). Outgoing tendencies, public awareness, and organizational strength of religious groups, for instance, can all affect both religious and protest participation. Moreover, the causal relationship can be reversed; participation and social interactions during protests might increase the salience of religion and thus facilitate religious participation.

Recent studies (Brooke, Chouhoud, and Hoffman forthcoming; Butcher and Pinckney 2022; Hoffman 2020a; 2020b; Iyer and Shrivastava 2018; Hoffman and Nugent 2017) address the endogeneity problem by using experimental and quasi-experimental approaches. They use survey

experiments by randomly assigning words that are expected to prime a communal religious mindset (e.g., "sects" and "sermon"). In addition, they also exploit as-if random coincidences for survey interviews with Friday—a day of Friday Prayer.[1]

Although the experimental and quasi-experimental approaches are quite useful and I do not necessarily claim that my design would be superior in every aspect, there is still room for improvement. As Hoffman (2020a) acknowledges, the extant designs only identify the immediate effects of communal gatherings; the survey experiment can analyze the effects of experimental primes within a few minutes or hours, while the natural experiment can analyze the effect within a day or week.[2] However, as the literature suggests (Putnam 2000; Verba, Schlozman, and Brady 1995), the core variable of interest is *regular* attendance at religious gatherings. Only through habitual attendance at religious gatherings, people gradually develop a relationship with religious leaders, accumulate social capital, and change their own beliefs. Thus, even though previous studies provide useful insights on the short-term effects of religious gatherings, it is also crucial to study the long-term effects.

Furthermore, previous studies tend to use self-reported accounts of protest participation.[3] Nonetheless, I am substantively interested in the actual occurrence of protests, which may or may not correspond to survey responses. Without referring to the problems of social desirability biases (Cantoni et al. 2019; Karp and Brockington 2005), survey questions are qualitatively different

[1] A few qualitative studies also analyze the Friday effect (Ketchley and Barrie 2020; Butt 2016).

[2] Hoffman (2020a; 2020b) address these problems by conducting associational analyses as well.

[3] A notable exception is Butcher and Pinckney (2022). They look at the short-term effects of Friday Prayer. This paper is interested in the long-term effects.

from imams' speeches or their brethren's requests for help. While people may not express their willingness to join protests in formal interviews, they may respond positively to imams' emotional calls or invitations from their brethren. This difference may account for null results in previous studies (Hoffman 2020a; Hoffman and Jamal 2014; Eisenstein 2006).

Finally, economic studies use as-if random variations in big religious events, such as Ramadan (Aksoy and Gambetta 2020; Hodler, Raschky, and Strittmatter 2020; Campante and Yanagizawa-Drott 2015) and Hajj (Clingingsmith, Khwaja, and Kremer 2009), to identify causal effects. However, those big events are different from habitual attendance at religious gatherings. Although this certainly does not deny the importance of Ramadan or Hajj, the literature instead emphasizes the roles of regular communal gatherings (Putnam 2000; Verba, Schlozman, and Brady 1995). Thus, it remains important to analyze the effects of regular communal gatherings. I fill these gaps by incorporating theoretical insights from American Politics, applying a research design that was recently proposed in a different context (Moreno-Medina 2021; Hungerman and Moorthy forthcoming),[4] and analyzing both macro- and individual-level outcomes.

Argument

I argue that regular attendance at communal religious gatherings allows a religious group to coordinate protests by solving collective action problems. Although earlier studies tend to focus on grievance (Gurr 1993), certain degrees of grievance exist in all societies, and grievance does not lead to protests in the presence of collective action problems (Olson 1971). That is, even if people would be collectively better off by having a protest, individuals may not be sufficiently

[4] Moreno-Medina (2021) analyzes the effect of Christians' Sunday gatherings on crime in the U.S. by using Sunday rainfall.

incentivized to join a protest. Joining a protest requires substantial time and effort as well as facing the potential risks of government repression and violence by opposing groups. With those costs, people may prefer to free ride by not joining a protest while enjoying its resulting benefits. But if everyone tries to free-ride, no one participates in protests.

Habitual attendance at religious gatherings addresses the collective action problem by nurturing leadership, social capital, and/or religious motivations (Wald, Silverman, and Fridy 2005; McCarthy and Zald 1977). First, religious leaders can recruit and cultivate a trusting relationship with followers through regular communal gatherings (*leadership mechanism*; Brooke, Chouhoud, and Hoffman forthcoming; Hoffman 2020b; Jamal 2005; Scheufele, Nisbet, and Brossard 2003; Jones-Correa and Leal 2001). Sermons can demonstrate religious leaders' oratory skills and knowledge about religious and public matters. In communal gatherings, religious leaders can also give advice and, if necessary, material support to followers. They can also provide social welfare, including the provision of basic materials, education, and medical care. These material and spiritual benefits can work as selective incentives for protest participation; if people respond to a religious leader's call to protest, they can continue to receive these benefits. If they refuse, however, they might be excluded from receiving benefits. People then join protests to maintain their relationship and access to benefits through their religious community.

Second, communal gatherings can also strengthen the horizontal relationship among brethren and thus create social capital resources (*social capital mechanism*; Lewis, Macgregor, and Putnam 2013; Djupe and Gilbert 2006; Jamal 2005; Scheufele, Nisbet, and Brossard 2003; Putnam 2000; Verba, Schlozman, and Brady 1995). Communal gatherings can nurture civic skills such as working with other people, combining different opinions, and organizing collective actions. Regular communication can also alleviate the problem of private information by allowing the

attendees to share their willingness to join protests. Finally, people may find new friends in religious gatherings, and these friendships and ensuing peer pressure can deter free riding. These social capital resources can address collective action problems and hence facilitate the coordination of a protest.

Third, communal gatherings can also foster in-group awareness and provide a sense of self-efficacy (*motivation mechanism*; Brooke, Chouhoud, and Hoffman forthcoming; Hoffman 2020a; Calhoun-Brown 1996; Harris 1994).[5] Communal gatherings can create in-group awareness and gradually ferment hostility against out-groups. The indoctrinating preaching of religious leaders and discussions with brethren make people more interested in religious and other public affairs and more motivated to act for just causes. Those group-level and individual-level motivations can outweigh the physical and psychological costs of joining protests. Although communal gatherings may not cause such a drastic change on everyone, changing even a few people's behavior is sometimes sufficient (Chenoweth and Belgioioso 2019; Bikhchandani, Hirshleifer, and Welch 1992; Kuran 1991; Granovetter 1978). If a few people join a protest for motivational reasons, it marginally improves the protest's prospect and thus induces more people to join, which in turn can elicit the participation of yet more people. This can even snowball into a large-scale protest.

Thus, based on previous studies, I hypothesize that communal religious gatherings increase the likelihood of religious protests, because they provide leadership, social capital, and motivational resources. Inversely, the lack of communal gatherings makes it more difficult to use

[5] Although group awareness and personal efficacy are sometimes considered different mechanisms, I combine them into a single group. From the perspective of collective actions, they deter free riding by changing the subjective payoffs of protest participation.

those resources, to address collective action problems, and thus to organize protests. Although this paper is not intended to emphasize particular mechanisms or to claim that the mechanisms would be mutually exclusive, I explore possible causal mechanisms at the end of the empirical analyses. A remaining problem is, however, the ways to identify the causal relationship. To this end, an Islamic religious practice—Friday Prayer—provides a unique analytical opportunity.

