

# Information-seeking in the Wake of Tragedy: An Examination of Public Response to Mass Shootings Using Google Search Data

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## Abstract

Mass shootings are a highly visible form of violence in the United States, although public response to these events varies considerably. Drawing on social problems and collective threat perception literature, we use search data for all Google-using Americans following mass shootings since 2004 to examine how event attributes such as the number of victims, venue, and type of weapon(s) predict public information-seeking related to gun control and gun rights. The results demonstrate that the number of victims, news coverage, school venue, and the use of certain weapons all significantly increase public interest in gun control and gun rights. These key predictors interact with one another to further influence information-seeking behaviors related to both gun control and gun rights. We conclude with a discussion of our findings and the potential for Google Search data in social science research.

## Keywords

mass shootings, Google search, social problems, firearms, crime, law, and deviance, collective threat perception

Mass shootings have become a routine and consistent part of the news cycle (Silva and Capellan 2019). Much of the scholarly research on mass shootings has focused on individual characteristics of the perpetrator (Duxbury, Frizzell, and Lindsay 2018; Fox and DeLateur 2014) or factors that influence how shootings are covered and reported in the news (Duwe 2000; Schildkraut, Elsass, and Meredith 2018), rather than the public's response to these events. The limited examinations of public response after mass shootings have typically been descriptive in nature (Niforatos, Zheutlin, and Pescatore 2019), relied on public opinion polls (Lee et al. 2020; Schutten et al. 2020; Wozniak 2017), or assessed single-case studies (Menachemi, Rahrurkar, and Rahrurkar 2017). The limited existing research on public response to mass shootings is notable given that collective interest in the wake of these shooting events can potentially mobilize social movements to influence policy development and gun violence reduction efforts (Burstein 2003; McGinty, Webster, and Barry 2013).

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In this study, we draw on literature regarding social problems and collective threat perception to theorize the means by which violent mass shooting events influence public information-seeking (Elsass, Schildkraut, and Stafford 2014; Huddy, Feldman, and Weber 2007; Newman and Hartman 2019; Stafford and Warr 1985). We argue that the magnitude of a shooting—as measured by the number of victims, type of weapon used, and its venue—impacts the public's conception of a shooting as part of a larger social problem and increases public information-seeking for solutions. Relatedly, we posit that mass shootings of greater magnitude elicit increased collective threat response, which further contributes to public information-seeking in the wake of a mass shooting event. We examine public interest in two different potential responses to mass shootings: gun control and gun rights. We leverage a novel means of using Google search traffic for all Americans in the aftermath of 71<sup>1</sup> mass shootings between 2004 and 2018 to examine how event attributes like venue, number of victims, and type of weapon predict heightened public interest in information regarding gun control and gun rights. We analyze Google search terms as proxies for divergent public responses to the social problem of mass shootings and the perception of collective threat that results from these shootings. This analytic approach enables a broader assessment of public response to mass shootings than afforded in prior research, which has largely leveraged public opinion polling or focused on media coverage as an outcome. Our results have potential implications for collective action that can shape the experience and prevention of gun violence in the United States.

## Background

### *Mass Shootings in the United States*

In 2018, more than 40,000 people died from gun-related injuries, although fatalities from mass shootings comprised only about 2 percent of these deaths (Centers for Disease Control and Prevention, National Center for Health Statistics 2020). Although mass shootings represent a small portion of the overall burden of gun violence in the United States, these events are arguably the most publicly visible forms of violence for many Americans (Luca, Malhotra, and Poliquin 2020). However, despite national protests and demands for gun control over the past two decades (Yee and Binder 2018), few policy changes have been generated in the aftermath of these shootings to prevent further incidents. Since there is not one universally agreed-upon definition of what constitutes a mass shooting, we use the current Federal Bureau of Investigation (FBI) definition of a single indiscriminate attack in a public place in which three or more victims are killed (Follman et al. 2018).

One area of research on mass shootings has focused on motivations and risk factors related to the individual perpetrators of these shootings, including media violence, mental illness, weapon access, and bullying victimization (Fox and DeLateur 2014; Muschert 2007; Sommer, Leuschner, and Scheithauer 2014). Another strain of scholarship has studied news coverage and how media outlets frame mass shootings (Chyi and McCombs 2004; Schildkraut and Muschert 2014; Silva and Capellan 2019). Relatedly, researchers have found that mass shootings increase public fear of crime and fear of future mass shootings (Burns and Crawford 1999; Fox and DeLateur 2014; Schildkraut, Elsass, and Stafford 2015). Finally, researchers have found that event attributes of shootings such as the number of fatalities, the location of shooting, and the types of weapons used all influence the amount of media coverage a particular event receives (Duwe 2000; Schildkraut et al. 2018). Taken together, much of the research on mass shootings has focused on individual characteristics of mass shooting perpetrators, media framing, and contributing factors for news coverage and public opinion.

