

Appendix To: Disorganized Political Violence: A Demonstration Case of Temperature and Insurgency

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Descriptive Statistics

TABLE 1. *Descriptive Statistics: Baghdad-Basrah Panel*

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
District	104	–	–	–	–	–	–
Date (Baghdad)	1848	2007-01-28	–	2005-01-01	–	–	2009-02-24
Date (Basrah)	1848	2006-02-10	–	2004-02-04	–	–	2008-02-17
Daily Temperature	2,991	76.577	18.127	36.500	60.400	93.900	106.500
Precipitation	2,991	0.004	0.044	0	0	0	1
Wind Speed	2,991	7.059	4.112	0.700	4.100	8.850	26.100
Dew Point	2,991	42.538	7.619	11.300	38.200	46.900	72.900
Visibility	2,991	5.534	1.200	0.300	5.000	6.200	7.000
Maximum Wind Speed	2,991	13.467	6.962	1.900	8.900	16.900	44.900
Daylight	2,991	12.136	1.445	10	10.8	13.5	14
Hours of Power	2,355	10.673	4.410	0.000	7.000	14.000	24.000
Least Constrained Violence	2,991	5.513	7.998	0	0	8	50
Indirect Fire	2,991	2.376	4.314	0	0	3	35
IED Attacks	2,991	7.171	9.167	0	0	13	43
Constrained Violence	2,991	0.883	1.799	0	0	1	16

TABLE 2. *Descriptive Statistics: Afghanistan's Most Violent Districts Panel*

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Province	5	–	–	–	–	–	–
Date (Across Provinces)	3000	2010-10-29	–	2005-01-01	–	–	2014-12-31
Daily Temperature	7,765	65.985	19.242	0.000	51.100	81.400	107.100
Precipitation	7,051	0.014	0.080	0.000	0.000	0.000	2.850
Wind Speed	7,723	4.826	2.361	0.000	3.200	6.000	20.500
Dew Point	7,761	29.384	12.377	–13.900	21.700	36.800	69.800
Visibility	7,613	6.232	1.155	0.200	5.900	7.000	10.000
Maximum Wind Speed	7,720	10.774	4.652	1.000	8.000	13.000	40.000
Daylight	7,765	12.269	1.598	9.850	10.750	13.867	14.467
Direct Fire	7,765	5.081	7.730	0	0	7	88
Indirect Fire	7,765	0.429	0.858	0	0	1	14
IED Attacks	7,765	1.456	2.248	0	0	2	19

TABLE 3. Descriptive Statistics: Baghdad Survey Dataset

Statistic	N	Mean	St. Dev.	Min	Pct(25)	Pct(75)	Max
Survey Block	549	-	-	-	-	-	-
Date	223	2006-12-04	-	2005-01-01	-	-	2008-09-16
Daily Temperature	39,875	88.376	17.894	50.000	71.600	105.800	116.600
Precipitation	36,966	0.003	0.020	0.000	0.000	0.000	0.310
Wind Speed	39,875	4.427	1.717	0.700	3.400	5.300	13.200
Dew Point	39,875	41.180	6.715	22.100	37.600	46.700	62.400
Visibility	39,875	5.313	1.186	0.700	4.600	6.300	7.000
Maximum Wind Speed	39,875	9.487	3.579	2.900	7.000	11.100	26.000
Daylight	39,875	12.229	1.390	9.967	11.067	13.633	14.350
Age	39,875	36.844	12.444	18	26	46	65
Hours Worked per Week	39,875	25.300	21.635	0	0	46	100
income.w	39,875	59,062.140	50,581.310	0.000	30,000.000	75,000.000	2,000,000.000
Household Size	39,875	7.444	3.600	1	5	9	40
Past Week Insurgent Violence	39,875	25.855	31.824	0.000	6.000	30.000	153.000
Perceptions of Electricity	31,140	0.878	0.328	0	1	1	1

Derivation of $\Delta T_{i,t}$ Graphically Illustrated

Figure 7 provides two sample illustrations of our derivation of $\Delta T_{i,t}$.