Case: Friday Prayer in Africa

Friday Prayer, more formally *Ṣalat al-Jum'ah*, is one of the most important religious obligations for Muslims. Muslims are obligated to perform daily prayers (*salat*) five times a day: *fajr* (sunrise), *zuhr* (noon), *asr* (afternoon), *maghrib* (sunset), and *isha* (night). Friday Prayer replaces *zuhr* and is held right after the sun passes its zenith. While daily prayers can be performed individually, Friday Prayer must be congregational and is usually held at mosques. Before the prayer, an imam gives a couple of sermons (*khutbah*). The sermons are supposed to be religious in principle, but they can also be political. Then, members of the congregation pray together. After the prayer, people often stay nearby their mosque and chat about various topics, or even go for lunch or coffee. Friday Prayer is mandatory for adult men in most Islamic denominations. Although it is not obligatory for women and children, a majority of women attend the prayer in Africa. In fact, it is reported that over 77% of female Muslims in Africa attend Friday Prayer every week, while the number reaches 91% for males (Pew Research Center 2010).

Although Friday Prayer is one of Islam's most important religious obligations, there exists an exemption. Upon bad weather, people are permitted to not attend the prayer. A jurist organization in Egypt states that "[t]here is a consensus among jurists on the permissibility of refraining from attending congregational prayers at mosques due to severe rain, floods, snow, or wind among other matters that pose danger to the safety of people or place hardship on them" (Dar

al-Ifta al Misriyyah 2022). Although the statement admits only "severe rain" as a cause, in practice, there exists no formal definition of this severity. This exemption therefore constitutes a loophole in the religious obligation of Friday Prayer; if one perceives a specific rainfall as "severe," then s/he can rightfully avoid the obligation. Although this behavior may seem sacrilegious to pious people, not everyone is willing to attend Friday Prayer. Although Muslim countries tend to observe Friday as a weekend, Friday is a working day in many countries. Even if Friday is a day off, people may want to spend time with family and on other private matters. For those people, rainy weather can provide a good excuse for their absence.

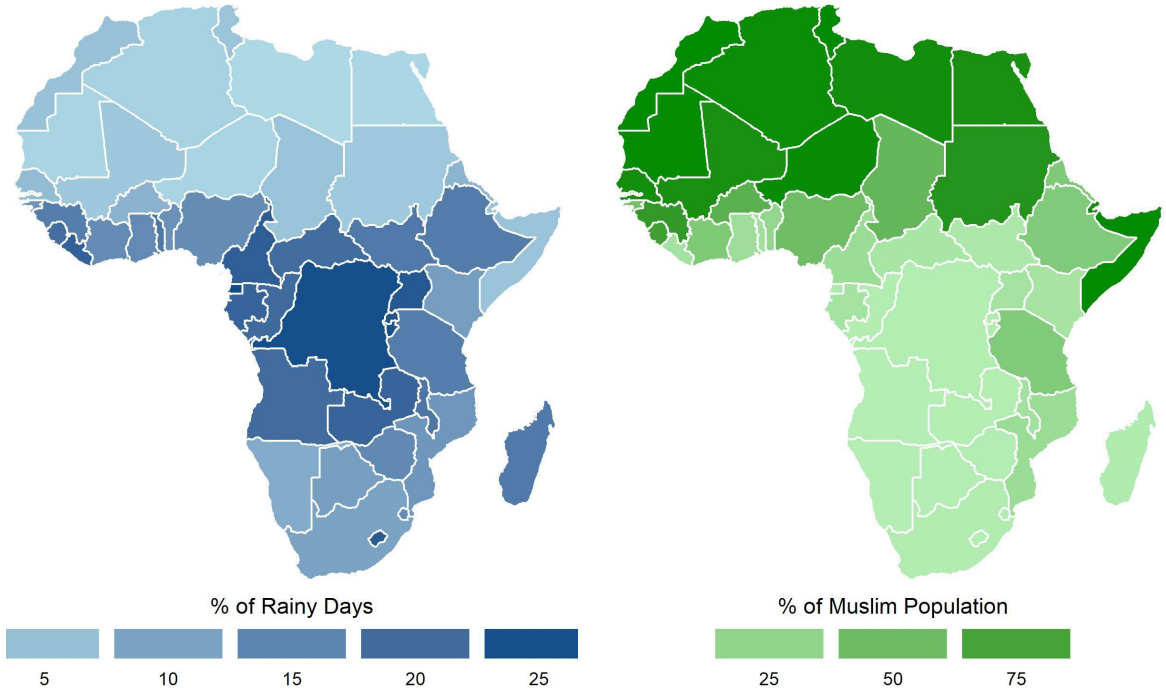
This feature of Friday Prayer provides an opportunity for a natural experiment. I can leverage the weather-induced variation to identify the causal effects of Friday Prayer. Importantly, this design enables me to analyze the effects of *regular* (non-)attendance at communal practices. While everyone has the same number of Fridays in a year, the number of rainy Fridays varies across locations and times. This variation can be used for identifying the long-term effects of religious attendance—the core parameter of interest.

This design, however, requires a meaningful variation in rainfall. If rainfall is scarce, there will be almost no rainfall-induced variation in religious attendance. For this reason, I analyze the case of Muslims in Africa. Compared to the arid climate of the Middle East, [6] African countries have higher amounts of precipitation. As seen in Figure 1, even though rainfall is rare in North Africa and the Sahara Desert, the Islamic faith permeates Sub-Saharan countries with greater amounts of precipitation, including Guinea, Sierra Leone, Ethiopia, Tanzania, and Mozambique,

[6] Extreme heat is usually not considered a legitimate reason of absence. With extreme heat, Friday Prayer is simply postponed to later in the day.

among others. Moreover, unlike in other regions, geo-coded surveys are available in Africa (i.e., Afrobarometer).[7] This allows me to calculate Friday rainfall for each individual and thus to check micro-level mechanisms. Together with a large number of protests, the coexistence of multiple religions, and the variation in political, economic, and social characteristics, those unique features make Africa particularly suitable for this analysis.

Figure 1. Rainfall and Muslim Population in Africa



NOTE: The maps show the percentages of rainy days (left) and Muslim population (right) in African countries.

Event Data Analysis: Design

I examine the effects of Friday Prayer in Africa by conducting two sets of analyses. By using macro-level event data, I first analyze whether Friday rainfall has any causal relationship with Muslim protests. I then use an individual-level survey to confirm that Friday rainfall indeed suppresses attendance at religious practices and also to explore the causal mechanisms. Given the

[7] The geo-locations of respondents are not available in the World Value Survey or Arab Barometer.

different coverages of the datasets, it is difficult to combine these analyses into a single estimate (i.e., Wald estimator or two-stage least square) without making strong assumptions (Zhao et al. 2019). Instead of relying on such assumptions, I simply show them as two separate analyses.[8]

In the event data analysis, I examine a "reduced-form" relationship between Friday rainfall and Muslim protests (aka., intention-to-treat effect). I assume that Friday rainfall affects Muslim protests only through its effect on Friday Prayer attendance (exclusion restriction) and also that Friday rainfall decreases attendance (relevance). With those assumptions, the reduced-form regression is sufficient for testing the hypothesis even without the instrumental variable approach (Angrist and Pischke 2009).[9] Because these assumptions are of critical importance, I later check possible violations of the exclusion restriction and also examine whether Friday rainfall indeed reduces attendance at Friday Prayer in an individual-level survey.

