# Supplementary Information for

## The emotional and mental health impact of the murder of George Floyd on the US population

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**This PDF file includes:**

## Supporting Information Text

## Materials and Methods

We draw on two data sets (the Gallup Panel COVID-19 and the U.S. Census Household Pulse Survey) to investigate the emotional and mental health impact of Floyd's murder across individuals in the U.S. by race, age, gender, income, education, and geographical location. We also draw on the Gallup-Sharecare Well-Being Index data set for historical context. They are described below together with the analytic steps we applied to them.

In this supplement, we provide additional information and diagnostics: For the Gallup Panel COVID-19 sample, we provide descriptive statistics, daily time series of anger and sadness levels, full $p$-values reported in **Fig. 1** (including for additional socioeconomic categories) and **Fig. 3**, and additional statistics about changes in anger and sadness pre-Floyd and post-Floyd. We also show weekly time series for the demographic and economic subgroups.

For the U.S. Census Household Pulse Survey data, we report descriptives, full effect sizes (Cohen's $d$) for anxiety and depression following Floyd's death in Minnesota and the rest of the USA, and the full $p$-values reported in **Fig. 2** and **Fig. 3**.

For the Gallup-Sharecare Well-Being Index we report descriptives, and show weekly anger and sadness time series and histograms.

**Gallup Panel COVID-19.** We obtained 117,568 responses from N = 47,355 respondents between March 24, 2020 and August 16, 2020. We focused on anger and sadness, as obtained as the response to the question "Did you experience the following feelings during a lot of the day yesterday?" with prompts including anger and sadness, requiring a binary (yes/no) response option. For simplicity, we did not use the fact that we had multiple responses from some respondents in the analytic strategy. Sample demographics are provided in Table S1.

**Weighting.** The obtained samples were weighted by Gallup to correct for non-response. Non-response adjustments were made by adjusting for gender, age, race, Hispanic ethnicity, education and region. Demographic weighting targets were based on the most recent population survey figures for the U.S. population aged 18 and older (1).

Regarding the line plot in **Fig. 1 a, b** showing weekly percentage of the respondents reporting having experienced anger and sadness respectively, the Gallup survey data was weighted following differing schemes: prior to April 27, responses are weighted at the daily level; after this date, responses are weighted at the weekly level. For the overall timeseries plots, we therefore weighted pre-April 27 data at the daily level to calculate proportions, and then took the unweighted mean across days to produce week-level estimates. Beginning April 27, proportions were calculated using weights directly at the week level. Percentages and error bars (indicating standard errors) are weighted estimates derived through post-stratification on gender, age, race, Hispanic ethnicity, education and region. Histograms on the right show associated distributions of weeks, the arrows point to the week after Floyd's death and are labeled with standard deviations across all 2020 weeks ($z$-scores). Regarding **Fig. 1 c, d**, following Gallup's guidelines, we applied their weights only to overall data (leftmost arrow) but did not apply them in subgroup analyses.

**Floyd week vs. Baseline Determination.** For the Gallup Panel COVID-19, the 4 weeks prior to Floyd's death were used as a baseline for calculating changes in anger and sadness, from April 27 to May 24. This baseline was compared against the week of June 1 to June 7, which was the first full week following Floyd's death. We did not include the week of May 25, when news of Floyd's death was still spreading, and for which the anger and sadness levels show intermediate values (see Fig. 1) and Fig. S1). We therefore have two time periods: the 4-week baseline period and the George Floyd week. For each of these time periods, we calculated proportions of individuals feeling anger and sadness (**Fig. 1 c, d**).

**Statistical Analyses.** In **Fig. 1 c, d**, our goal was to establish whether the change in anger or sadness for one demographic category was significantly larger than that of another demographic category. We made pairwise comparisons between mutually exclusive categories only, e.g., we compared White-only to Black-only Americans. **Fig. 1 c** and **d** shows increases of anger and sadness experienced by different racial, gender, age and political groups in the week after Floyd's death compared to the four preceding baseline weeks; shaded boxes indicate standard errors (SEs). Gallup did not provide weights suitable for the subgroup analysis in **Fig. 1 c** and **d**; they are unweighted means and SEs. See Fig. S2 for the full $p$-values reported in Fig. 1, and for additional socioeconomic categories.

For each pair, a bootstrap test was used to establish significance. We took $B = 10,000$ bootstrap samples for each of the categories; for each sample, we calculated the change in anger or sadness and subtracted it from the other category's change. Our $p$-value is the percentage of samples with a difference greater than the observed difference. Descriptive statistics on changes in anger and sadness pre-Floyd and post-Floyd are shown in Table S2.

To see the time series of anger and sadness rates at the daily level, see Fig. S1. To see weekly time series for the demographic and economic subgroups, please refer to Figs. S3, S4, S5, S6, S7, S8.

**Physical Proximity.** Gallup provided county-level FIPS codes for respondents, from which county and state of residence could be determined. For **Fig. 3 a**, we calculated three proportions to measure change in sadness and anger reported in the week following Floyd's death compared to the previous four weeks across respondents within: a) Hennepin County (where Minneapolis is located), b) Minnesota, and c) all other US respondents. These proportions were unweighted. See Table S3 and Fig. S10 for the full $p$-values reported in **Fig. 3**.

**U.S. Census Household Pulse Survey.** From the U.S. Census Household Pulse Survey we obtained symptoms of anxiety and depression from April 23 to June 2, 2020 across 409,652 responses from N = 319,471 respondents (2). For this number of respondents both PHQ and GAD responses were available. (We included a small number of additional responses ($< 1,000$) from respondents who were missing one of the responses to obtain the average of the other), see Table S4). Anxiety was measured using the Generalized Anxiety Disorder 2-item (GAD-2) instrument and depression was measured using the Patient Health Questionnaire-2 (PHQ-2). Descriptive statistics of the sample are shown in Table S4. For simplicity, we did not use the fact that we had multiple responses from some respondents in the analytic strategy.

*Weighting.* Depression and anxiety symptom severity and percentages were calculated using a weighted mean across respondents for the baseline and Floyd groups, separately, using the respondent-level weights provided with the survey. Estimates incorporate Census-provided weights for age, gender, education, race and non-response.

*Floyd week vs. Baseline Calculation.* Each week of data collected for the Household Pulse Survey contains six days of data, with one day gaps between collection periods. Data for the baseline weeks before Floyd's death was obtained as responses from April 23 to May 26, which we compared to the period following Floyd's death, May 28 to June 2. We included 5 weeks in the baseline period as the Census reported the first two weeks cumulatively.

*Statistical Analyses.* In **Fig. 2** and **Fig. 3, b)** we calculated increases in anxiety and depression as standardized effect sizes (Cohen's $d$) comparing the five weeks before Floyd's death (April 23 to May 26) to the week following Floyd's death (May 28 to June 2) using data from the Census Household Pulse survey (see Table S5 and Table S6). We used the sum of the person-level item scores to estimate total symptom severity for the PHQ-2 and GAD-2 scales.

Significance tests of effect sizes are calculated based on a weighted $t$-test between the baseline and Floyd week; significance *between* effect sizes across racial groups are based on a $z$-test as described below. To compare Cohen's $d$ values, we first calculate the sampling variance for each $d$: $var(d_i) = \frac{1}{n_1} + \frac{1}{n_2} + \frac{d_i^2}{2(n_1+n_2)}$. We then calculate $z$ as follows: $z = \frac{d_1 - d_2}{\sqrt{var(d_1) + var(d_2)}}$ and report the associated $p$-value (3). See Fig. S9 for the full $p$-values reported in Fig. 2.

*Physical Proximity.* The Household Pulse data provided state of residence for each response. We calculated symptom severity for Minnesota responses separately from all other states to investigate the role of proximity and reported differences in anxiety and depression in **Fig. 3 b**, analogous to **Fig. 2**. Effect sizes (Cohen's $d$) for anxiety and depression following Floyd's death in Minnesota and the rest of the USA are shown in Table S7; see Table S8 for proportions with GAD-2 and PHQ-2 scores $> 2$. See Fig. S10 for the full $p$-values reported in Fig. **3**.

*Additional depression burden among Black Americans.* As seen in Table S6, in the baseline period, 22.46% White-only Americans and 26.67% Black-only Americans screened positive for depression using a customary threshold score of 3 or higher on the PHQ-2 (4). In the week after Floyd's death, this increased to 23.66% and 29.91% among White and Black Americans respectively. While the rates of positive screening increased for both, Black Americans screened positive at a rate that was 2.0539% ($\Delta_{MH}$) higher compared to White Americans.

The US Census reports that 13.4% of 328,239,523 = 43,984,096 Americans are Black (5) ($Black American Population US$). Thus, the 2.0539 % increased positive screen rate for depression would correspond to an additional 903,389 ($\Delta_{MH} *$ $Black American Population US$) positive screens for depression among Black Americans.

The PHQ-2 questions in the US Census Household Pulse Survey asked the respondents about their symptoms "Over the last 7 days" with answer choices "Not at all" (0 points), "Several days" (1 point), "More than half the days" (2 points) and "Nearly every day" (3 points). Assuming thus that a positive screen for depression is associated with depressive symptoms for 3 to 7 days, the 903,389 additional positive depression screens in Black Americans correspond to between 2.710 and 6.324 million mentally unhealthy days.

**Gallup-Sharecare Well-Being Index.** Historical emotional responses, anger, from January 2, 2009 to January 4, 2017, and sadness, from January 2, 2009 to December 20, 2016, were obtained from Gallup-Sharecare Well-Being Survey. Data on anger responses was not available for the years 2014 and 2015. We focused on anger and sadness, obtained as the response to the questions: "Did you experience the following feelings during a lot of the day yesterday?" with answer choices including anger and sadness, with a binary (yes/no) response option. Descriptive statistics of the sample are shown in Table S9.

*Weighting.* Gallup weights the data daily to compensate for unequal selection probabilities and non-response. In addition, Gallup weights the data to match targets from the U.S. Census by age, sex, region, gender, education, ethnicity, and race, as well as population density of self-reported location.

Fig. S11 shows weekly aggregate of anger (top) and sadness (bottom). Error bars (indicating standard errors) are Gallup-weighted estimates derived through post-stratification on gender, age, race, Hispanic ethnicity, education and region. Fig. S12 shows histograms of weekly distribution of mean anger (top) and sadness (bottom).

**Data Sharing.** The Gallup Panel COVID-19 data and the historical Gallup Gallup-Sharecare Well-Being Index are available from the Gallup organization; we are not allowed to share it. The US Census Household Pulse Survey data is available from the US Census (2). We also share the weekly aggregated data in the OSF repository associated with this project (https://osf.io/ytsae/), together with our analysis code (R scripts).