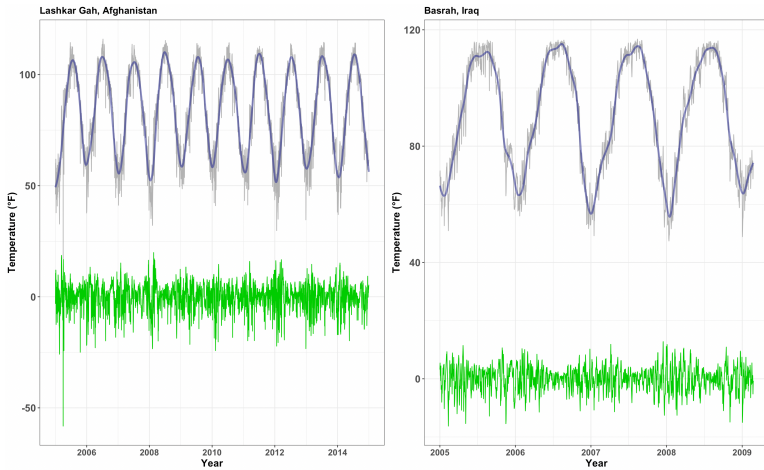


FIGURE 1. This figure provides two sample illustrations of our derivation of $\Delta T_{i,t}$. For the Afghan and Iraqi districts of Lashkar Gah and Basrah, we plot i) the actual temperature time series for each district (gray); ii) the estimated trend from local polynomial regression (blue); and, finally, $\Delta T_{i,t}$ (green), residual variation in day-to-day temperatures estimated from the difference in observed and fitted temperature values.

Primary Insurgent Violence Model Controls (Temperature Response and Deviation)

Insurgent Violence by Type: As indicated previously, we controlled for other types of insurgent violence (e.g., indirect fire, IED attacks, and constrained violence) in our model of least constrained attacks. We also included vectors of each of these lagged variables. *Hours of Daylight:* Longer days are warmer. We included daily daylight hours in the model to account for the possibility that more attacks occurred in warmer weather because greater numbers of daylight hours affected insurgents' opportunities to attack.⁹² *Meteorological Conditions:* Weather patterns related to temperature may influence some insurgent tactics. For instance, sandstorms reportedly provided cover to insurgents firing rockets and mortars against international positions in Baghdad.⁹³ *V* therefore includes data on visibility, wind speed, maximum wind speed, precipitation, and dew point.⁹⁴

Hours of Power: Temperatures in Baghdad, Basra, Helmand, and Kandahar reach extreme highs. During the study period, they extended beyond 120°F. As temperatures increased, especially at such high levels, electricity demand for cooling was likely to have grown concurrently. The electricity supply was irregular. Community dissatisfaction with the government's inability to supply electricity, particularly during warmer periods when most needed, may have facilitated an increase in insurgent attacks through two mechanisms. First, by diminishing the willingness of civilians to share intelligence about insurgents with Afghan/Iraqi and international forces; second, by increasing their motivation to take part in the insurgency. To address this possibility, for Baghdad and Basra, we controlled for the number of hours of power supplied per day.⁹⁵ Unfortunately, we lacked such data for Afghanistan. *Seasonal Factors:* Early findings associating ambient temperatures with violent crime levels were challenged because seasonal factors such as "vacation

92. Astronomical Applications Department, n.d.

93. Samuels 2008.

94. National Climatic Data Center, n.d.; Manual, n.d.

95. Shaver and Tenorio 2015.

time, students being out of school, and alcohol consumption” might account for statistical results.⁹⁶ While alcohol consumption patterns are not relevant to patterns of insurgency in predominately Muslim Afghanistan and Iraq, growing seasons and whether schools are in session were plausible confounding factors. Evidence from modern insurgencies suggests that students in recess are sometimes recruited.⁹⁷ The model’s weekly fixed effects generated estimates through within-week comparisons, effectively controlling for any remaining potential seasonal factors.

The Use of Direction Questions in Our Analysis

Although direct questions on sensitive topics can elicit biased responses, we do not believe this was a concern in this case. First, just under 90% (116,102 of 130,676) of those questioned provided a direct answer despite being offered a response choice of “Don’t Know”. Therefore, there is minimal indication that respondents sought to avoid answering this question. Second, IIACSS’ Iraqi enumerators introduced themselves as unaffiliated researchers, which should have eased concern over the destination of the survey data. Most importantly, even if respondents feared answering this question because of possible retaliation, we would expect this to result in an overall shift in the baseline response but not in changes in responses to temperature levels/deviations.

Baghdad Nighttime (Curfew) Results

Temperature response and deviation results for the Baghdad nighttime (curfew-restricted) results appear in Figure 8.

Country-Wide Analyses

In this section, we replicated the day-level analyses for all districts in Afghanistan and Iraq.⁹⁸ This approach externalized our findings. The

96. Anderson 1987.

97. O’Connell and Benard 2006; Ki-moon, Ban, and Secretary-General 2013.

98. Given the extensive spatio-temporal coverage of these analyses, we lacked some of the controls included in our primary regressions. For this reason, the more focused models for Baghdad and Basra remain our preferred specifications.