Since recent studies point out several issues related to the rainfall-based designs, I carefully assess those problems. First, rainfall has broad effects, including those on conflict itself, agriculture, and other economic activities (Mellon 2022; Gallen 2020; Sarsons 2015).[10] This may mean that the exclusion restriction will not hold. I address this problem by focusing on the unique effect of *Friday* rainfall; that is, I only look at whether Fridays happen to be rainy or not, and remove any broad effects of rainfall common to Fridays and other days of the week. *Unless Friday rainfall has*

[8] To be sure, I mention a naïve Wald estimator in the survey data analysis.

[9] More precisely, I can test, if not point-estimate, the effect of Friday Prayer. The Wald estimator is $\rho = \frac{\text{the effect in the reduced form}}{\text{the effect at the first stage}}$. Under the assumption that the first-stage effect is negative and constant, ρ is non-zero only if the effect in the reduced form is non-zero.

[10] In fact, Ritter and Conrad (2016) use rainfall as an instrumental variable of protests.

the same effect on Muslim protests as rainfall on other days except for its effect through Friday Prayer, the exclusion restriction holds. To be sure, I analyze whether Friday rainfall has any other special effects (e.g., the effect on "Friday nights"). I also examine the effects on placebo outcomes; Christian and non-religious protests. If the exclusion restriction holds, Friday rainfall should not affect Christian or non-religious protests.

Second, rainfall is spatially correlated, and spatial dependency might bias the estimates (Betz, Cook, and Hollenbach 2020). Moreover, spatial regressions (e.g., spatial lag models) tend to depend on relatively strong assumptions, such as those about the order and functional form of spatial dependency. I address these problems by using spatial eigenvector filtering, which accounts for arbitrary forms of spatial dependency without relying on strong assumptions (see Griffith, Chun, and Li 2019 for details; see Ito 2021 for a recent application). I also adjust the standard errors by using spatial heteroscedasticity and autocorrelation consistent errors (spatial HAC; Conley and Molinari 2007).

Finally, the weather-related variables might be subject to systematic measurement errors if their measurement depends on observations at weather stations (Schultz and Mankin 2019). Combined with the reporting biases in conflict event datasets (Weidmann 2016), this might bias the estimates. In this study, however, I use satellite-based rainfall data that do not depend on observations made at weather stations. Importantly, because Friday rainfall is exogenous, the reporting biases of the conflict events pose less concern as well; "as long as the measurement error is uncorrelated with the independent variables, measurement error in the dependent variable is not particularly problematic in a standard regression framework other than increasing the uncertainty around the estimates we obtain" (Weidmann 2016, 208).

Sample and Unit

The unit of analysis is a grid-cell i and week t.[11] The sample includes 10,675 grid-cells in 49 African countries for 1999-2018.[12] The grid-cells have 50km on each side and are based on the PRIO GRID dataset—standard spatial units widely used in conflict studies (Tollefsen, Strand, and Buhaug 2012). Although the analysis can be done at a daily level as well, the sheer amount of the data makes it difficult.

Outcome Variable

The outcome variable Y_{it} is the incidence of protest events in a grid-cell i and week t. The data are derived from the Integrated Crisis Early Warning System (ICEWS) dataset (Boschee et al. 2015). The ICEWS dataset is a machine-coded dataset based on more than 38 million multilingual news sources. Metternich et al. (2013) even accredited it as "the current gold standard for event data" (901), though its quality is still disputed (Wang et al. 2016; Ward et al. 2013). I therefore conduct additional analyses with the Social Conflict Analysis Database as well (SCAD; Hendrix and Salehyan 2013). Although the SCAD substantially underreports events (the SCAD reports only 144 incidences of Muslim protests in my sample, which is about one-sixth that of the ICEWS), it contains richer information about individual events, such as issues, targets, and sizes of protests. To my knowledge, the ICEWS and SCAD are the only data that fit the analytical purpose of this paper. The Armed Conflict Location and Event Data (ACLED; Raleigh et al. 2010) contains no

[11] See Appendix 1 for summary statistics.

[12] The time period includes all weeks in which the data are available.

information about protestors' religion.[13] The Mass Mobilization Protest Dataset (Clark and Regan 2021) does provide this information, but they list only 31 Muslim protests in Africa between 2000 and 2020. The Nonviolent and Violent Campaigns and Outcomes (NAVCO) dataset does not contain information about protestors' religiosity and only has available data for 11 African countries (Chenoweth and Lewis 2013).

If the ICEWS classifies the initiator of a protest as Muslim, Sunni, or Shia (the ICEWS makes this classification based on news stories; see Boschee et al. 2015 for details), the event is counted as a Muslim protest.[14] In total, the sample contains 917 incidences of Muslim protests. In later robustness checks, I also use the count and its logarithm of Muslim protests.

Treatment Variable

The treatment variable $D_{\text{Fri},i(t-52,t)}$ is the proportion of rainy Fridays in a grid-cell i in the last 52 weeks ($= 364$ days; excluding week t) from week t. If there is any precipitation in the daytime, that Friday is counted as a rainy day. This choice is based on a previous study (Moreno-Medina 2021) and the substantive contexts that I discussed. Although only "severe" rainfall is considered a legitimate reason for absence from Friday Prayer, in practice, people can use any rainfall as an

[13] The ACLED has recently launched ACLED-Religion, but it only includes four Arabic countries for the year of 2020 or later (as of 2022-04-21).

[14] Because the actor names are less standardized in the SCAD, I use a keyword search. An event is classified as a Muslim protest if the names of demonstrators contain either "Muslim," "Islam," "Shia," "Shiite," "Sunni," or "Salafi."

excuse.[15] The precipitation data come from the Tropical Rainfall Measuring Mission (TRMM) of NASA and the Japan Aerospace Exploration Agency (JAXA; Huffman et al. 2007). The TRMM is based on satellite images and radar and is available at a resolution of 0.25 degrees (about 25km) every three hours between 1998 and 2018. In the main analysis, I use the precipitation between 9:00 and 18:00 as daytime rainfall and later disaggregate the analysis to every three hours in a day.

Specification

With these variables, I use a linear regression model:[16]

$$Y_{it} = \alpha + \delta D_{\text{Fri},i(t-52,t)} + \beta D_{i(t-52,t)} + h_i(\text{W}) + \varepsilon_{it}. \quad (1)$$

The control variable $D_{i(t-52,t)}$ is the proportion of rainy days in grid-cell i in the last 52 weeks from week t (including Fridays). The spatial eigenvectors $h_i(\text{W})$ account for an arbitrary form of spatial dependency (Griffith, Chun, and Li 2019).[17] The model also includes an intercept α and error term ε_{it}. I estimate the coefficients by OLS with the spatial HAC standard errors of a 200km

[15] Note also that average rainfall does not properly capture the theoretical argument. For example, average rainfall can be the same in the following two cases: (a) a day of disastrous rainfall and a sunny day, and (b) two days of rainfall. However, a person is obliged to attend Friday Prayer on the second day of case (a), while a person has no such obligation in case (b).