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**Table S1. Gallup Panel COVID-19 data set: Demographic characteristics (unweighted).**

| | N | % Angry (SE) | % Sad (SE) |
|---|---|---|---|
| **Total Participants** | 47,355 | 23.7% (0.13%) | 29.3% (0.14%) |
| **Race** | | | |
| White (non-Hispanic) | 41,293 | 23.4% (0.14%) | 29.0% (0.15%) |
| Hispanic | 2,461 | 26.3% (0.62%) | 32.8% (0.66%) |
| Black | 2,228 | 25.0% (0.65%) | 29.7% (0.69%) |
| Asian | 800 | 25.6% (1.20%) | 33.6% (1.18%) |
| Other | 495 | 27.1% (1.38%) | 30.6% (1.43%) |
| Refused | 78 | 31.9% (3.61%) | 30.7% (3.57%) |
| **Gender** | | | |
| Male | 25,252 | 23.3% (0.18%) | 24.1% (0.18%) |
| Female | 22,101 | 24.1% (0.20%) | 35.2% (0.22%) |
| Other | 2 | 0% (0%) | 0% (0%) |
| **Age** | | | |
| 18–30 | 2,035 | 26.2% (0.72%) | 36.2% (0.78%) |
| 31–45 | 8,454 | 26.3% (0.34%) | 29.7% (0.35%) |
| 46+ | 36,866 | 23.0% (0.15%) | 28.9% (0.16%) |
| **Education** | | | |
| High School, Vocational School, or Less | 6,188 | 24.2% (0.37%) | 28.8% (0.39%) |
| Some College or College Graduate | 14,375 | 24.4% (0.25%) | 29.7% (0.26%) |
| Postgraduate Degree or Work | 11,196 | 24.1% (0.28%) | 28.6% (0.29%) |
| Refused | 15,596 | 22.6% (0.23%) | 29.7% (0.25%) |
| **Income** | | | |
| $0–$59,999 | 12,901 | 25.4% (0.26%) | 34.6% (0.28%) |
| $60,000–$119,999 | 16,719 | 23.2% (0.22%) | 27.9% (0.23%) |
| $120,000+ | 13,886 | 22.6% (0.24%) | 26.2% (0.25%) |
| Refused | 3,849 | 24.4% (0.57%) | 29.4% (0.61%) |
| **Political party** | | | |
| Democrat | 20,656 | 28.1% (0.22%) | 36.3% (0.23%) |
| Republican | 14,072 | 23.2% (0.26%) | 28.1% (0.28%) |
| Other/Refused | 17,153 | 18.5% (0.21%) | 21.5% (0.22%) |

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**Table S2. Gallup Panel COVID-19 data set: Percentage of each demographic group experiencing anger or sadness before and immediately after Floyd's death. The top row uses Gallup-provided weights (corresponding to Fig. 1 A, B and the overall arrow in Fig. 1 C, D); all other rows are unweighted percentages. Also included: standard errors, the percent change in anger or sadness, $z$ statistics for the difference in proportion with corresponding $p$-value, and $N$s. When computing the $z$ statistic and associated p-value for the top (weighted) row, we used weighted proportions but the same $N$s as in the unweighted case.**

| | Anger | | | | | Sadness | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % Pre-Floyd (SE) | % Floyd (SE) | Change | $z$ | $p$ | % Pre-Floyd (SE) | % Floyd (SE) | Change | $z$ | $p$ | N Pre-Floyd | N Floyd |
| **Overall (weighted)** | 24.0% (0.33%) | 38.4% (0.82%) | 14.4% | 18.0 | <0.001 | 28.9% (0.35%) | 38.1% (0.80%) | 9.20% | 11.1 | <0.001 | 16,681 | 3,760 |
| **Overall (unweighted)** | 22.4% (0.30%) | 34.8% (0.80%) | 12.4% | 15.9 | <0.001 | 28.0% (0.30%) | 36.9% (0.80%) | 8.90% | 10.8 | <0.001 | 16,681 | 3,760 |
| **Race** | | | | | | | | | | | | |
| White | 22.2% (0.34%) | 33.5% (0.82%) | 11.3% | 13.60 | <0.001 | 27.9% (0.37%) | 35.7% (0.83%) | 7.77% | 8.84 | <0.001 | 14,614 | 3,320 |
| Hispanic | 24.4% (1.47%) | 41.1% (3.50%) | 16.7% | 4.65 | <0.001 | 30.9% (1.59%) | 45.4% (3.54%) | 14.5% | 3.79 | <0.001 | 848 | 198 |
| Black | 22.3% (1.52%) | 47.7% (4.09%) | 25.4% | 6.31 | <0.001 | 28.3% (1.64%) | 47.3% (4.09%) | 19.0% | 4.45 | <0.001 | 750 | 149 |
| Asian | 23.5% (2.64%) | 50.9% (6.62%) | 27.3% | 3.97 | <0.001 | 29.1% (2.83%) | 52.6% (6.61%) | 23.6% | 3.26 | <0.001 | 258 | 57 |
| Other | 24.6% (3.14%) | 45.7% (8.42%) | 21.1% | 2.35 | 0.002 | 23.5% (3.09%) | 42.9% (8.36%) | 19.3% | 2.17 | 0.003 | 188 | 35 |
| **Gender** | | | | | | | | | | | | |
| Male | 22.1% (0.44%) | 34.8% (1.05%) | 12.8% | 12.0 | <0.001 | 22.5% (0.44%) | 31.6% (1.03%) | 9.1% | 8.61 | <0.001 | 8,815 | 2,041 |
| Female | 22.7% (0.47%) | 34.8% (1.15%) | 12.0% | 10.4 | <0.001 | 34.3% (0.54%) | 43.3% (1.20%) | 9.0% | 7.04 | <0.001 | 7,866 | 1,719 |
| **Age** | | | | | | | | | | | | |
| 18–30 | 23.1% (1.76%) | 46.5% (4.41%) | 23.4% | 5.24 | <0.001 | 33.9% (1.97%) | 49.2% (4.42%) | 15.4% | 3.16 | <0.001 | 576 | 128 |
| 31–45 | 24.6% (0.81%) | 41.1% (1.99%) | 16.5% | 8.26 | <0.001 | 27.5% (0.84%) | 39.4% (1.97%) | 11.9% | 5.80 | <0.001 | 2,854 | 614 |
| 46+ | 21.9% (0.36%) | 33.0% (0.86%) | 11.2% | 12.9 | <0.001 | 27.9% (0.39%) | 35.9% (0.87%) | 8.0% | 8.69 | <0.001 | 13,251 | 3,018 |
| **Education** | | | | | | | | | | | | |
| High School, Vocational School, or Less | 23.1% (0.91%) | 36.8% (2.21%) | 13.7% | 6.09 | <0.001 | 26.8% (0.95%) | 34.2% (2.18%) | 7.3% | 6.09 | <0.001 | 2,166 | 475 |
| Some College or College Graduate | 23.1% (0.590%) | 35.0% (1.45%) | 11.9% | 8.09 | <0.001 | 28.0% (0.63%) | 35.3% (1.46%) | 7.3% | 8.09 | <0.001 | 5,104 | 1,078 |
| Postgraduate Degree or Work | 23.3% (0.69%) | 36.3% (1.61%) | 13.0% | 7.90 | <0.001 | 27.4% (0.73%) | 38.7% (1.63%) | 11.3% | 7.90 | <0.001 | 3,743 | 894 |
| **Income** | | | | | | | | | | | | |
| $0–$59,999 | 23.9% (0.62%) | 35.4% (1.46%) | 11.5% | 7.71 | <0.001 | 33.9% (0.69%) | 41.4% (1.50%) | 7.6% | 4.65 | <0.001 | 4,772 | 1,079 |
| $60,000–$119,999 | 22.3% (0.53%) | 34.3% (1.27%) | 12.0% | 9.39 | <0.001 | 26.2% (0.56%) | 35.5% (1.28%) | 9.3% | 7.01 | <0.001 | 6,227 | 1,407 |
| $120,000+ | 21.1% (0.57%) | 35.0% (1.41%) | 13.9% | 9.94 | <0.001 | 24.9% (0.60%) | 34.6% (1.40%) | 9.7% | 6.68 | <0.001 | 5,131 | 1,147 |
| **Political party** | | | | | | | | | | | | |
| Democrat | 25.4% (0.52%) | 40.1% (1.24%) | 14.7% | 11.60 | <0.001 | 34.7% (0.57%) | 45.3% (1.26%) | 10.6% | 7.77 | <0.001 | 6,919 | 1,560 |
| Republican | 22.3% (0.65%) | 32.9% (1.53%) | 10.6% | 6.80 | <0.001 | 26.6% (0.69%) | 35.4% (1.56%) | 8.80% | 5.36 | <0.001 | 4,159 | 938 |

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**Table S3. Gallup Panel COVID-19 data set: Unweighted percentage of each geographic group experiencing anger or sadness before and immediately after Floyd's death.  Also included: standard errors, the percent change in anger or sadness, $z$ statistics for the difference in proportion with corresponding $p$-value, and $N$s.**