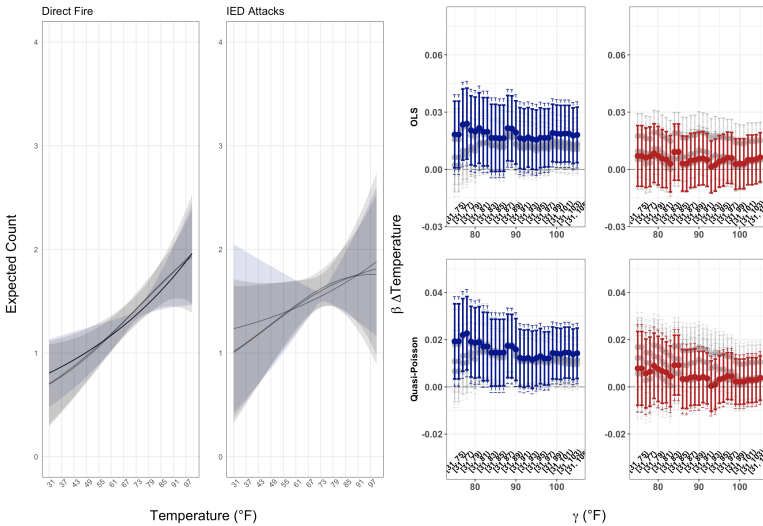


FIGURE 2. *This figure displays temperature response and deviation results for direct fire and improvised explosive device attacks for the subset of attacks in Baghdad between 11:00 pm and 5:00 am when a nighttime curfew held civilian movement constant. The times and routes of relatively slow-moving military supply convoys were purposefully varied. Together, these results help to confirm that military target movement did not drive the systematic variation in the observed temperature-violence relationship.*

results demonstrate substantial effects of ambient temperature on relatively unconstrained violence.

Afghanistan

For Afghanistan, we studied insurgent violence between January 01, 2005 and December 31, 2014, when U.S. Operation Enduring Freedom/NATO's International Security Assistance Force ended. This was a total of 1,453,496 (district-day) observations.⁹⁹ Following the statistical tests

99. Formally, these missions ended on December 28, 2014. However, the SIGACTs data extend to the end of the year. Therefore, we included the three extra days in our analysis.

described in the article, we analyzed variation in direct fire attacks and ambient temperature across the entire country.

Iraq

For Iraq, our panel spanned from January 01, 2005 to February 24, 2009, producing 157,664 district-day observations.¹⁰⁰ Following the statistical tests described in the article, we analyzed variation in the least constrained forms of insurgent violence and ambient temperature.

Temperature and Precipitation Data

For each of the subnational country-wide analyses carried out, we used ambient maximum daily temperature and precipitation (daily millimeters) data from.^{101 102} Descriptive statistics are shown in Table 4.

Although the U.S. invaded Afghanistan earlier than 2005, from extensive use of the SIGACTS datasets in other projects and discussions with officials involved in their production, it is our understanding that insurgent data were not systematically collected before this period. The same goes for our analysis of Iraq, described below.

100. Although Operation Iraqi Freedom did not come to an end until the end of December 2011, the final date for available SIGACTs data, released by (Berman, Shapiro, and Felter 2011), is February 24, 2009. In any case, the overwhelming majority of wartime violence occurred before this date.

101. Chen, Shi, Xie, Silva, et al. 2021; Chen, Shi, Xie, Higgins, et al. 2021.

102. Precipitation data are missing for a small number of days, negligibly reducing panel observations.

TABLE 4. Afghanistan Country-Wide Analysis Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
District	398	—	—	—	—	—	—
Date	3,652	2009-12-31	—	2005-01-01	—	—	2014-12-31
Daily Temperature	1,453,496	67.186	21.597	-14.010	50.530	84.390	118.850
Precipitation	1,453,098	0.989	3.493	0.000	0.000	0.115	124.605
Direct Fire	1,453,496	0.082	0.543	0	0	0	77
Indirect Fire	1,453,496	0.019	0.165	0	0	0	12
IED Explosions	1,453,496	0.026	0.201	0	0	0	11

TABLE 5. Iraq Country-Wide Analysis Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
District	104	—	—	—	—	—	—
Date	1,516	2007-01-28	—	2005-01-01	—	—	2009-02-24
Daily Temperature	157,560	84.161	20.699	13.880	67.420	103.120	124.130
Precipitation	157,560	0.598	2.526	0	0	0	83
Least Constrained Violence	157,560	0.242	1.000	0	0	0	29
Most Constrained Violence	157,560	0.035	0.237	0	0	0	8
IED Explosions	157,560	0.364	1.130	0	0	0	24