[16] For the purpose of causal inference, a linear probability model is preferable to logit or probit models (see Angrist and Pischke 2009).

[17] The model controls for all eigenvectors whose eigenvalues are at least one fourth of the maximum eigenvalue (Griffith, Chun, and Li 2019).

window (Conley and Molinari 2007).[18] Because $D_{\text{Fri},i(t-52,t)}$ highly correlates with $D_{i(t-52,t)}$ ($r = 0.97$), I remove the multicollinearity in a robustness check by using the deviation of rainy Fridays (i.e., $D_{\text{Fri},i(t-52,t)} - D_{i(t-52,t)}$).

The quantity of interest is δ, the effect of rainy Fridays on protests. Importantly, δ captures the effect of rainy days *specific to Friday*. Any effect of rainy days that is common to Friday and other days of the week is captured by β. To see this, equation (1) is derived as follows;

$$\begin{aligned} Y_{it} &= \alpha + (\delta + \beta) D_{\text{Fri},i(t-52,t)} + h_i(\text{W}) + \varepsilon_{it} \\ &= \alpha + \delta D_{\text{Fri},i(t-52,t)} + \beta D_{\text{Fri},i(t-52,t)} + h_i(\text{W}) + \varepsilon_{it} \\ &= \alpha + \delta D_{\text{Fri},i(t-52,t)} + \beta D_{i(t-52,t)} + h_i(\text{W}) + \varepsilon_{it}. \end{aligned} \tag{2}$$

As seen in the first and second lines of equation (2), rainy Fridays have the effect unique to Friday δ and common effect of rainy days β. From the second to the last line, I separate these effects by using the fact that the common effect β is, by definition, the same on Friday and other days of the week. This means that I can simply replace $\beta D_{\text{Fri},i(t-52,t)}$ with $\beta D_{i(t-52,t)}$—the proportion of rainy days in a year. The common effect β includes a wide array of the effects of rainfall, such as its direct effects on protests and other conflicts, agriculture, and the economy (Mellon 2022; Gallen 2020). The common effect β also accounts for confounders, such as geo-climatic conditions. The treatment effect δ is the remainder of rainfall's effects that are specific to Fridays. *Whether it is a causal mechanism, violation of exclusion restriction, or confounding bias, only Friday-specific reasons explain* δ.

[18] The spatial window is chosen using the rule of thumb (Berge et al. 2020). The results are robust to the choices of the spatial windows. See a later robustness check.

I do not include any fixed effects because $D_{i(t-52,t)}$ accounts for nearly all confounders. For instance, the grid-cell fixed effects are redundant because geo-climatic factors are already accounted for by $D_{i(t-52,t)}$. Similarly, the week fixed effects are not necessary since the treatment is as-if randomly assigned over time. In fact, as I will show later in a robustness check, the results are nearly identical regardless of the fixed effects.

Finally, note that the estimate $\hat{\delta}$ is proportional to the local average treatment effect (Angrist and Pischke 2009): an effect that is local to observations in which rainfall reduces Friday Prayer attendance. As I mentioned in the case description, those observations tend to be less religious; they do not dare to visit mosques on rainy Fridays. Less pious people, however, often constitute a critical mass in protests. Because pious people are more likely to join protests, collective action depends on the participation of less pious people. The key is whether communal gatherings can change the minds of the less pious people and thus stop them from free riding.

Event Data Analysis: Results

Table 1 shows the results of the event data analysis. As seen in the second row, if a year has more rainy Fridays, it decreases the likelihood of protests by Muslims. By contrast, rainy Fridays have a null effect on protests by Christians or non-religious actors, providing indirect evidence for exclusion restriction. The null results also suggest that the spatial eigenvectors and HAC properly account for the spatio-temporal autocorrelation and inflated sample size. Finally, the general effect of rainy days captured by $\hat{\beta}$ is positive for Muslim and non-religious protests, but the coefficients include confounding biases and thus cannot be easily interpreted.

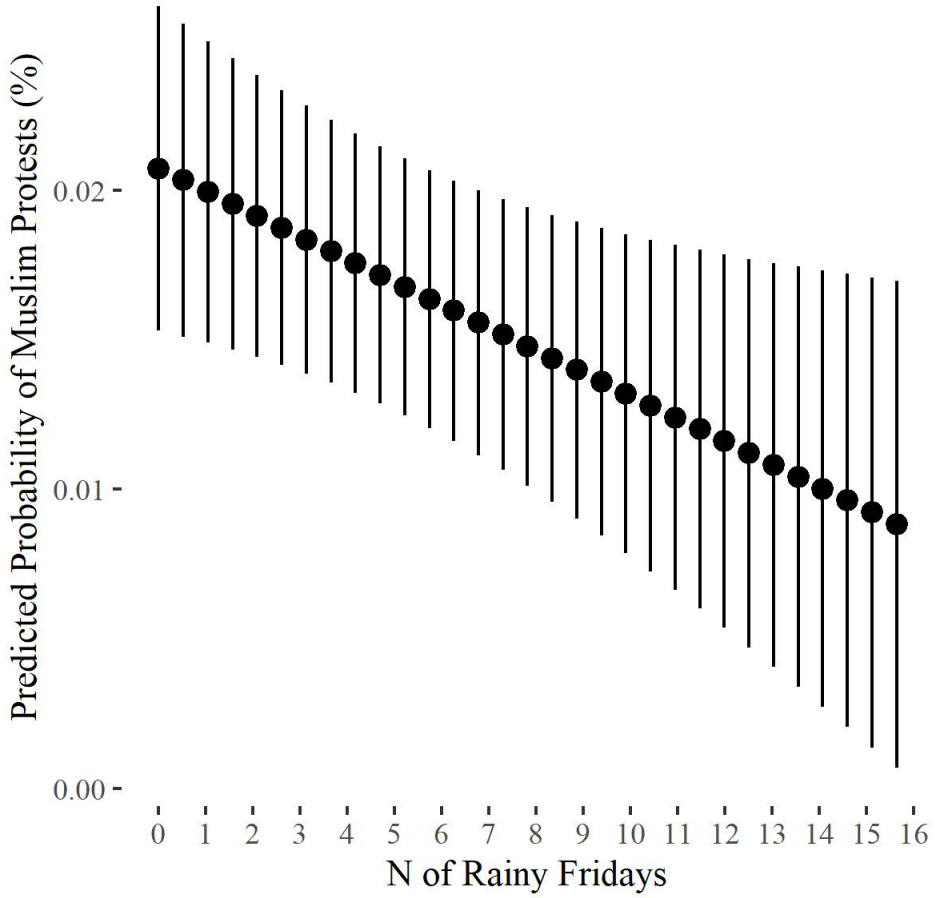
Table 1. The Effects of Rainy Fridays on the likelihoods of Protests

	Muslim protests (%)	Christian protests (%)	Non-religious protests (%)
Rainy Fridays ($\hat{\delta}$, prop.)	-0.040^{*} (0.017)	0.012 (0.015)	0.493 (0.344)
Rainy days ($\hat{\beta}$, prop.)	0.070^{*} (0.029)	0.000 (0.012)	1.086^{*} (0.468)
N		10,751,823	

NOTE: The model includes spatial eigenvectors. The standard errors are the spatial HAC with a 100km window. * $p < 0.05$, † $p < 0.1$.