| | Anger | | | | | | | Sadness | | | | | | |
| | % Pre-Floyd (SE) | % Floyd (SE) | Change | z | p | N Pre-Floyd | N Floyd | % Pre-Floyd (SE) | % Floyd (SE) | Change | z | p | N Pre-Floyd | N Floyd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Overall | 22.4% (0.30%) | 34.8% (0.80%) | 12.5% | 15.939 | <0.001 | 16,600 | 3,739 | 28.0% (0.30%) | 37.0% (0.80%) | 8.90% | 10.766 | <0.001 | 16,596 | 3,746 |
| Minneapolis | 13.7% (3.4%) | 60.0% (12.6%) | 46.3% | 3.863 | <0.001 | 102 | 15 | 25.2% (4.3%) | 60.0% (12.6%) | 3.48% | 2.451 | 0.014 | 103 | 15 |
| Minnesota | 16.3% (1.9%) | 47.1% (5.90%) | 30.8% | 5.609 | <0.001 | 367 | 70 | 28.5% (2.30%) | 49.3% (5.90%) | 20.8% | 3.314 | 0.001 | 369 | 71 |
| Other states | 22.5% (3.00%) | 34.6% (0.80%) | 12.1% | 15.297 | <0.001 | 16,206 | 3668 | 28.0% (4.0%) | 36.7% (0.8%) | 8.7% | 10.39 | <0.001 | 16,200 | 3674 |
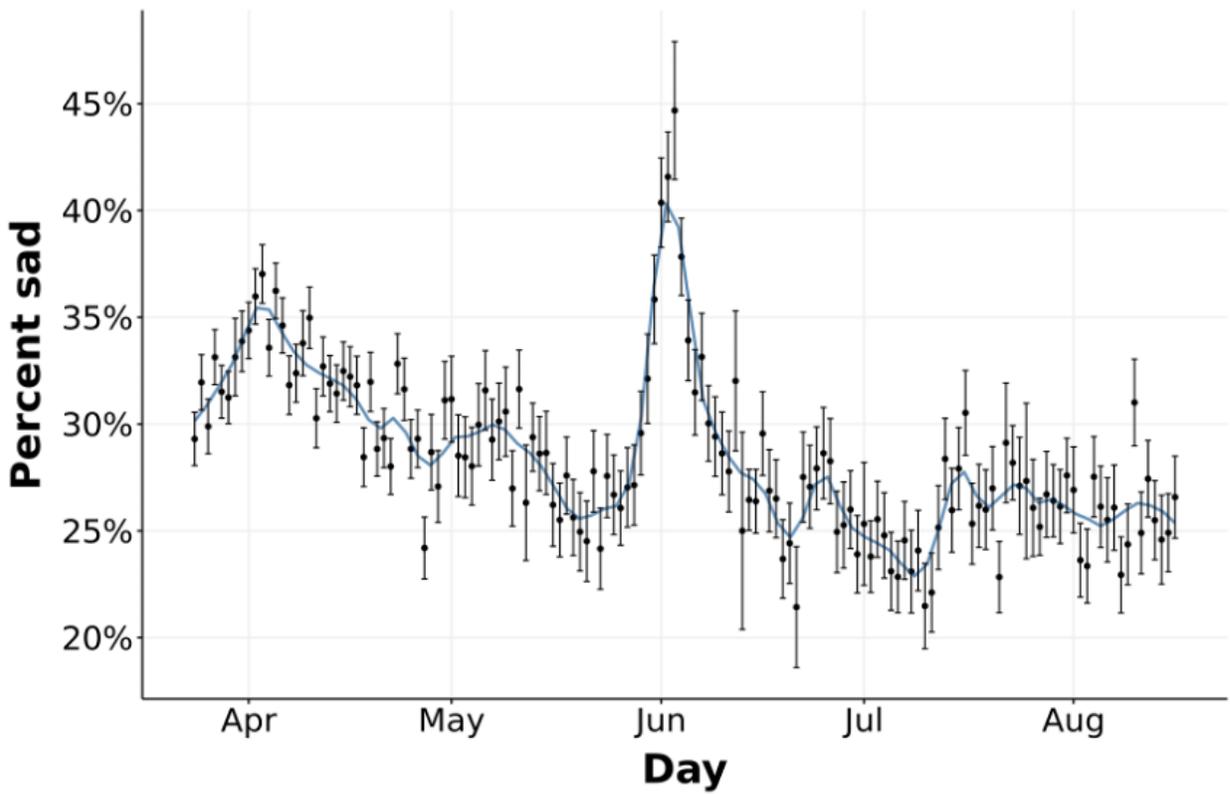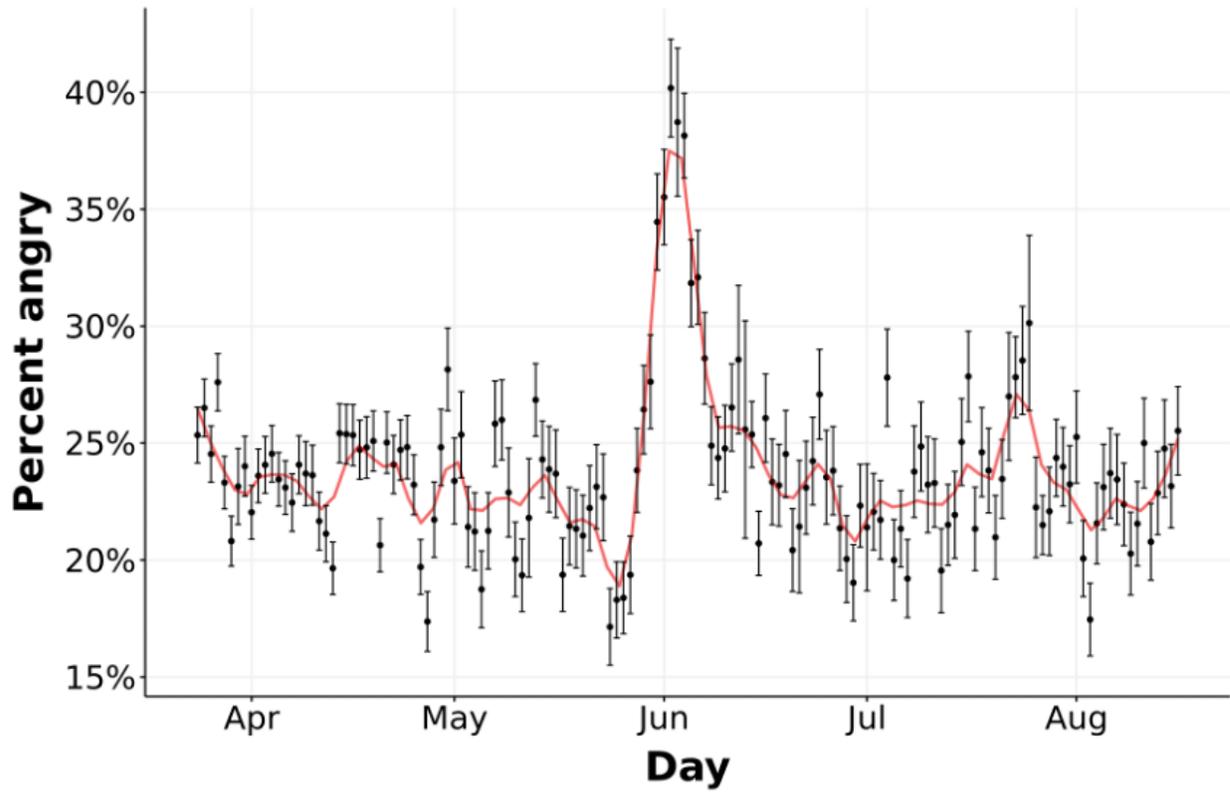
**Fig. S1.** Gallup Panel COVID-19 data set: (**Top**) Daily percentage of the respondents reporting having experienced anger and (**Bottom**) sadness 'a lot of the day yesterday.'. Percentages and error bars (showing SEs) are unweighted since Gallup's weights applied only to weekly periods for much of the time shown.

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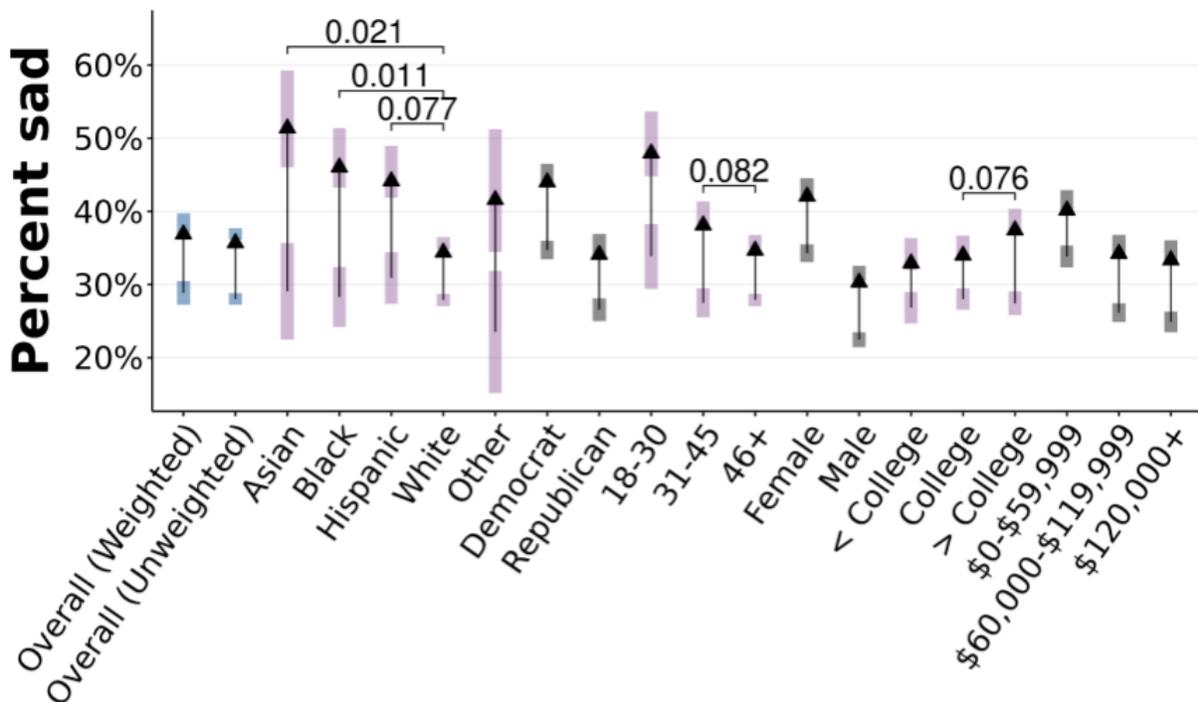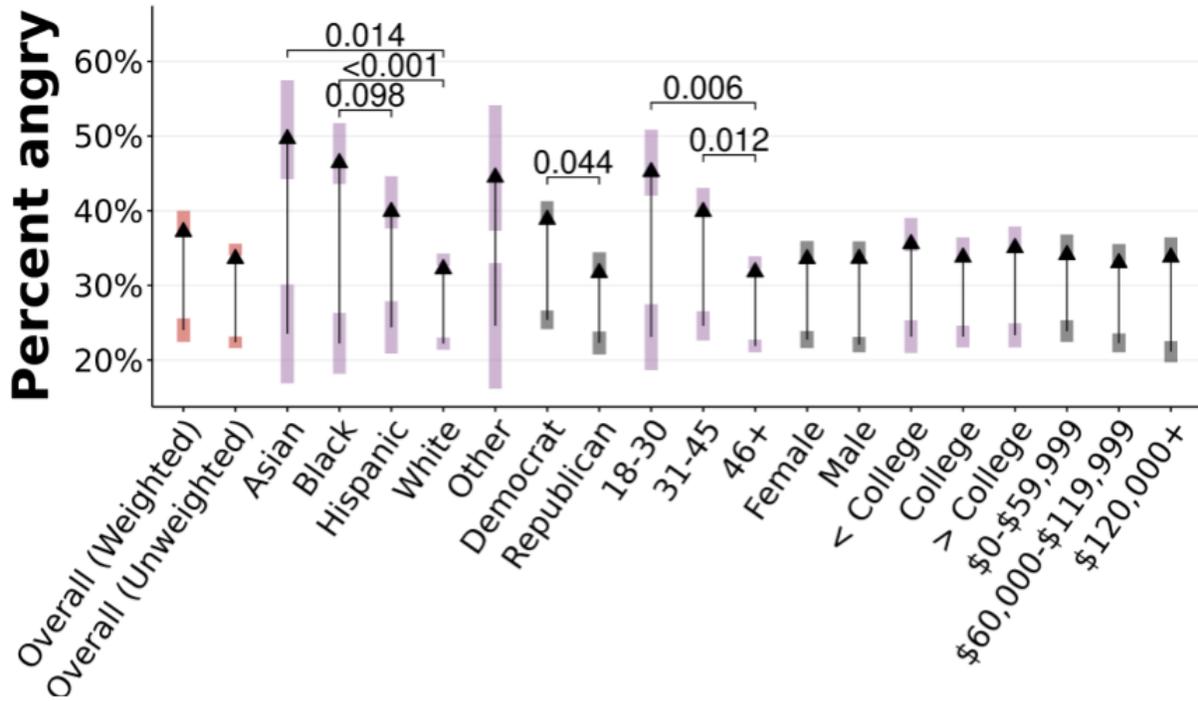
**Fig. S2.** Gallup Panel COVID-19 data set: Increases in anger (**Top**) and sadness (**Bottom**) experienced by race, political party, age, gender, education and income in the week after Floyd's death compared to the four preceding baseline weeks; shaded boxes indicate SEs. Gallup did not provide weights suitable for the subgroup analysis; they are unweighted means and SEs. Between-bar significances are calculated as the proportion of bootstrapped samples with a greater difference than that observed.