Results

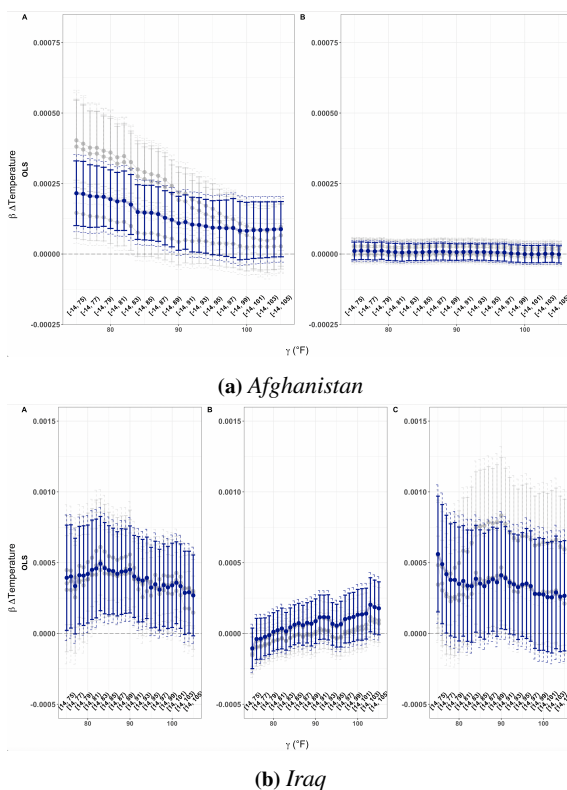


FIGURE 3. These figures display the results of the Afghanistan and Iraq country-wide temperature deviation analyses. For Afghanistan, changes in direct fire and improvised explosive device attacks appear to the left and right, respectively. For Iraq, changes in least constrained violence, most constrained violence, and improvised explosive device attacks appear in the left, center, and right, respectively.

Mean Daily Temperature

Median Daily Temperatures

Binned Regression and Generalized Additive Model Results

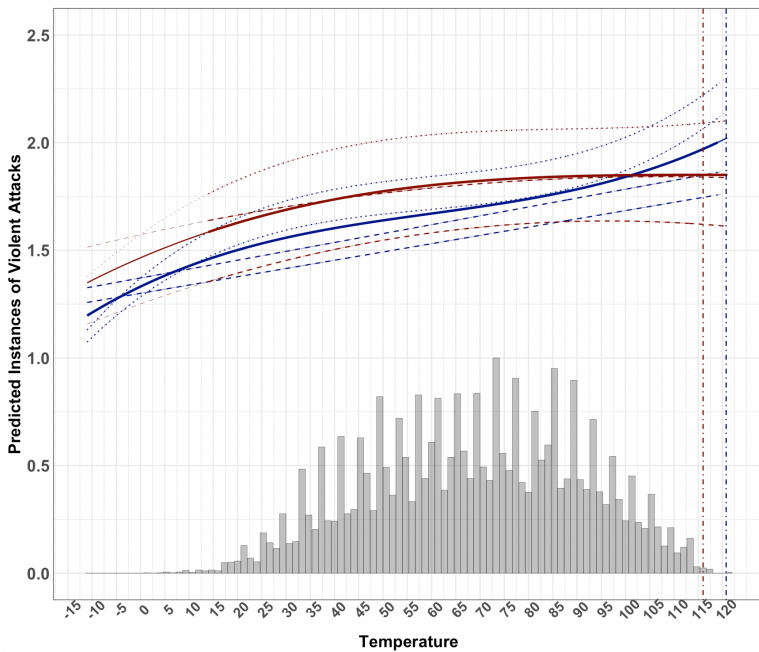


FIGURE 4. *This figures display the results of the Afghanistan and Iraq country-wide temperature response function analyses.*

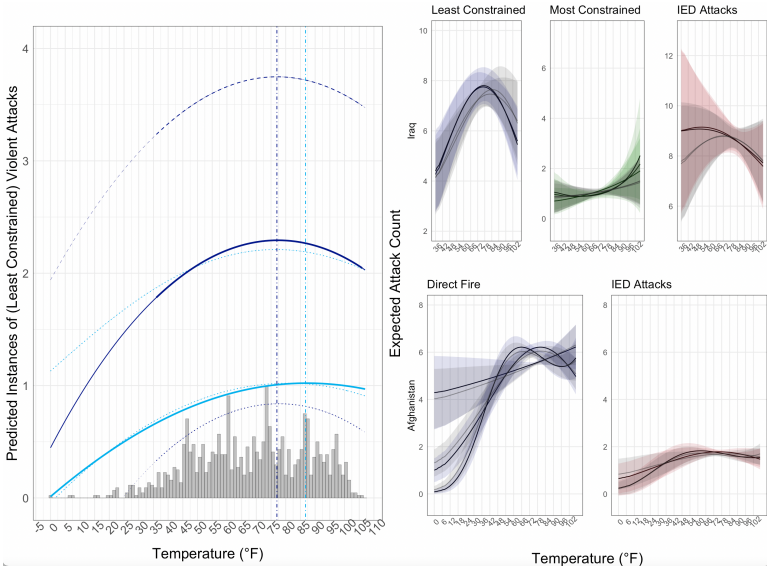


FIGURE 5. The figure replicates Figure 2, replacing daily maxima with daily mean temperatures.