Figure 2 shows the substantive effect sizes of rainy Fridays (the proportion is scaled back to the count of rainy days) on the likelihood of Muslim protests. Because the sample probability of Muslim protests is 0.008%, if a year happens to have seven more rainy Fridays, it decreases the probability of Muslim protests by about 50% from the average. Although the rarity of Muslim protests makes it rather difficult to interpret the results, the analysis indicates that Friday rainfall has a sizable effect on Muslim protests.

Figure 2. The Effect of Rainy Fridays on Muslim Protests



NOTE: The figure shows the substantive effects of rainy Fridays (the proportion is scaled back to the count of rainy days) on the probability of Muslim protests (%). The vertical bars are the 95% confidence intervals.

In Table 2, I also conduct placebo tests by using *future* Friday rainfall (proportion of rainy Fridays in the next 52 weeks). The results indicate that none of the outcomes are associated with future Friday rainfall. Only the control variable—the proportion of future rainy days—is associated with non-religious protests. The control variable accounts for geo-climatic confounders and thus can correlate with the overall likelihood of protests.

Table 2. Placebo Tests with Future Rainfall

	Muslim protests (%)	Christian protests (%)	Non-religious protests (%)
Future rainy Fridays ($\hat{\delta}$, prop.)	−0.016	0.008	0.491
	(0.018)	(0.010)	(0.345)
Future rainy days ($\hat{\beta}$, prop.)	0.050	0.004	1.182*
	(0.031)	(0.007)	(0.476)
N		10,751,823	

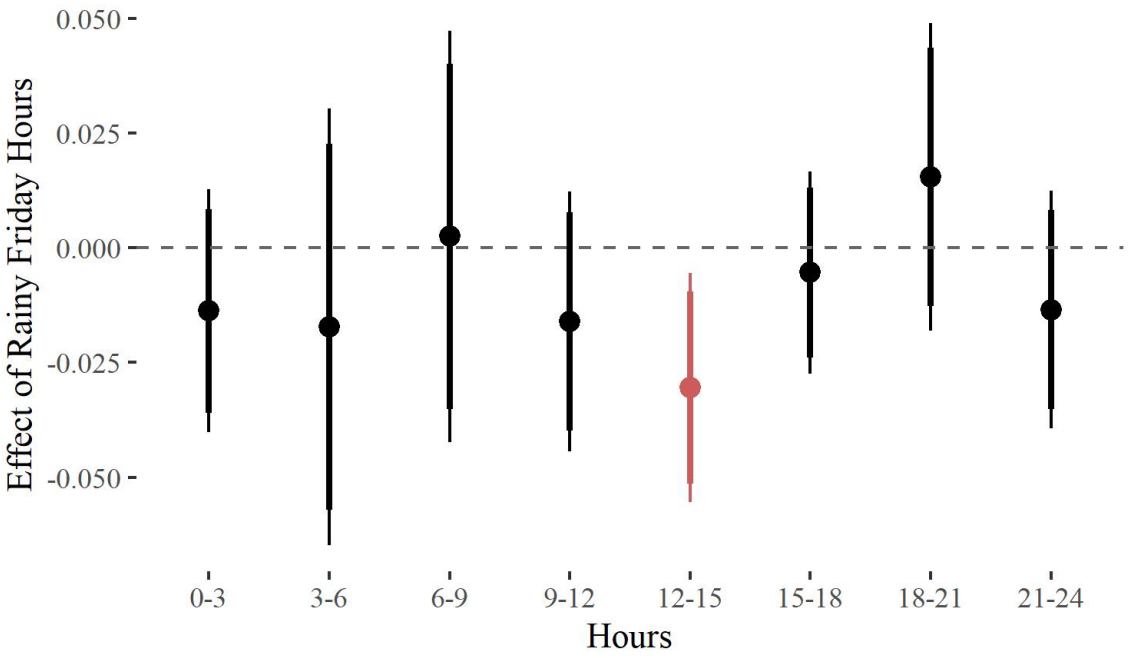
NOTE: The model includes spatial eigenvectors. The standard errors are the spatial HAC with a 100km window. * $p < 0.05$, † $p < 0.1$.

Decomposition

Because the rainfall data are available every three hours, I decompose the estimate by hours.[19] If the main results represent the effects of Friday Prayer, the effect should be pronounced at the time of Friday Prayer (early afternoon). As seen in Figure 3, the effect of rainfall is large and statistically significant at 12:00-15:00, while the effects at other hours are null.

[19] To avoid multicollinearity, I made a regression model equivalent to (1) for every three hours, and then I separately estimated the coefficients. The treatment variable is the proportion of Fridays that have precipitation at the given hours.

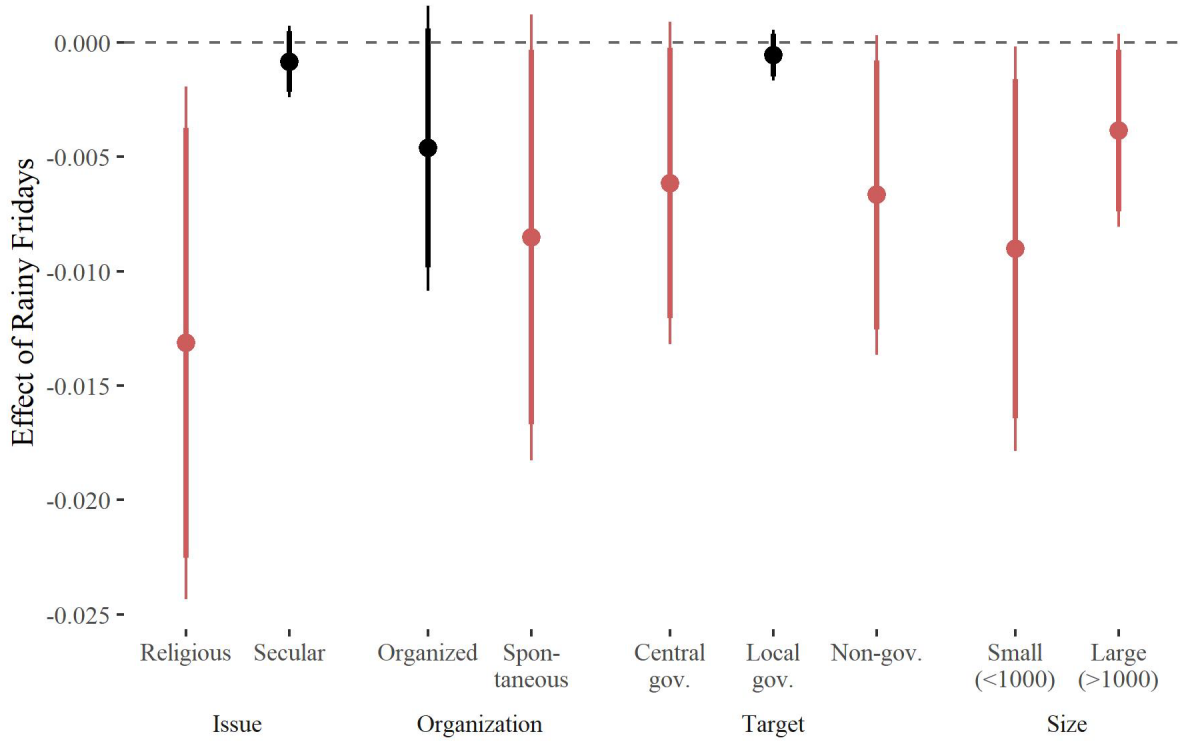
Figure 3. The Effect of Rainy Fridays for Every Three Hours (Event Data Analysis)



NOTE: The figure shows the effect of rainy Fridays for every three-hour interval on protests. The vertical bars are the 95% (thin) and 90% (thick) confidence intervals.