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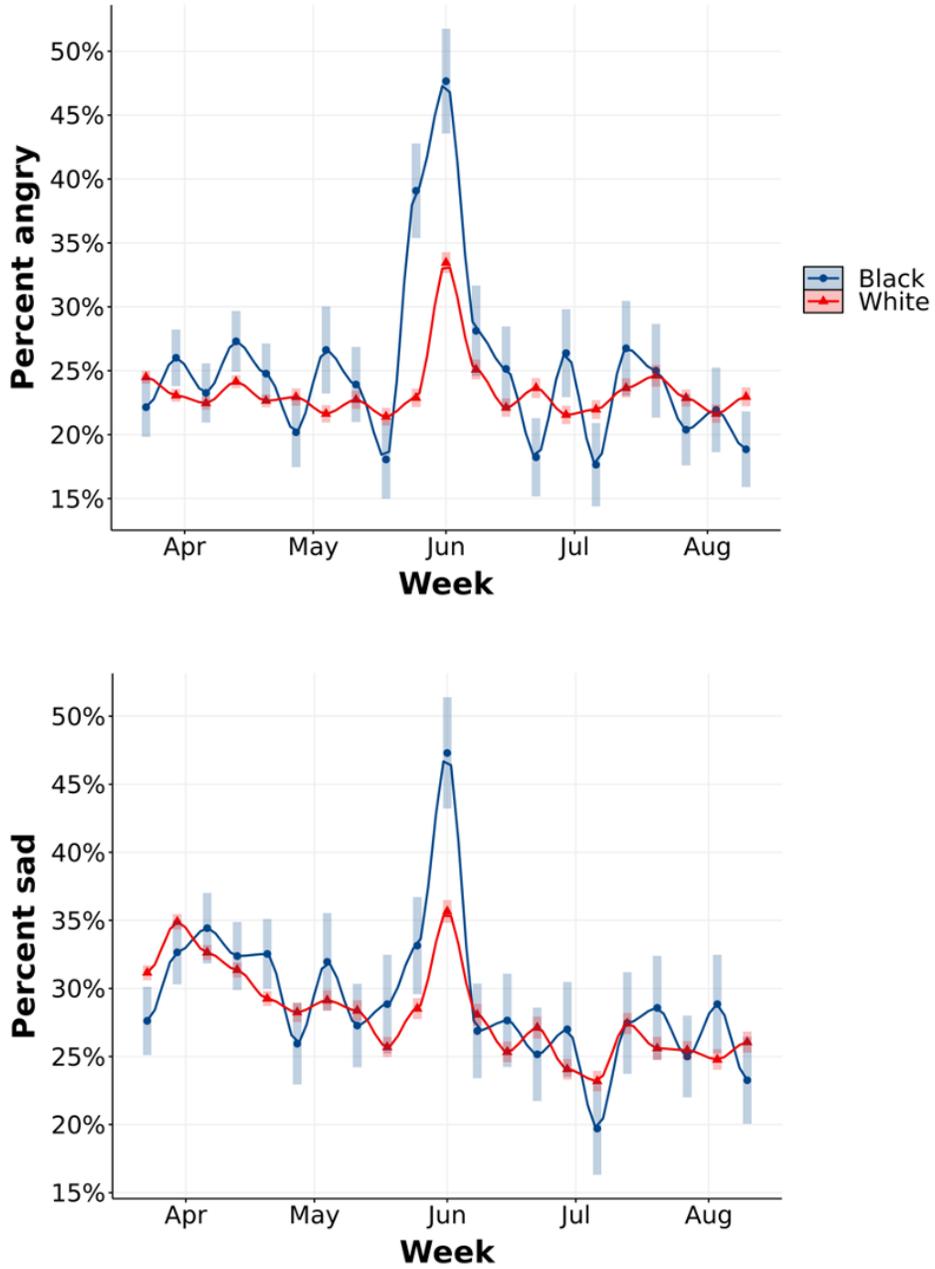
**Fig. S3.** Gallup Panel COVID-19 data set: (**Top**) Weekly percentage of Black Americans and White Americans reporting having experienced anger and (**Bottom**) sadness 'a lot of the day yesterday.' Percentages and error bars (indicating standard errors) are unweighted estimates.
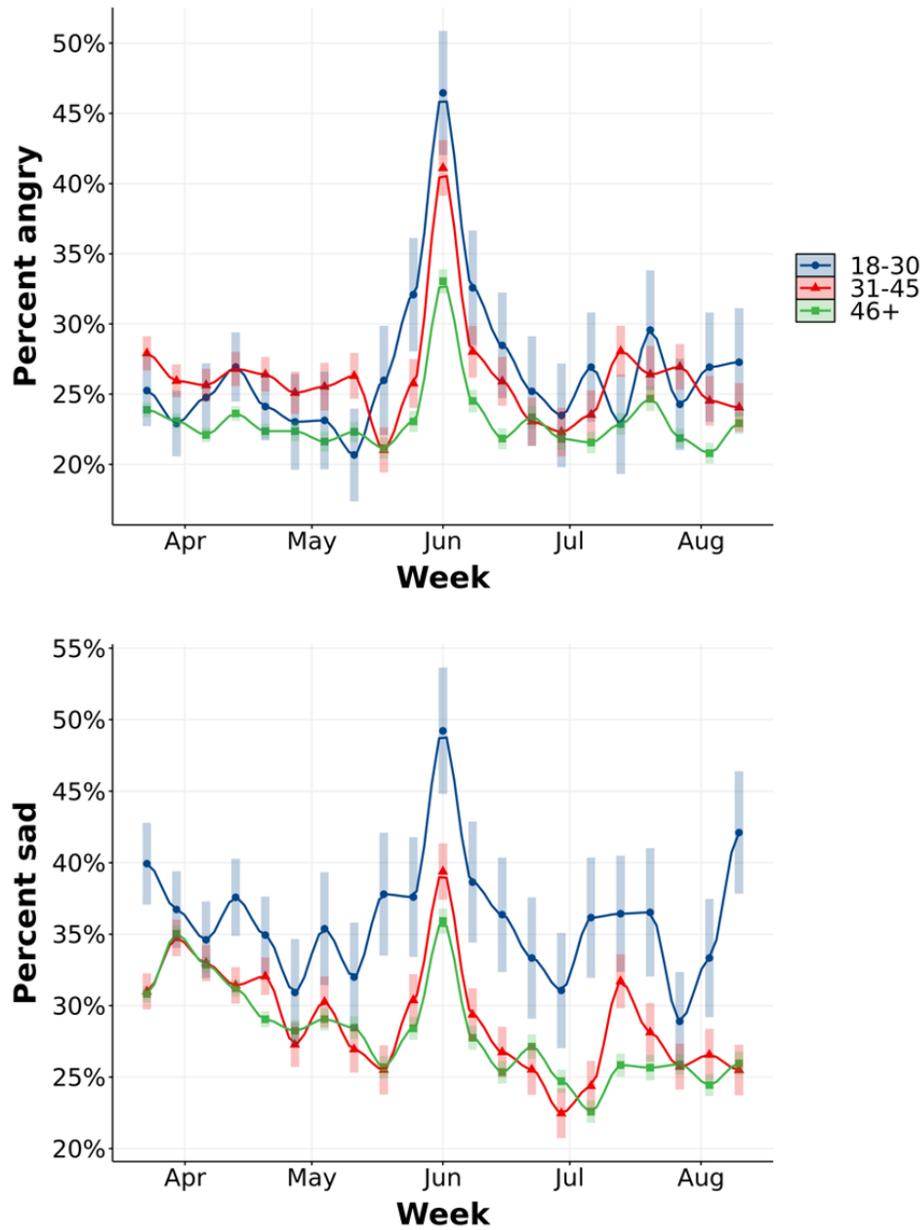
**Fig. S4.** Gallup Panel COVID-19 data set: (**Top**) Weekly percentage of respondents broken down by age reporting having experienced anger and (**Bottom**) sadness 'a lot of the day yesterday' in the representative 2020 Gallup Panel COVID-19 survey. Percentages and error bars (indicating standard errors) are unweighted estimates.
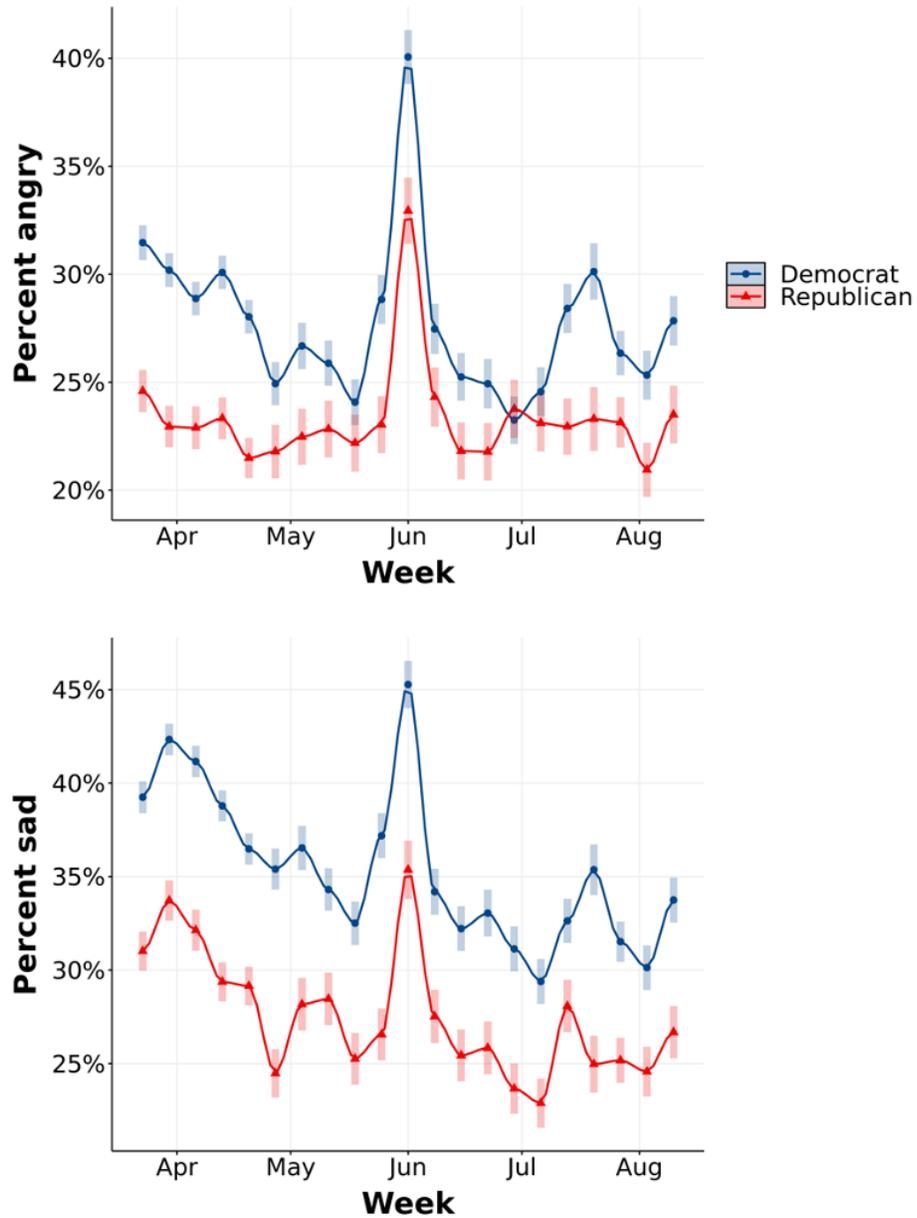
**Fig. S5.** Gallup Panel COVID-19 data set: (**Top**) Weekly percentage of self-identified Democrat and Republican respondents having experienced anger and (**Bottom**) sadness 'a lot of the day yesterday' in the representative 2020 Gallup Panel COVID-19 survey. Percentages and error bars (indicating standard errors) are unweighted estimates.
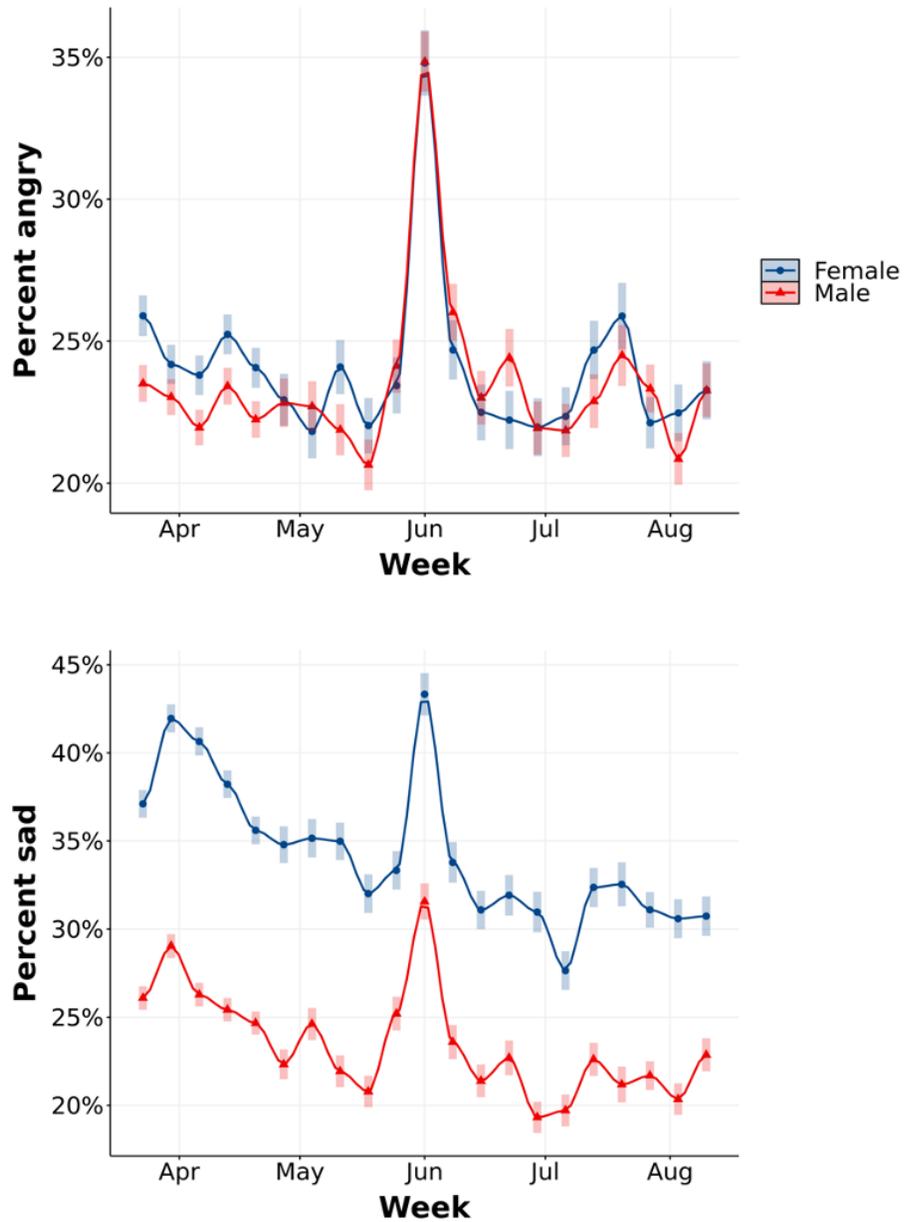