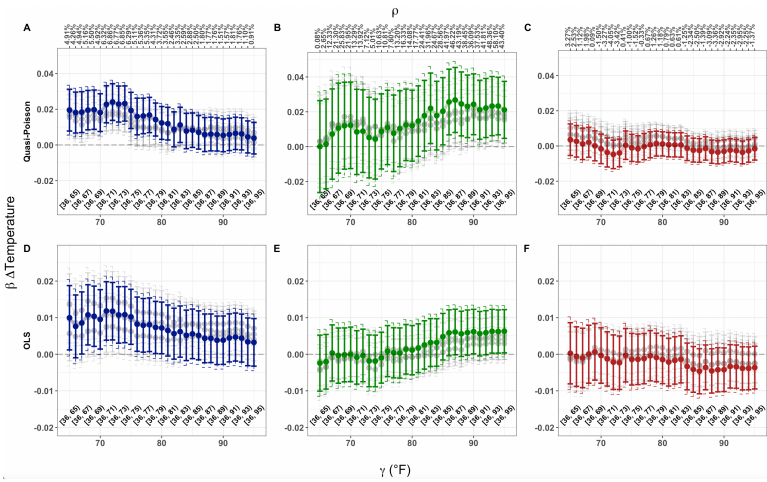


FIGURE 6. The figure replicates Figure 3, replacing daily maxima with daily mean temperatures, and adds OLS model results.

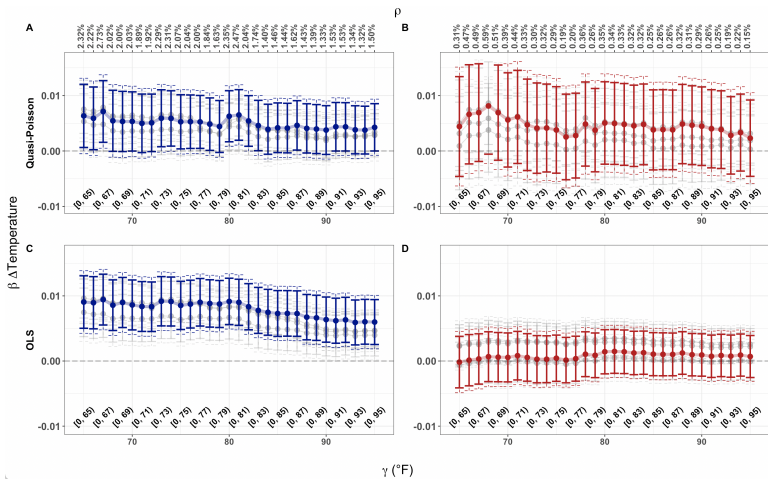


FIGURE 7. The figure replicates Figure 4, replacing daily maxima with daily mean temperatures, and adds OLS model results.

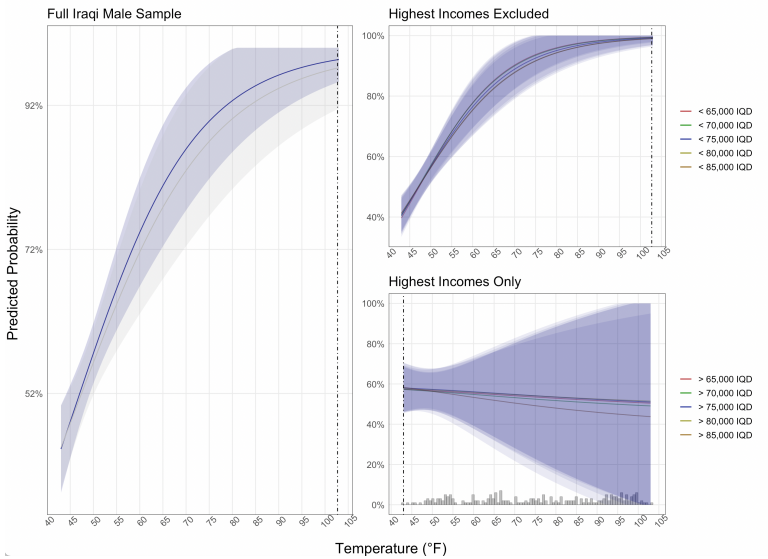


FIGURE 8. The figure replicates Figure 5, replacing daily maxima with daily mean temperatures.