In Figure 4, I use the SCAD and decompose the effects by issues, organizational levels, targets, and sizes of protests by Muslims. The fact that the effects are large for small-scale spontaneous protests may cast doubt on the leadership mechanism (assuming that mobilization by religious leaders is more likely to result in large-scale organized protests). In addition, the effect is small for protests targeting local governments. This is not surprising given the fact that local governments are less responsible for religious matters and thus Muslim protestors often target central governments or non-state actors, such as Christians.

Figure 4. Analysis with the Alternative Dataset (SCAD)



NOTE: The figure shows the effects of rainy Fridays on protests by different categories of protest events. The vertical bars are the 95% (thin) and 90% (thick) confidence intervals.

Additional Analyses

Finally, I conduct a series of additional analyses, which are summarized in Table 3 and detailed in the online appendix. I first check possible violations of exclusion restriction by analyzing the effects of rainy Fridays on economic activities (measured by nightlight density) and agriculture (measured by surface vegetation). I find no Friday-specific effect. The results are also robust to the different measurements of the outcome variable, use of rainy-days deviations, control for rainy days on the surrounding days of the week, inclusion of various fixed effects, different specification of the variance-covariance matrix, and omission of any country.

Table 3. Additional Analyses (Event Data Analysis)

	Results	Appendix
Exclusion restriction (night light and vegetation)	✓	Table A2-1
Different transformations of the outcome (count and its log)	−*	Table A3-1
Deviation of rainy Fridays ($D_{\text{Fri},it} - D_{it}$)	−*	Table A3-2
Controlling for rainy Thursdays and Saturdays	−*	Table A3-3
Grid-cell fixed effects	−*	Table A3-4
Year-week fixed effects	−*	Table A3-4
Two-way fixed effects	−*	Table A3-4
Different windows for spatial HAC errors (0-500km)	−*	Figure A3-1
Standard errors clustered by countries	−*	Table A3-5
Leave-one-country-out tests	−*[1]	Figure A3-2

NOTE: The table shows the results of additional analyses and the corresponding parts of the appendix. Note 1: Significant only at a 10% level in one out of 49 cases. * $p < 0.05$, † $p < 0.1$.

Survey Analysis: Design

The event data analysis indicates that rainy Fridays decrease Muslim protests. The macro-level analysis, however, must be supplemented with individual-level analyses. To this end, I now turn to an individual-level survey to analyze the "first-stage" relationship at an individual level (i.e., the effect of rainy Fridays on Friday Prayer attendance) and also to explore the causal mechanisms.[20]

The basic design is the same as that in the event data analysis; I leverage rainy Fridays as exogenous variation in Friday Prayer attendance. I also check placebo effects on non-Muslims. If Friday rainfall only affects Friday Prayer, it should not affect non-Muslims. Finally, I account for problems related to measurement errors and spatial dependency by using satellite-based data, spatial eigenvector approach, and spatial HAC errors.

[20] I also analyzed the effects on respondents' intent to join demonstrations. However, I only found null results, perhaps due to the measurement problems mentioned in the literature review (see p.6 of this manuscript).

Sample and Unit

The unit of analysis is a respondent in the sixth wave of the Afrobarometer (2016).[21] The Afrobarometer is the most consistent and extensive survey in Africa. The sixth wave is the only round of the Afrobarometer that includes an item about religious practices. Importantly, unlike other surveys such as the World Value Survey and Arab Barometer, the Afrobarometer contains respondents' location, which is necessary for calculating the amount of rainfall in each respondent's locality. The sample includes 15,366 Muslims and 32,380 non-Muslims in 32 African countries between 1 March 2014 and 22 November 2015.[22] Only about 14% of Muslims refer to their denomination.

Outcome Variable

The outcome variable Z_k is a seven-point scale about the frequency of religious practices. The sixth wave of the Afrobarometer asks the question: "[a]side from weddings and funerals, how often do you personally engage in religious practices like prayer, reading a religious book, or attending a religious service or a meeting of a religious group?" (2016, 64).[23] Unfortunately, unlike previous studies (Hoffman 2020a; 2020b), the question contains personal religious practices. Because people are likely to stay home and conduct personal, instead of congregational, religious practices on rainy Friday (personal prayer and reading books are indoor activities), I conjecture that the measurement error for this question creates a bias toward positive values. This means that if rainy

[21] See Appendix 4 for summary statistics.

[22] Non-responses are dropped.

[23] The interview answers range from "never," "a few times a year," "once a month," "once a week," "few times a week," "once a day" to "more than once a day" (Afrobarometer 2016, 64).

Fridays decrease the frequency of religious practices, this can be considered a conservative estimate. Thus, although I fully admit the limitations of using this data, I emphasize that the Afrobarometer is the only dataset that covers multiple African countries with precise geo-locations. The analytical opportunities provided by those features, in my view, outweigh the limitations.

Treatment Variable

The treatment variable $D_{\text{Fri},k}$ is the proportion of rainy Fridays in the past 52 weeks (= 364 days) from the day of a survey interview (excluding the day of the interview). Importantly, unlike other surveys, the Afrobarometer is geocoded, and the dates of survey interviews are available for all respondents. Using this information and rainfall data from the TRMM, I calculate the proportion of rainy Fridays for every respondent.

Specification

In the survey analysis, I made the following regression model:

$$Z_k = a + bM_k + \lambda_0(1 - M_k)D_{\text{Fri},k} + \lambda_1 M_k D_{\text{Fri},k} + \gamma_0(1 - M_k)D_k + \gamma_1 M_k D_k + g_k(\text{W}) + \epsilon_k. \quad (3)$$

Because Friday rainfall should only affect Muslims, I include the dummy of Muslims (M_k takes 1 if k is a Muslim) and estimate the effects of rainy Fridays for Muslims (λ_1) and non-Muslims (λ_0). With the same specification, I control for the effects of rainy days D_k (the proportion of rainy days in the past 52 weeks since an interview). The term $g_k(\text{W})$ is the spatial eigenvectors that account

for spatial dependencies.[24] The terms a and ϵ_k are an intercept and error term. I estimate the coefficients by OLS with the spatial HAC errors of the 100km window.[25]

The parameter of interest is λ_1, which represents the causal effect of rainy Fridays on Muslims' frequency of engaging in religious practices. The parameter λ_0 is a placebo effect of rainy Fridays on the religious practices of non-Muslims. If Friday rainfall affects the outcomes other than Muslims' Friday Prayer, λ_0 might be non-zero. The terms γ_0 and γ_1 capture the effects of rainy days in general (e.g., effects on economic statuses and moods) and the confounding biases (e.g., geo-climatic conditions). Thus, as in the event data analysis, the Friday-specific causal effect λ_1 is isolated from the common effects of rainy days γ_1. *Whether it is causal mechanisms or selection biases, the value of the coefficient λ_1 must be explained by Friday-specific reasons*. Because D_k already accounts for confounders, the model does not contain any fixed effect.[26]

Survey Analysis: Results

Table 4 shows the results of the main analysis. As seen in the second row, rainy Fridays decrease the frequency of religious practices among Muslims, while the effects are indistinguishable from zero for non-Muslims (third row). Substantively, if a year happens to have seven additional rainy Fridays, it lowers the frequency of religious practices by one point. If this result is combined with the findings in the event data analysis, a one-point increase in the frequency of religious practices

[24] The eigenvectors are chosen using the same criteria as in the event data analysis. See footnote 17.