**Fig. S6.** Gallup Panel COVID-19 data set: (**Top**) Weekly percentage of self-identified Male and Female respondents having experienced anger and (**Bottom**) sadness 'a lot of the day yesterday' in the representative 2020 Gallup Panel COVID-19 survey. Percentages and error bars (indicating standard errors) are unweighted estimates.
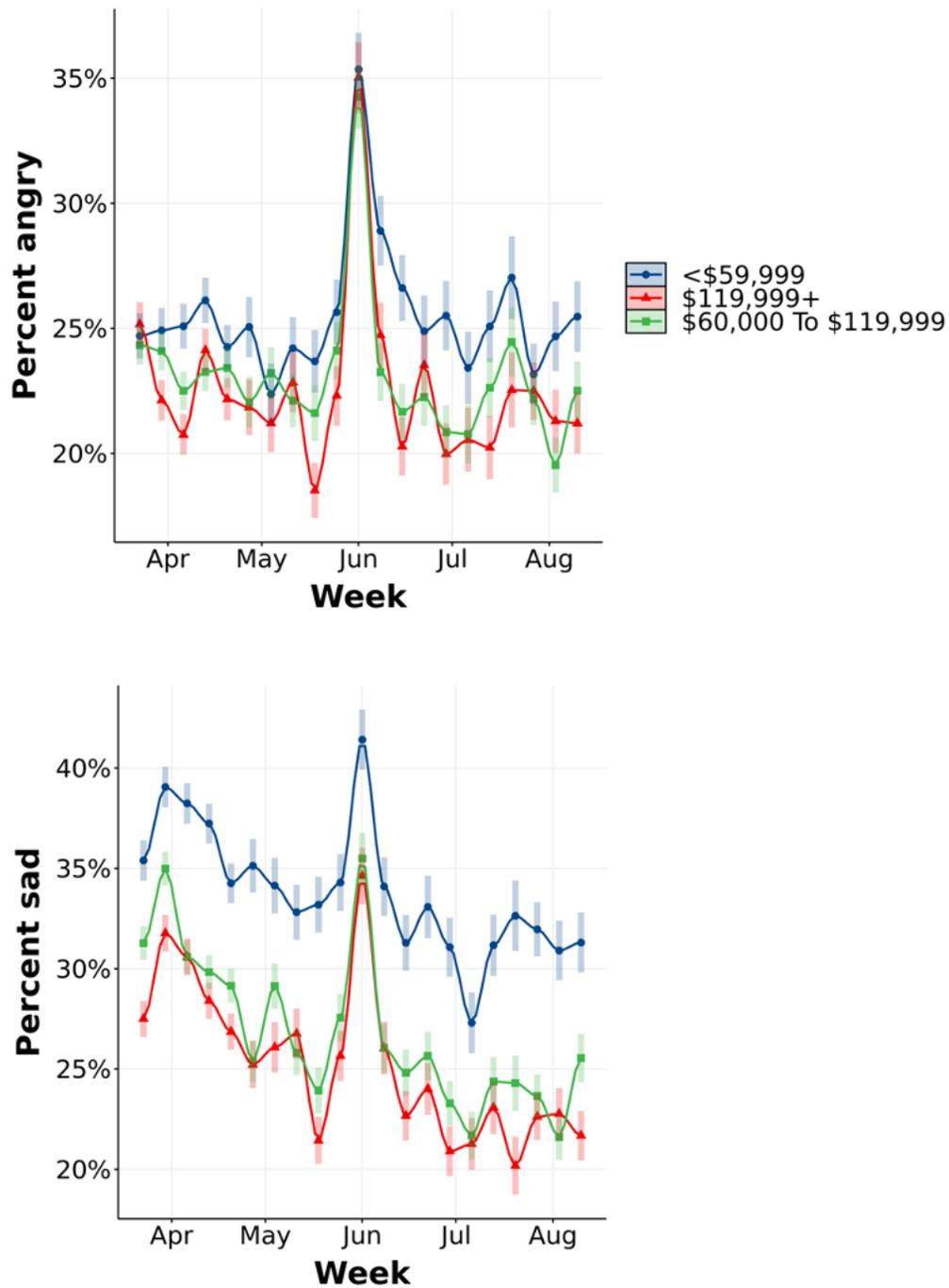
**Fig. S7.** Gallup Panel COVID-19 data set: (**Top**) Weekly percentage of respondents broken down by yearly income having experienced anger and (**Bottom**) sadness 'a lot of the day yesterday' in the representative 2020 Gallup Panel COVID-19 survey. Percentages and error bars (indicating standard errors) are unweighted estimates.
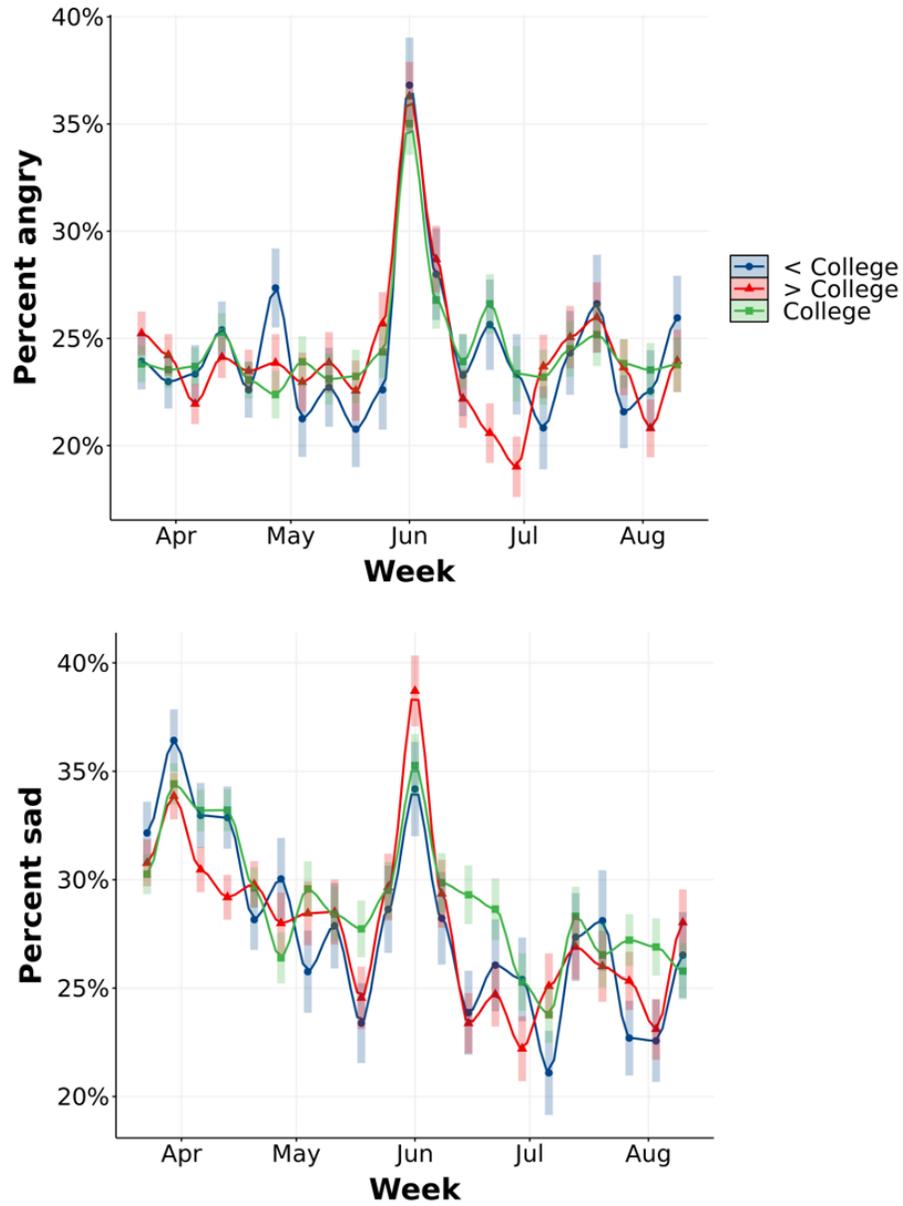
**Fig. S8.** Gallup Panel COVID-19 data set: (**Top**) Weekly percentage of respondents broken down by education level having experienced anger and (**Bottom**) sadness 'a lot of the day yesterday' in the representative 2020 Gallup Panel COVID-19 survey. Percentages and error bars (indicating standard errors) are unweighted estimates.