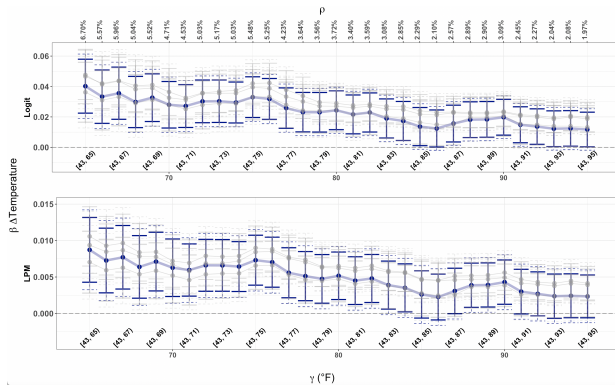


FIGURE 9. The figure replicates Figure 6, replacing daily maxima with daily mean temperatures, and adding linear probability model results.

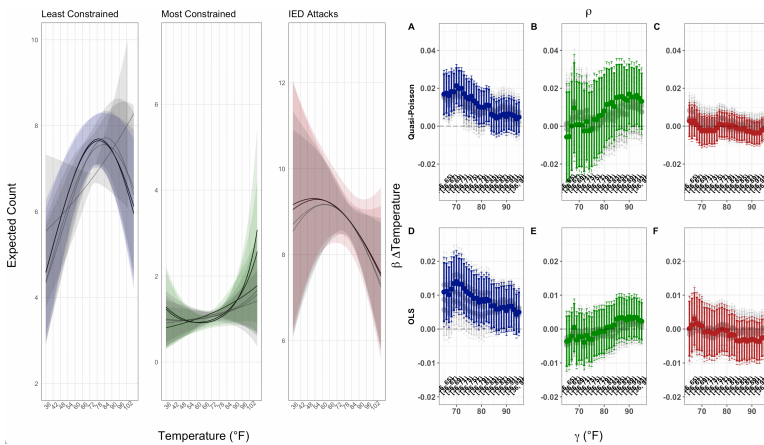


FIGURE 10. This figure plots temperature response and deviation results for the Baghdad-Basra panel, substituting daily maximum temperatures with daily median temperatures, derived from hourly weather station data.

This analysis considered whether, as the most frequently experienced temperature each day changed, levels of violence by type tended to vary. We estimated that those days with most common temperature of around the low 80's °F were the most likely to experience the greatest levels of least organizationally constrained violence.

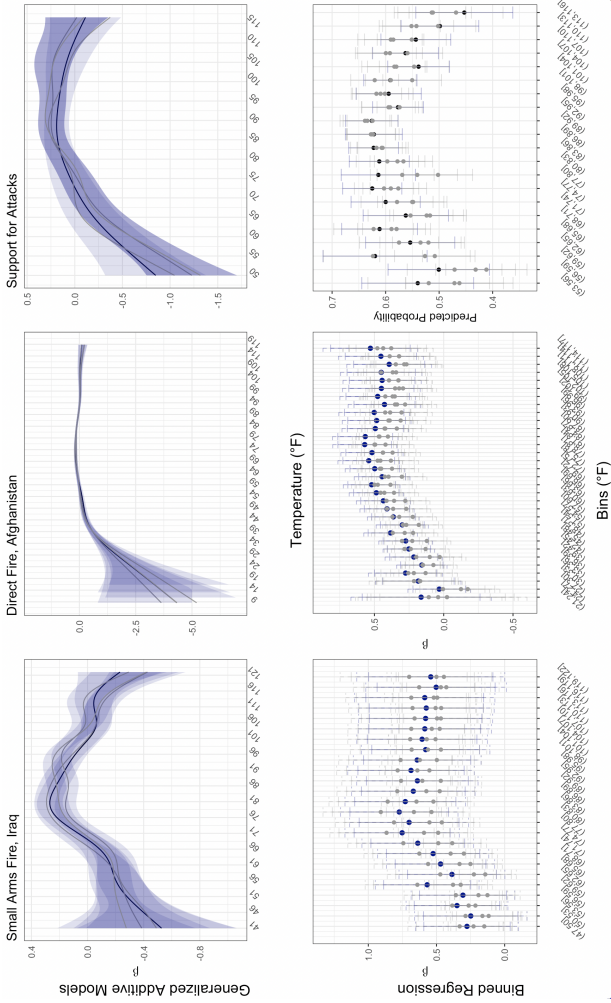


FIGURE 11. This figure displays the binned regression and generalized additive model results associating maximum daily temperatures and small arms fire (Iraq sample), direct fire (Afghanistan sample), and expressions of support for violence against international forces among survey respondents (Baghdad survey sample). For binned regression estimates, standard errors were “robust”. 90% and 95% confidence intervals are displayed in solid and dashed lines, respectively. Point estimates and confidence intervals in gray denote alternative specifications described in the text. GAM results include 95% Bayesian credible intervals.