[25] The spatial window is chosen using the same criteria as in the event data analysis. See footnote 18.

[26] See p.19 for a discussion about fixed effects.

increases the likelihood of Muslim protests by 0.005.[27] This corresponds to a 63% increase from the sample probability of Muslim protests. However, as stated earlier, this calculation relies on strong assumptions (Zhao et al. 2019) and should be taken with extreme caution. Finally, the fourth and fifth rows of Table 5 suggest that rainy days are associated with a higher frequency of religious practices, but the estimates are not precise or easily interpretable.

Table 4. The Effects of Rainy Fridays on the Frequency of Religious Practices

	Religious practices
Rainy Fridays, Muslim ($\hat{\lambda}_1$, prop.)	-7.064^{*} (2.786)
Rainy Fridays, non-Muslim ($\hat{\lambda}_0$, prop.)	-0.826 (1.534)
Rainy days, Muslim ($\hat{\gamma}_1$, prop.)	5.888 (3.808)
Rainy days, non-Muslim ($\hat{\gamma}_0$, prop.)	1.339 (1.663)
N	45,694

NOTE: The model includes a dummy for Muslims and spatial eigenvectors. The standard errors are the spatial HAC with a 200km window. * $p < 0.05$, † $p < 0.1$.

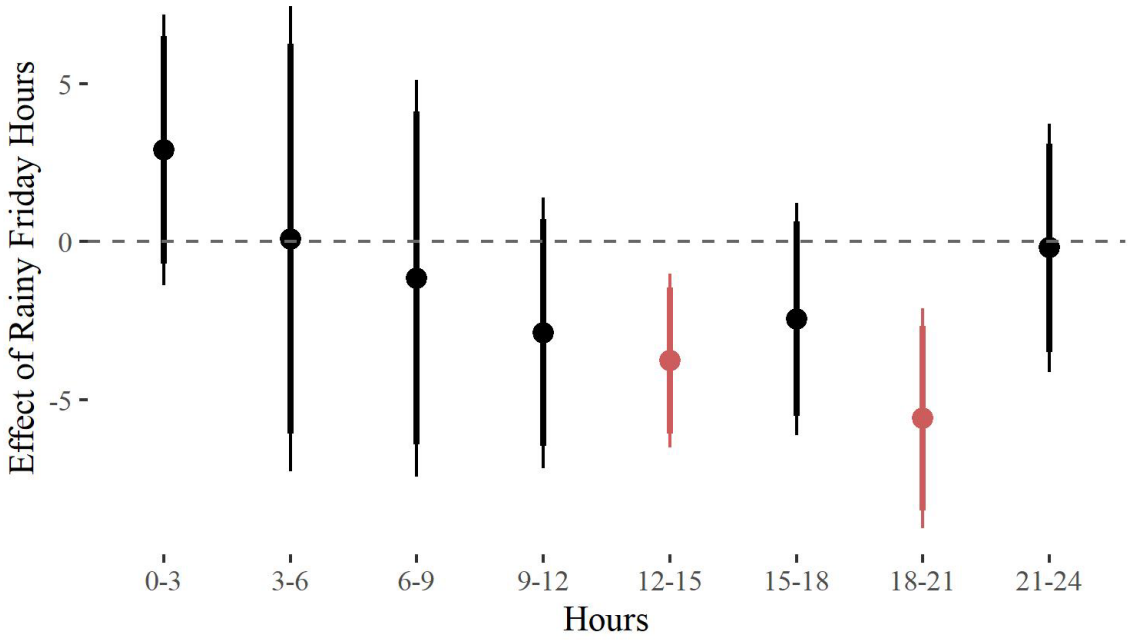
Decomposition

Similar to the event data analysis, I decompose the estimates to every three hours. In each column of Figure 5, I use the proportion of Fridays that have precipitation in certain hours of the day. As seen in Figure 5, the effects are relatively large during busier hours (9:00-21:00), especially 12:00-15:00 and 18:00-21:00. The result for precipitation during the period 12:00-15:00 is consistent with the event data analysis and the fact that Friday Prayer is usually held in the early afternoon. The result for 18:00-21:00 is trickier. One possibility is that people may be inspired by the

[27] The naïve Wald estimate is $-0.040/-7.064$.

communal practices at Friday Prayer and thus conduct personal religious practices at night (e.g., reading religious books). On a rainy Friday, however, they do not attend Friday Prayer and thus may not be inspired to conduct personal religious practices at night (or they conduct these practices earlier). Having said that, the results should not be over-interpreted as the hourly measures of rainfall are highly correlated with each other.

Figure 5. The Effect of Rainy Fridays for Every Three Hours (Survey Analysis)



NOTE: The figure shows the effect of rainy Fridays for every three-hour interval on protests. The vertical bars are the 95% (thin) and 90% (thick) confidence intervals.

Additional Analyses

I also conduct additional analyses, which are summarized in Table 5 and detailed in the appendix. First, I checked the covariate balances by using each of the demographic covariates as an outcome variable. Since I found a few imbalances with respect to age, race, and cash income, I also repeated the main analysis while controlling for the demographic covariates and found similar results. Additionally, I examine effect heterogeneity due to demographic characteristics and also possible violations of exclusion restriction. Finally, the results are robust to different measurement of the

treatment variable, control for rainy days on surrounding days of the week, inclusion of fixed effects, different specification of the standard errors, and omission of a country. The only exception is the inclusion of interview-date fixed effects, though the main results are maintained in a more restrictive model of the two-way fixed effects. Since I look at a relatively small variation of rainfall (rainy Fridays controlling for rainy days), the fixed effects can easily cause overfitting problems, making the estimates sensitive to measurement errors (Wooldridge 2005), and thus resulting in large attenuation biases. However, because the fixed effects are not essential in the identification strategy,[28] I do not think the results pose particular concerns.