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**Table S4. U.S. Census Household Pulse Survey: Demographic characteristics of survey respondents for data collected between April 23 to June 2, 2020. Estimates incorporate Census-provided weights for gender, age, race, and education and non-response. Also shown are mean GAD-2, mean PHQ-2, % anxious, and % depressed along with SEs in the sample. GAD-2 and PHQ-2 range from 0–6 and anyone scoring >2 SEs in the sample. GAD-2 and PHQ-2 range from 0–6 and anyone scoring >2 on GAD-2 and PHQ-2 were identified as anxious and depressed respectively. Total N for which both GAD and PHQ were available is 319,471, as reported in manuscript.**

| | GAD-2 | | | PHQ-2 | | |
|---|---|---|---|---|---|---|
| | N (respondents) | sum (SE) | % Anxious (SE) | N (respondents) | sum (SE) | % Depressed (SE) |
| **Overall** | 320,203 | 1.97 (0.01) | 29.81 (0.18) | 320,053 | 1.66 (0.01) | 24.44 (0.17) |
| **Race** | | | | | | |
| Asian | 14,775 | 1.83 (0.04) | 25.34 (0.73) | 14,780 | 1.55 (0.03) | 21.07 (0.68) |
| Black | 24,617 | 2.08 (0.03) | 32.53 (0.61) | 24,595 | 1.77 (0.03) | 27.31 (0.57) |
| Hispanic | 28,009 | 2.26 (0.03) | 34.9 (0.65) | 27,988 | 1.92 (0.03) | 28.77 (0.6) |
| White | 243,957 | 1.86 (0.01) | 27.92 (0.2) | 243,863 | 1.57 (0.01) | 22.7 (0.18) |
| **Gender** | | | | | | |
| Male | 131,494 | 1.72 (0.01) | 25.65 (0.27) | 131,423 | 1.52 (0.01) | 22.16 (0.24) |
| Female | 192,537 | 2.2 (0.01) | 33.75 (0.24) | 192,452 | 1.8 (0.01) | 26.58 (0.22) |
| **Age** | | | | | | |
| 19-30 | 27,005 | 2.46 (0.03) | 40.36 (0.59) | 26,984 | 2.21 (0.03) | 35.78 (0.57) |
| 31-45 | 97,958 | 2.19 (0.02) | 33.7 (0.34) | 97,893 | 1.8 (0.02) | 26.57 (0.31) |
| 46+ | 197,709 | 1.71 (0.01) | 24.78 (0.23) | 197,644 | 1.44 (0.01) | 20.08 (0.2) |
| **Education** | | | | | | |
| < College | 46,240 | 2.06 (0.02) | 32.23 (0.4) | 46,222 | 1.82 (0.02) | 28.15 (0.38) |
| > College | 80,641 | 1.63 (0.01) | 22.41 (0.29) | 80,589 | 1.23 (0.01) | 15.23 (0.25) |
| College | 197,630 | 1.99 (0.01) | 30.07 (0.22) | 197,556 | 1.66 (0.01) | 24.2 (0.2) |
| **Income** | | | | | | |
| $0-$74,999 | 110,399 | 2.29 (0.02) | 36.77 (0.32) | 110,292 | 2.04 (0.02) | 32.34 (0.3) |
| $150,000+ | 58,431 | 1.47 (0.02) | 19.43 (0.37) | 58,408 | 1.08 (0.01) | 12.83 (0.29) |
| $75,000-$149,999 | 157,653 | 1.8 (0.01) | 26.21 (0.28) | 157,627 | 1.47 (0.01) | 20.2 (0.25) |

**Table S5. U.S. Census Household Pulse Survey: Weighted severity of depression and anxiety symptoms experienced by each demographic group before and immediately after Floyd's death (sum of item scores). Estimates incorporate Census-provided weights for gender, age, race, and education and non-response. Also included: standard errors, the change in anxiety and depression severity, Cohen's d statistics for the difference with corresponding $t$-value, degrees of freedom, $p$-value, and number of responses.**

| | GAD-2 | | | | | | | | | PHQ-2 | | | | | | | | |
| | pre-Floyd | | Floyd | | Change (Floyd - pre-Floyd) | | | | | pre-Floyd | | Floyd | | Change (Floyd - pre-Floyd) | | | | |
| | N (responses) | sum (SE) | N (responses) | sum (SE) | delta | Cohen's d | t-value | df | p-value | N (responses) | sum | N (responses) | sum | delta | Cohen's d | t-value | df | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Overall** | 317,075 | 1.96 (0.01) | 93,631 | 2.01 (0.02) | 0.05 | 0.023 | 6.14 | 147986.72 | 0 | 317,044 | 1.65 (0.01) | 93,565 | 1.71 (0.02) | 0.06 | 0.034 | 9.15 | 146958.30 | 0 |
| **Race** | | | | | | | | | | | | | | | | | | |
| Asian | 14,223 | 1.82 (0.04) | 3,971 | 1.92 (0.07) | 0.10 | 0.054 | 2.99 | 6224.33 | 0.003 | 14,229 | 1.54 (0.04) | 3,969 | 1.6 (0.07) | 0.06 | 0.035 | 1.91 | 6073.10 | 0.057 |
| Black | 22,314 | 2.06 (0.04) | 6,714 | 2.18 (0.06) | 0.12 | 0.057 | 4.11 | 10867.31 | 0 | 22,313 | 1.74 (0.03) | 6,700 | 1.93 (0.06) | 0.19 | 0.102 | 7.28 | 10630.42 | 0 |
| Hispanic | 25,014 | 2.29 (0.04) | 7,905 | 2.15 (0.05) | -0.13 | -0.068 | -5.29 | 13603.47 | 0 | 25,004 | 1.93 (0.04) | 7,892 | 1.88 (0.05) | -0.05 | -0.025 | -1.92 | 13393.11 | 0.055 |
| White | 244,730 | 1.85 (0.01) | 71,830 | 1.9 (0.02) | 0.05 | 0.023 | 5.46 | 112584.49 | 0 | 244,708 | 1.56 (0.01) | 71,790 | 1.61 (0.02) | 0.05 | 0.025 | 5.84 | 112715.90 | 0 |
| **Gender** | | | | | | | | | | | | | | | | | | |
| Male | 130,201 | 1.72 (0.02) | 38,317 | 1.74 (0.03) | 0.03 | 0.013 | 2.19 | 60612.71 | 0.028 | 130,186 | 1.51 (0.02) | 38,300 | 1.58 (0.03) | 0.07 | 0.038 | 6.52 | 59780.29 | 0 |
| Female | 186,874 | 2.19 (0.01) | 55,314 | 2.25 (0.03) | 0.07 | 0.033 | 6.69 | 87321.36 | 0 | 186,858 | 1.78 (0.01) | 55,265 | 1.84 (0.02) | 0.06 | 0.031 | 6.33 | 87066.16 | 0 |
| **Age** | | | | | | | | | | | | | | | | | | |
| 19-30 | 23,405 | 2.45 (0.04) | 7,260 | 2.53 (0.06) | 0.08 | 0.038 | 2.80 | 11571.62 | 0.005 | 23,392 | 2.19 (0.04) | 7,252 | 2.25 (0.05) | 0.06 | 0.028 | 2.09 | 11686.28 | 0.037 |
| 31-45 | 94,197 | 2.18 (0.02) | 26,245 | 2.24 (0.03) | 0.06 | 0.029 | 4.11 | 41661.07 | 0 | 94,168 | 1.78 (0.02) | 26,218 | 1.85 (0.03) | 0.06 | 0.034 | 4.84 | 41352.86 | 0 |
| 46+ | 199,473 | 1.71 (0.01) | 60,126 | 1.73 (0.03) | 0.03 | 0.013 | 2.77 | 96994.36 | 0.006 | 199,484 | 1.43 (0.01) | 60,095 | 1.49 (0.02) | 0.06 | 0.033 | 6.99 | 95575.01 | 0 |
| **Education** | | | | | | | | | | | | | | | | | | |
| < College | 42,441 | 2.05 (0.02) | 12,356 | 2.1 (0.04) | 0.04 | 0.021 | 2.10 | 19926.48 | 0.035 | 42,432 | 1.81 (0.02) | 12,334 | 1.88 (0.04) | 0.08 | 0.040 | 3.89 | 19824.79 | 0 |
| > College | 81,769 | 1.63 (0.02) | 24,528 | 1.62 (0.03) | -0.01 | -0.006 | -0.79 | 40427.07 | 0.43 | 81,762 | 1.22 (0.02) | 24,521 | 1.26 (0.02) | 0.04 | 0.024 | 3.29 | 39957.67 | 0.001 |
| College | 192,865 | 1.98 (0.01) | 56,747 | 2.05 (0.02) | 0.07 | 0.033 | 6.88 | 90873.56 | 0 | 192,850 | 1.65 (0.01) | 56,710 | 1.72 (0.02) | 0.07 | 0.035 | 7.23 | 90137.71 | 0 |
| **Income** | | | | | | | | | | | | | | | | | | |
| $0-$74,999 | 102,836 | 2.28 (0.02) | 31,494 | 2.35 (0.03) | 0.07 | 0.031 | 4.87 | 52766.26 | 0 | 102,803 | 2.02 (0.02) | 31,436 | 2.1 (0.03) | 0.07 | 0.037 | 5.81 | 52637.85 | 0 |
| $150,000+ | 58,220 | 1.47 (0.02) | 16,499 | 1.48 (0.04) | 0.01 | 0.006 | 0.66 | 25847.06 | 0.509 | 58,222 | 1.08 (0.02) | 16,483 | 1.1 (0.03) | 0.03 | 0.018 | 1.98 | 26054.24 | 0.048 |
| $75,000-$149,999 | 153,542 | 1.8 (0.01) | 45,638 | 1.83 (0.02) | 0.03 | 0.017 | 3.21 | 74278.05 | 0.001 | 153,552 | 1.46 (0.01) | 45,646 | 1.52 (0.02) | 0.06 | 0.037 | 6.79 | 72900.44 | 0 |

**Table S6.** U.S. Census Household Pulse Survey: Weighted percent of each demographic group experiencing anxiety and depression before and immediately after Floyd's death (PHQ-2 $>$ 2 or GAD-2 $>$ 2). Also included: the change in % anxious and % depressed, and number of responses.