Other Meteorological Variables

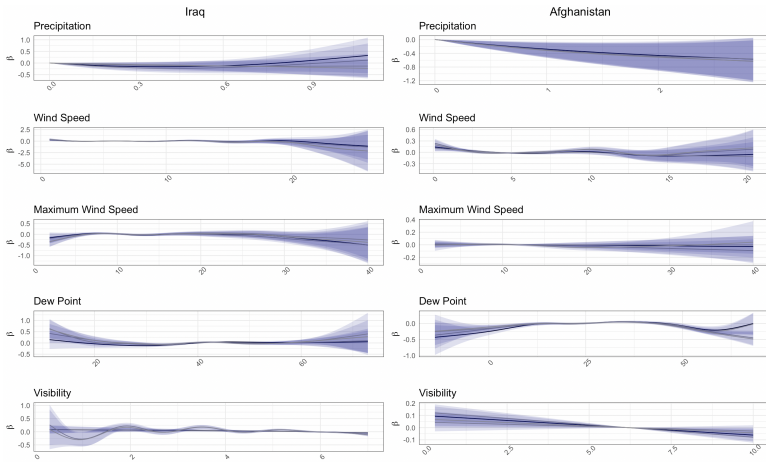


FIGURE 12. *The figure shows the estimated associations between small arms fire (Iraq) and, separately, direct fire attacks (Afghanistan), as well as measures of precipitation, wind speed, maximum wind speed, dew point, and visibility. The results show that no other meteorological variable consistently correlated with this violence measure in the way that temperature did. Results were generated using generalized additive models with 95% Bayesian credible intervals.*

Substantive Comparisons

Primary Replicated Using OLS/LPM

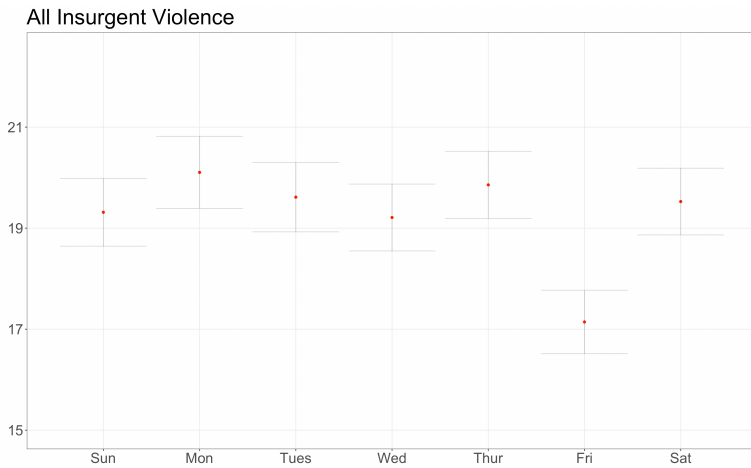


FIGURE 13. Following research by Reese et al., this figure shows that Fridays typically experienced approximately two fewer attacks than other days of the week during the days included in our study.¹⁰³ This magnitude is similar to the estimated effect of moving from the coldest maximum daily temperatures to maxima twenty to thirty degrees warmer.

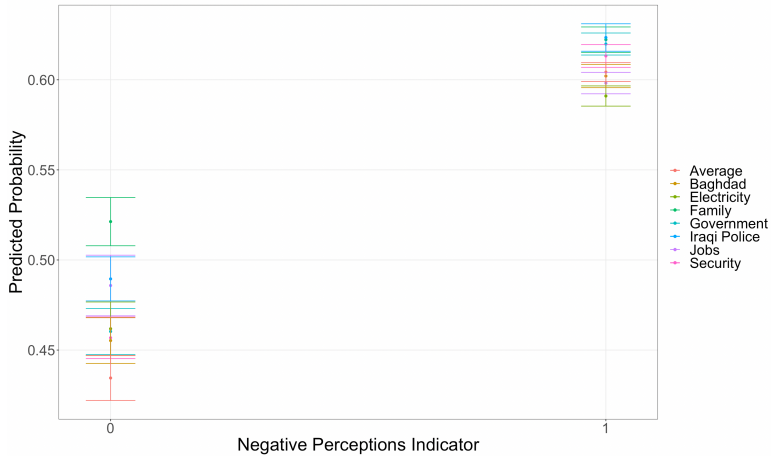


FIGURE 14. *This figure shows that Iraq male respondents from whom generated temperature-aggression estimates were roughly fifteen percentage points more likely to endorse the use of violence against government forces when they negatively evaluated recent changes in a variety of local conditions, including overall conditions in Baghdad, overall conditions for their families, the effectiveness of the government, the availability of jobs, the availability of electricity, general security, and the ability of the Iraqi police to provide security. This dissatisfaction magnitude is similar to moving from the coldest maximum daily temperatures experienced in Baghdad during the study period to those $\approx 20^{\circ}F$ warmer.*