Table 5. Additional Analyses (Survey Analysis)

	Results	Appendix
Balance checks	✓[1]	Figure A5-1
Effect heterogeneity by demographic characteristics	✓	Figure A6-1
Exclusion restriction (moods)	✓	Figure A7-1
Controlling for demographic characteristics	−*	Table A8-1
Deviation of rainy Fridays ($D_{\text{Fri},it} - D_{it}$) as a treatment	−*	Table A8-2
Controlling for rainy Thursdays and Saturdays	−*	Table A8-3
Location fixed effects	−*	Table A8-4
Interview date fixed effects	−	Table A8-4
Two-way fixed effects	−*	Table A8-4
Different windows for spatial HAC errors (0-500km)	−*	Figure A8-1
Standard errors clustered by countries	−*	Table A8-5
Leave-one-country-out tests	−*[2]	Figure A8-2

NOTE: The table shows the results of additional analyses and the corresponding parts of the appendix. Note 1: There is an imbalance with respect to age, race, and cash income. Note 2: Only significant at a 10% level in one out of 32 cases. * $p < 0.05$, † $p < 0.1$.

Causal Mechanisms

The above analyses indicate that Friday rainfall decreases attendance at religious practices. Combined with the event data analysis, the evidence is consistent with the argument that Friday rainfall curbs Friday Prayer attendance, which in turn makes it difficult to coordinate protests.

[28] See p.19 for a discussion about fixed effects.

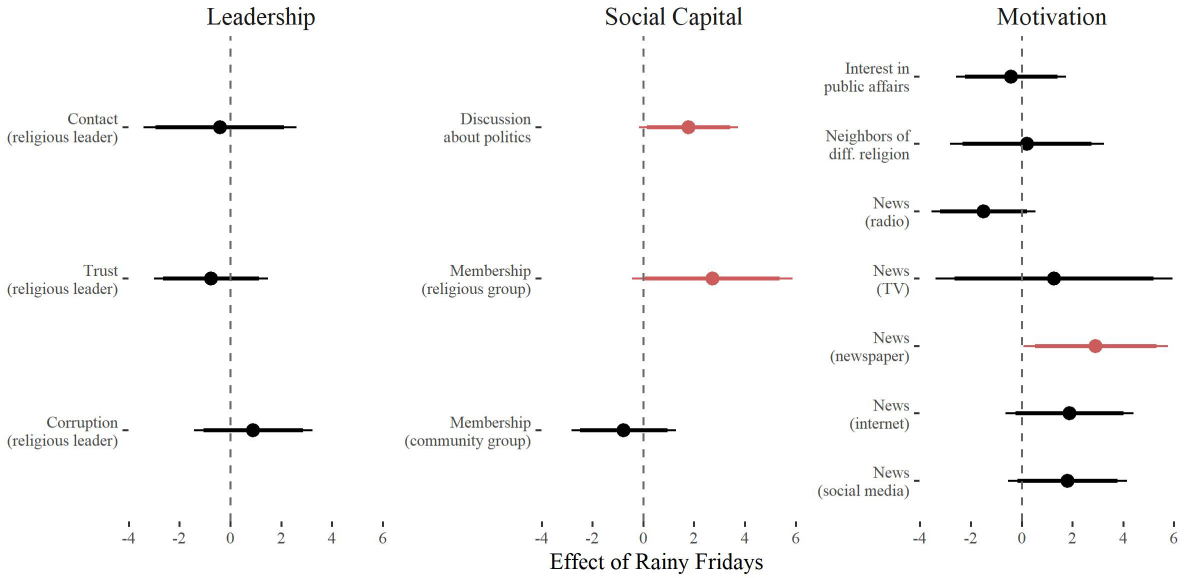
Although I have already examined the individual-level mechanism (religious attendance), further investigation is worthwhile. To this end, I empirically explore the three mechanisms—leadership, social capital, and motivation—by using corresponding survey items.[29]

For the leadership mechanism, I use three items about religious leaders in the Afrobarometer: frequency of contact with religious leaders, trust in religious leaders, and perceived corruption of religious leaders. For the social capital mechanism, I select the frequency of discussions about politics, membership in religious groups, and membership in community groups. Finally, for the motivation mechanism, I use positive attitudes toward neighbors of different religions, interest in public affairs, and frequency of consuming the news via radio, television, newspaper, the internet, and social media.

As seen in Figure 6, the results provide a more nuanced picture, suggesting that the causal mechanisms are more complicated than predicted by previous studies. Rainy Fridays have null effects on the indicators of leadership, and the point estimates are nearly zero (first column of Figure 6). By contrast, rainy Fridays *increase* the frequency of discussing politics, memberships in religious groups, and the frequency of reading news in newspapers and, to a lesser extent, via the internet and social media. These are contradictory to the social capital and motivation mechanisms.

[29] See Appendix 9 for detailed information on these survey items.

Figure 6. Causal Mechanisms



NOTE: The figure shows the effects of rainy Fridays on various items related to the causal mechanisms. The horizontal bars are the 95% confidence intervals.

A potential explanation is people's adaptive responses. That is, when people lose their opportunity to attend communal prayer, they seek social capital by actively discussing politics and joining religious groups. Upon bad weather, people can also spend more time watching the news. These responses, in turn, allow people to maintain their relationship with religious leaders, as well as their religious and political beliefs. However, these independent activities can potentially make people less reliant on religious organizations, making it more difficult for religious leaders to mobilize them, and thus lowering the likelihood of Muslim protests.

Clearly, these are retrospective conjectures and over-interpretations. I did not expect these mechanisms before conducting this research. Moreover, the statistical evidence is not particularly strong; the results are only significant at a 10% level and are not significant once adjusted for multiple hypothesis testing. Thus, the above results should be considered suggestive evidence, and the proposed mechanisms must be rigorously tested in separate research.

Discussion

In this paper, I argued that regular attendance at communal religious gatherings can address collective action problems by providing leadership, social capital, and motivational resources. Because religious attendance can be endogenous to protests, I use Friday rainfall as an exogenous variation. That is, rainy Fridays can deter Friday Prayer attendance, which in turn makes it more difficult to solve problems of collective action and thus coordinate protests. The event data analysis indicates that rainy Fridays indeed decrease the likelihood of protests. The survey analysis confirms that rainy Fridays also forestall Muslims from attending religious practices. The exploratory analyses on the causal mechanisms, however, imply that the causal mechanisms are more nuanced than previously expected.

These findings underline a micro-level dynamic between religion and collective action. As Verba et al. (1995) and Putnam (2000) argue in the context of American Politics, communal religious gatherings can provide opportunities for collective action. Previous literature on social movements also emphasizes the role of religious activities (Wald, Silverman, and Fridy 2005; McCarthy and Zald 1977). These insights, however, have not been extended to quantitative studies of conflict until recently (Brooke, Chouhoud, and Hoffman forthcoming; Hoffman 2020a; 2020b). Moreover, even studies in the field of American Politics tend to explain the effects of religious gatherings without accounting for people's adaptive responses. Expanding the scope of these theories and empirical analyses is a task for future studies.

In addition, this paper proposed a new approach to rainfall-based research designs. Although rainfall is used in almost every field of social sciences, I exploit the unique effects of *Friday* rainfall and explicitly separate it from the broader effects of general rainfall. By using an exogenous shock that is very specific to the treatment, I can minimize, if not eliminate, possible

violations of the exclusion restriction. Similar approaches can be used with other weather-induced variations (e.g., snowfall, natural disasters), outcomes (e.g., political attitudes, economic development), regions (e.g., Middle East, Southeast Asia), and religions (e.g., Sunday gatherings for Christians, religious festivals for Hindus). This approach can address the increasing skepticism toward rainfall-based research designs (Mellon 2022; Gallen 2020).

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