| | GAD-2 | | | | | PHQ-2 | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Pre-Floyd | | Floyd | | Change | Pre-Floyd | | Floyd | | Change |
| | N (responses) | % Anxious | N (responses) | % Anxious | % Anxious | N (responses) | % Depressed | N (responses) | % Depressed | % Depressed |
| Overall | 317075 | 29.62 | 93631 | 30.62 | 1.00 | 317044 | 24.24 | 93565 | 25.26 | 1.02 |
| **Age** | | | | | | | | | | |
| 19-30 | 23405 | 39.86 | 7260 | 42.24 | 2.38 | 23392 | 35.517 | 7252 | 36.801 | 1.284 |
| 31-45 | 94197 | 33.50 | 26245 | 34.60 | 1.11 | 94168 | 26.393 | 26218 | 27.307 | 0.913 |
| 46+ | 199473 | 24.70 | 60126 | 25.10 | 0.40 | 199484 | 19.924 | 60095 | 20.723 | 0.799 |
| **Education** | | | | | | | | | | |
| < College | 42441 | 32.09 | 12356 | 32.83 | 0.74 | 42432 | 27.996 | 12334 | 28.785 | 0.789 |
| > College | 81769 | 22.42 | 24528 | 22.36 | -0.07 | 81762 | 15.092 | 24521 | 15.761 | 0.669 |
| College | 192865 | 29.76 | 56747 | 31.32 | 1.56 | 192850 | 23.931 | 56710 | 25.296 | 1.366 |
| **Income** | | | | | | | | | | |
| $0-$74,999 | 102836 | 36.55 | 31494 | 37.67 | 1.12 | 102803 | 32.105 | 31436 | 33.284 | 1.179 |
| $150,000+ | 58220 | 19.35 | 16499 | 19.73 | 0.38 | 58222 | 12.94 | 16483 | 12.364 | -0.577 |
| $75,000-$149,999 | 153542 | 26.02 | 45638 | 26.98 | 0.96 | 153552 | 19.94 | 45646 | 21.288 | 1.348 |
| **Gender** | | | | | | | | | | |
| Male | 130201 | 25.57 | 38317 | 25.96 | 0.39 | 130186 | 21.964 | 38300 | 22.961 | 0.996 |
| Female | 186874 | 33.44 | 55314 | 35.03 | 1.58 | 186858 | 26.38 | 55265 | 27.423 | 1.044 |
| **Race** | | | | | | | | | | |
| Asian | 14223 | 24.63 | 3971 | 28.42 | 3.79 | 14229 | 20.842 | 3969 | 22.036 | 1.193 |
| Black | 22314 | 32.20 | 6714 | 33.85 | 1.65 | 22313 | 26.665 | 6700 | 29.912 | 3.247 |
| Hispanic | 25014 | 35.60 | 7905 | 32.09 | -3.50 | 25004 | 29.374 | 7892 | 26.324 | -3.049 |
| White | 244730 | 27.67 | 71830 | 28.99 | 1.32 | 244708 | 22.465 | 71790 | 23.657 | 1.193 |

**Table S7. U.S. Census Household Pulse Survey: Weighted severity of depression and anxiety symptoms experienced by each geographic group before and immediately after Floyd's death. Estimates incorporate Census-provided weights for gender, age, race, and education and non-response. Also included: standard errors, the change in anxiety and depression severity, Cohen's d statistics for the difference with corresponding $t$-value, degrees of freedom, $p$-value, and number of responses.**

| | GAD-2 | | | | | | | | | PHQ-2 | | | | | | | | |
| | Pre-Floyd | | Floyd | | Change (Floyd - pre-Floyd) | | | | | Pre-Floyd | | Floyd | | Change (Floyd - pre-Floyd) | | | | |
| | N (responses) | sum (SE) | N (responses) | sum (SE) | sum | Cohen's d | t-value | df | p-value | N (responses) | sum | N (responses) | sum | sum | Cohen's d | t-value | df | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Overall | 317,075 | 1.96 (0.01) | 93,631 | 2.01 (0.02) | 0.05 | 0.023 | 6.14 | 147986.72 | 0 | 317,044 | 1.65 (0.01) | 93,565 | 1.71 (0.02) | 0.06 | 0.034 | 9.15 | 146958.3 | 0 |
| Minnesota | 6,337 | 1.74 (0.05) | 1,735 | 1.92 (0.1) | 0.18 | 0.091 | 3.26 | 2503.12 | 0.001 | 6,329 | 1.34 (0.05) | 1,736 | 1.48 (0.09) | 0.13 | 0.073 | 2.59 | 2505.86 | 0.01 |
| Other States | 310,738 | 1.96 (0.01) | 91,896 | 2.01 (0.02) | 0.04 | 0.022 | 5.78 | 145482.4 | 0 | 310,715 | 1.66 (0.01) | 91,829 | 1.72 (0.02) | 0.06 | 0.034 | 8.9 | 144444.29 | 0 |

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**Table S8.** U.S. Census Household Pulse Survey: Weighted percent of each geographic group experiencing anxiety and depression before and immediately after Floyd's death (PHQ-2 $>$ 2 or GAD-2 $>$ 2). Estimates incorporate Census-provided weights for gender, age, race, and education and non-response. Also included: the change in % anxious and % depressed, and number of responses.

| | GAD-2 | | | | | | PHQ-2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre-Floyd | | Floyd | | Change | | Pre-Floyd | | Floyd | | Change | |
| | N (responses) | % Anxious | N (responses) | % Anxious | % Anxious | | N (responses) | % Depressed | N (responses) | % Depressed | % Depressed | |
| Overall | 317,075 | 29.62 | 93,631 | 30.62 | 1 | | 317,044 | 24.24 | 93,565 | 25.26 | 1.02 | |
| Minnesota | 6,337 | 25.37 | 1,735 | 27.5 | 2.13 | | 6,329 | 19.17 | 1,736 | 19.07 | -0.1 | |
| Other States | 310,738 | 29.69 | 91,896 | 30.67 | 0.98 | | 310,715 | 24.32 | 91,829 | 25.36 | 1.04 | |
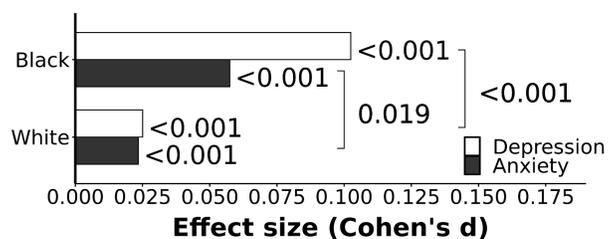
**Fig. S9.** U.S. Census Household Pulse Survey: Increases in anxiety and depression as standardized effect sizes (Cohen's $d$'s) comparing the five weeks before Floyd's death (April 23 to May 26) to the week following Floyd's death (May 28 to June 2) using data from the Census Household Pulse survey. Depression was measured using the Patient Health Questionnaire (PHQ-2), anxiety using the Generalized Anxiety Disorder (GAD-2) screener. We used the sum of the person-level item scores to estimate total symptom severity. Estimates incorporate Census-provided weights for age, gender, education, race and non-response. Significance tests of bars are based on a weighted t-test; significance between bars is based on a z-test as described in (3). Numbers adjacent to bars indicate p-values.
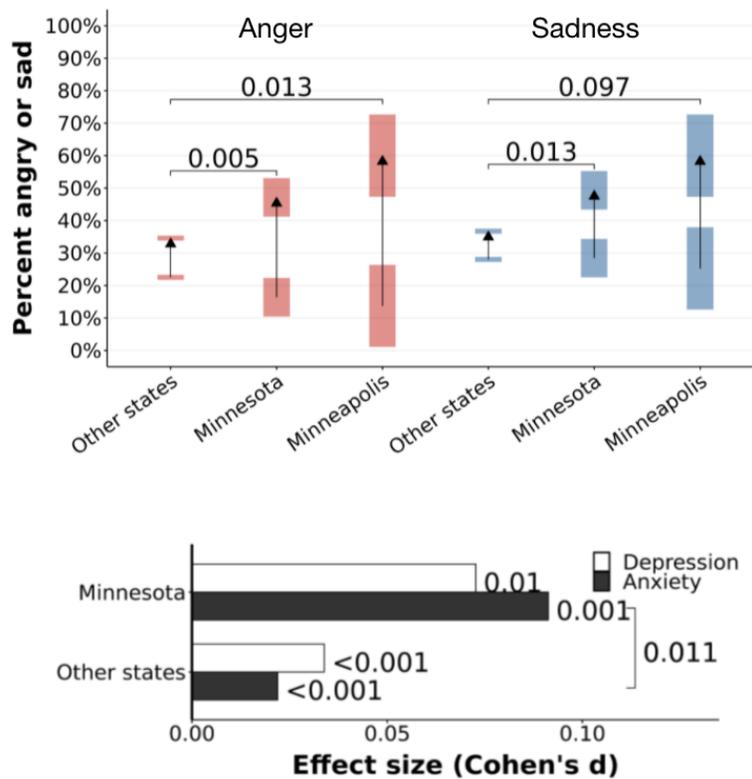
**Fig. S10. (Top)**: Gallup Panel COVID-19 data set: Increases in sadness and anger reported in the week following Floyd's death compared to the four baseline weeks (analogous to **Fig. 1 c** and **d**). Increases in anger and sadness were significantly larger in Minnesota than in other states during the same period. **(Bottom)**: U.S. Census Household Pulse Survey: Increases in anxiety and depression as standardized effect sizes (Cohen's *d*'s) during the week of Floyd's death as compared to the previous five-week baseline period using data from the Census Household Pulse survey (analogous to **Fig. 2**). While anxiety and depression symptom severity increased significantly (*p*'s < 0.001) nation-wide in response to Floyd's death, these increases were more pronounced in Minnesota. Numbers adjacent to bars indicate p-values.

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**Table S9. Gallup-Sharecare Well-Being Index: Unweighted demographic characteristics of Gallup survey respondents from data collected between 2009 and 2016.**

| Descriptive Statistics of Gallup Data (2009 - 2016)* : Anger | | | Descriptive Statistics of Gallup Data (2009 - 2016) : Sadness | | |
|---|---|---|---|---|---|
| **Anger** | | **% Angry** | **Sadness** | | **%Sad** |
| (Max: 11/07/2016: 17%; Min: 12/26/2011: 10%) | N | Mean (SD) | (Max: 12/10/2012 22%; Min: 10/31/2016: 15%) | N | Mean (SD) |
| **Overall** | **1,746,447** | **12% (32.6)** | **Overall** | **2,119,712** | **16.7% (37.3)** |
| Party Affiliation | | | Party Affiliation | | |
| Democrat | 673,563 | 12% (32.5) | Democrat | 719,812 | 18% (38.4) |
| Republican | 661,954 | 11.3% (31.6) | Republican | 709,209 | 14.7% (35.4) |
| Other | 139,438 | 14.8% (35.5) | Other | 151,362 | 19.2% (39.3) |
| Gender | | | Gender | | |
| Female | 884,584 | 11.4% (31.7) | Female | 1,070,758 | 19.5% (39.6) |
| Male | 861,859 | 12.7% (33.3) | Male | 1,048,949 | 13.8% (34.5) |
| Age | | | Age | | |
| Age (18-30) | 215,734 | 16% (36.7) | Age (18-30) | 270,248 | 15.1% (35.8) |
| Age (31-45) | 312,935 | 15.8% (36.5) | Age (31-45) | 378,076 | 15.8% (36.4) |
| Age (45+) | 1,195,007 | 10.4% (30.5) | Age (45+) | 1,442,435 | 17.2% (37.8) |
| Race | | | Race | | |
| Asian | 31,872 | 12% (32.5) | Asian | 39,809 | 13.9% (34.6) |
| Black | 129,273 | 13.9% (34.5) | Black | 162,553 | 17% (37.6) |
| Hispanic | 121,171 | 16.5% (37.1) | Hispanic | 155,716 | 22.3% (41.6) |
| Other | 41,942 | 16.5% (37.1) | Other | 47,579 | 20.4% (40.3) |
| White | 1,360,707 | 11.3% (31.6) | White | 1,640,705 | 16% (36.7) |
| Education | | | Education | | |
| College Graduate | 390,924 | 11.3% (31.6) | College Graduate | 472,008 | 13.6 %(34.3) |
| High School degree | 349,783 | 12.3% (32.8) | High School degree | 434,886 | 18.7% (39) |
| Less than high school diploma | 96,673 | 16.8% (37.3) | Less than high school diploma | 118,823 | 29.1% (45.4) |
| Post graduate work or degree | 339,433 | 10.1% (30.1) | Post graduate work or degree | 408,889 | 13% (33.6) |
| Some college | 427,402 | 12.7% (33.3) | Some college | 521,491 | 17.1% (37.7) |
| Technical/Vocational school | 115,324 | 13.4% (34.1) | Technical/Vocational school | 130,614 | 18.5% (38.8) |