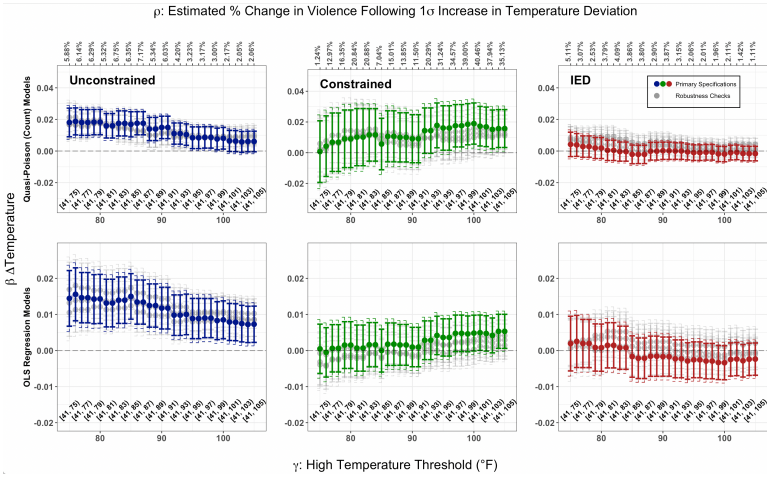


FIGURE 15. This figure replicates Figure 3 of the paper, adding OLS results as well.

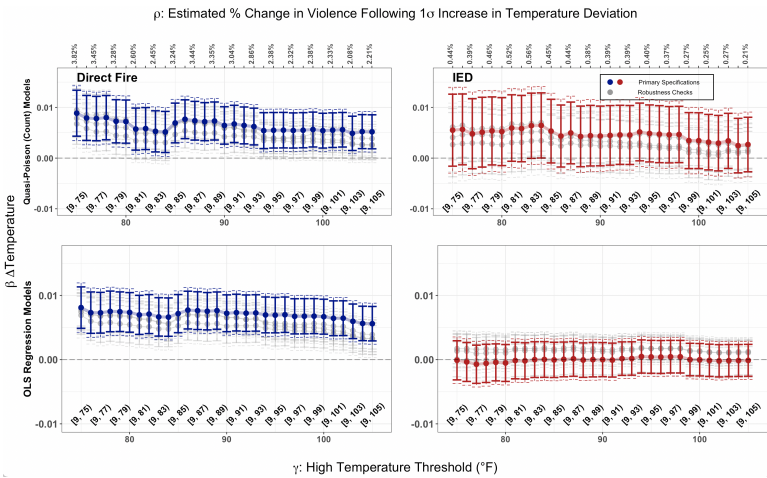


FIGURE 16. This figure replicates Figure 4 of the paper, adding OLS results as well.

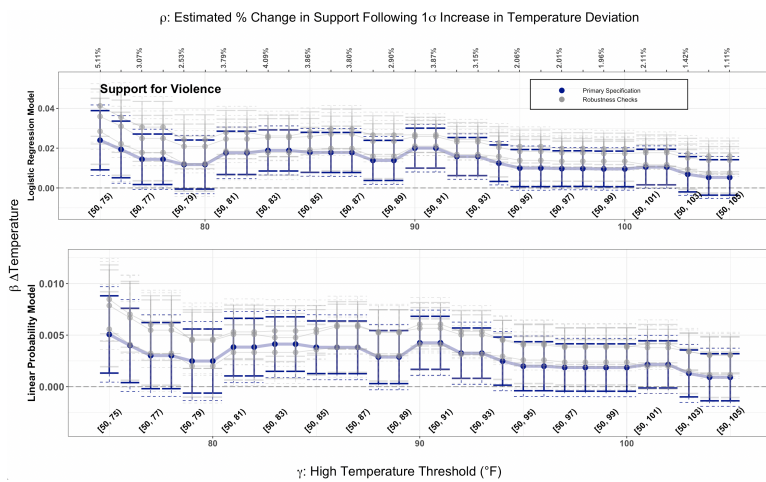


FIGURE 17. *This figure replicates Figure 6 in the paper, adding linear probability model results as well.*

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