\* Data from 2014-2015 is not available
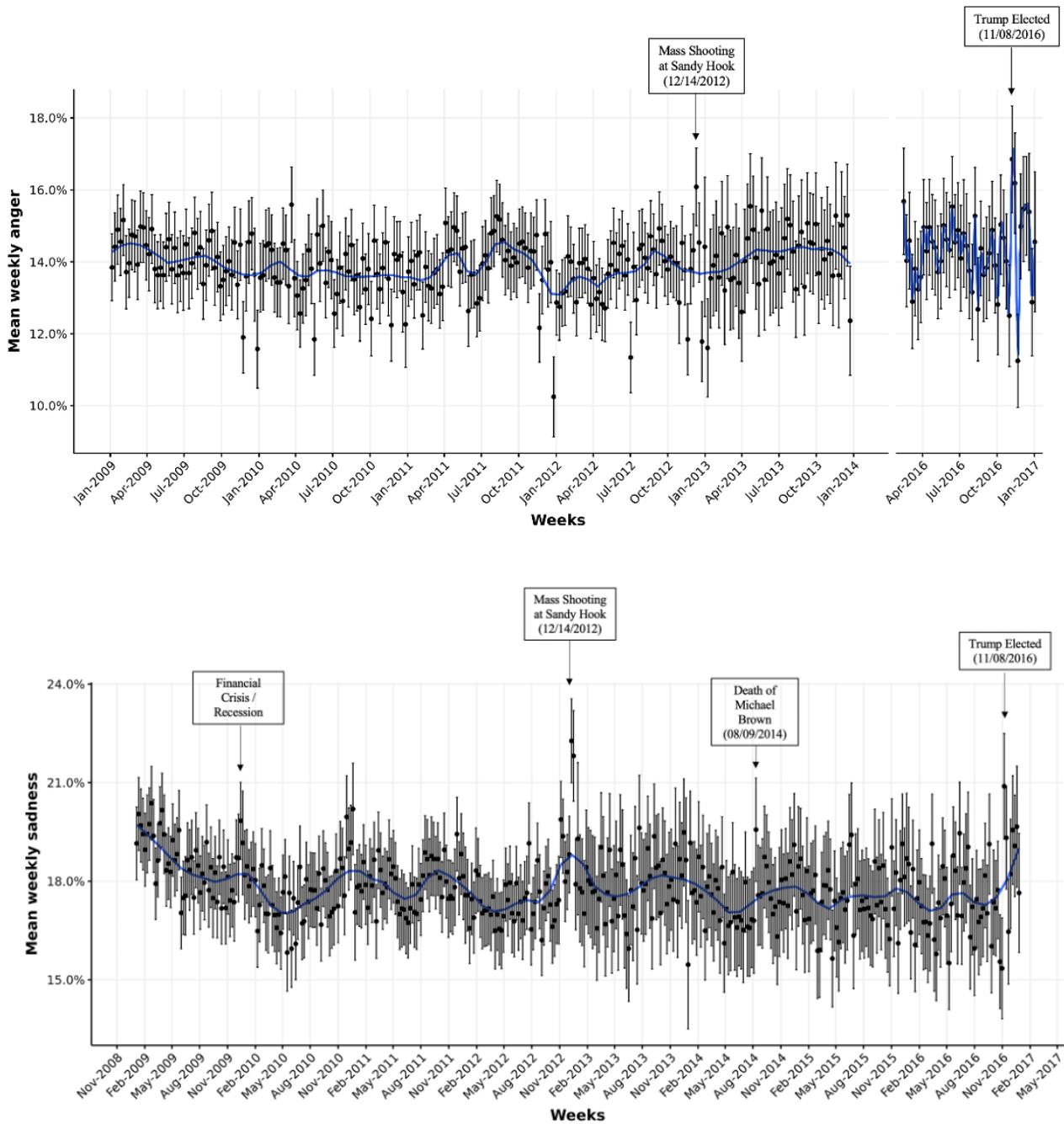
**Fig. S11.** Gallup-Sharecare Well-Being Index: (**Top**) Weighted weekly percentage of the respondents reporting having experienced anger from January 2, 2009 to January 4, 2017 (data for 2014 and 2015 is unavailable) and (**Bottom**) sadness 'a lot of the day yesterday' from January 2, 2009 to December 20, 2016 in the representative historical Gallup survey. Error bars (indicating standard errors) are weighted estimates derived through post-stratification on gender, age, race, Hispanic ethnicity, education and region.
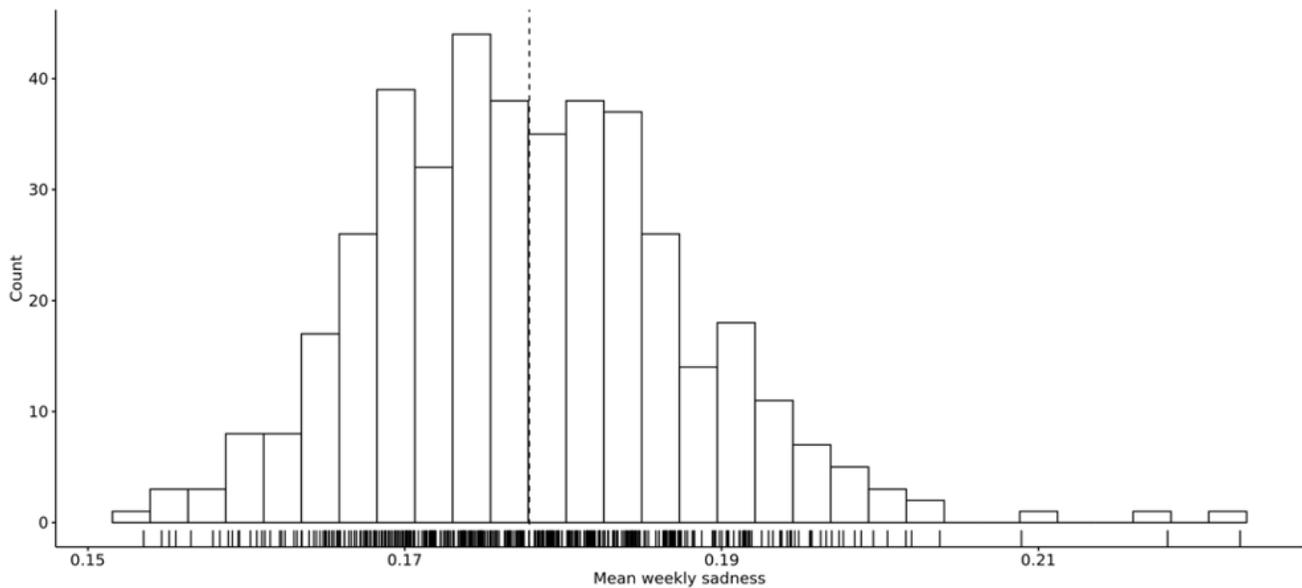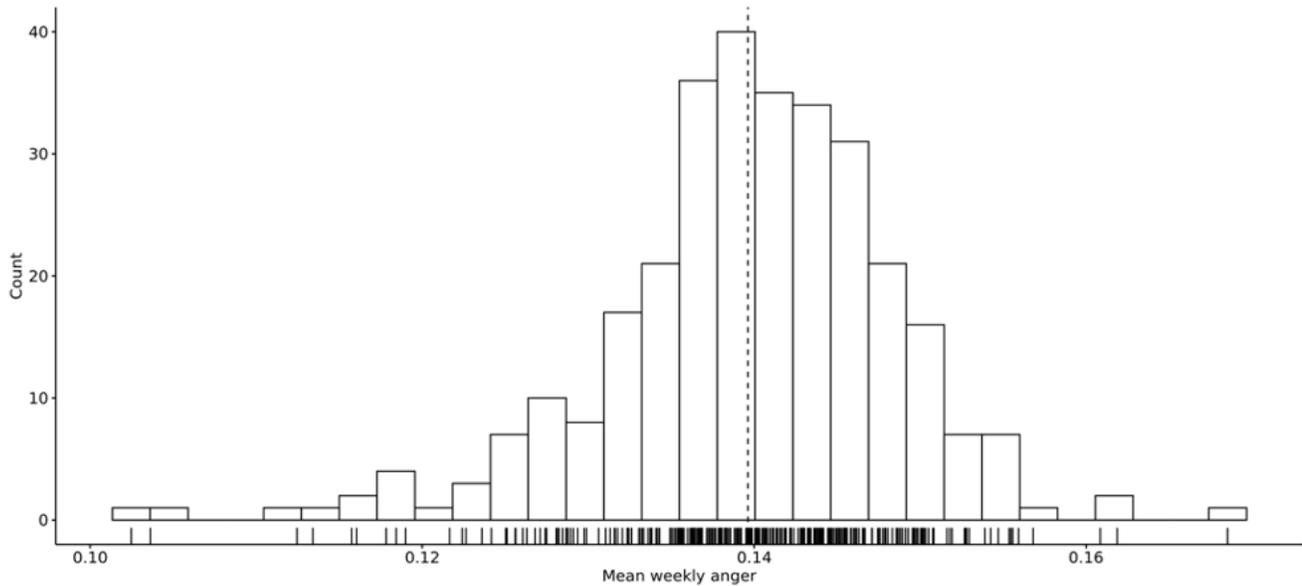
**Fig. S12.** Gallup-Sharecare Well-Being Index: Histograms showing weekly distribution of (**Top**) weighted mean weekly anger and (**Bottom**) weighted mean weekly sadness from historical Gallup-Sharecare Well-Being data between 2009 and 2016.

## References

1. Gallup, Inc., Gallup panel: COVID-19 survey (2020).
2. U.S. Census Bureau, Week 1 Household Pulse Survey: April 23 - May 5 (https://www.census.gov/data/tables/2020/demo/hhp/hhp1.html) (2020).
3. M Borenstein, LV Hedges, JP Higgins, HR Rothstein, *Introduction to meta-analysis*. (John Wiley & Sons), (2021).
4. B Levis, et al., Accuracy of the PHQ-2 alone and in combination with the PHQ-9 for screening to detect major depression: systematic review and meta-analysis. *JAMA* **323**, 2290–2300 (2020).
5. U.S. Census Bureau, Population estimates, July 1, 2019, (v2019) (https://www.census.gov/quickfacts/fact/table/US#) (2019).