Departing from recent emphasis on mass shooting perpetrator characteristics and media coverage, we focus here on examining the specific attributes of mass shooting events and their

influence on public response for two key reasons. First, before media coverage begins, an event must pass through key gatekeepers who consider these event attributes (i.e. number of victims, type of weapon) to determine what is covered and how it is presented to the public (Shoemaker et al. 2001). Past research has found that the media plays an important role in disseminating information to the public and not all mass shooting events will receive equal media coverage (Duwe 2000; Schildkraut et al. 2018), suggesting that these attributes represent key information that influences public response. Second, the means by which people consume news about mass shootings has shifted dramatically due to increasing availability of the Internet and the dissemination of news across social media (Castells 2010). Therefore, there are countless outlets that provide information about any given mass shooting and ultimately influence the perception of the event via differential framing and narrative manipulation. This problematizes a focus on media framing because the means of receiving information is so highly fractured. Resultantly, we assert that increased attention to the factual details of shootings is needed, in addition to how these events are covered, framed, and filtered through the media.

### *Mass Shootings as a Social Problem*

Although mass shootings occur with relative frequency in the United States, not all shootings result in the same public call to action to prevent future attacks (Schildkraut 2016). We argue that public interest in a solution to mass shootings is influenced by a collective understanding of mass shootings as a social problem, and that certain shootings influence this collective definition and resultant responses more so than others. Prior research by Jaclyn Schildkraut (2016) and Joel Best (2006) have discussed mass shootings as a form of constructed social problem, suggesting that the process entails first defining the problem, then leveraging examples to substantiate the issue, and finally backing up the seriousness of the claim with statistics. We leverage Richard C. Fuller and Richard R. Myers' (1941) classic definition of a social problem here, which states that it is a "condition which is an actual or imagined deviation from some social norm cherished by a considerable number of persons" (pp.25). Mark C. Stafford and Mark Warr (1985) expand this definition to theorize that there are three key conditions which define a social problem.

First, people must condemn the problem as wrong or hazardous. Second, a social problem must be perceived as prevalent or frequent. Finally, the problem must be considered mutable by the public. Mass shootings are traumatic events that result in a senseless loss of life, prompting terror and mourning in communities around the country. It is likely, therefore, that the majority of the public would consider these events both a deviation from the norm of daily living and hazardous. Given substantial coverage in the media and empirical evidence of a recent increase in shootings (Follman et al. 2018), mass shootings are also likely to be perceived as prevalent even if they only make up a small portion of America's gun violence. Finally, politically driven arguments regarding appropriate means of prevention for future mass shootings typically follow a shooting, suggesting that the public believes this to be a social problem that can be changed.

Since the issue of mass shootings in America aligns with definitions of what constitutes a social problem, we argue that shooting events which result in greater harm and/or loss of life will have a more significant influence on the public's definition of mass shootings as a social problem. Resultantly, mass shootings of a greater magnitude will reinforce public interest in a solution than shootings with lesser associated harm and different event attributes. While past researchers categorize the definition of a social problem by the public as a constructive process of collective behavior (Gusfield 1984), this construction ultimately relies on the objective facts of the larger problem in question. In short, we anticipate that more extreme events will reinforce the public's perception that the problem of mass shootings is not normal, hazardous, and prevalent and that it must be addressed to prevent further violence.

### *Collective Threat Perception*

The definition of mass shootings as a social problem extends beyond a collective agreement regarding the condemnation of the problem, its frequency, and its mutability. We assert that mass shootings also engage public interest in a solution via increased collective threat perception (Huddy et al. 2007; Newman and Hartman 2019). According to this perspective, groups of people may perceive violent events that happen to others in the present as threatening to themselves in the future, resulting in feelings of powerlessness, mistrust, and fear that shape the cognitive worldview of the group (Ross 2011; Ross and Mirowsky 2009). In response to violent events such as mass shootings, individuals may question their own safety and consider the likelihood of themselves or someone they know becoming a victim. However, because of their unpredictable nature, mass shootings do not have a clearly defined aggressor to direct these perceptions of threat (Silva and Capellan 2019). Thus, a more generalized feeling of vulnerability and fear may result in the wake of these tragedies. Individuals may seek to mitigate this threat through different means such as political organizing, purchasing weapons, or seeking information on potential solutions. Therefore, we conceptualize heightened threat perception here as an individual-level counterpoint to the collective definition of mass shootings as a social problem because it leads individuals to consider their own future well-being and imagine the potential for victimization within the context of that larger social problem (Ferraro 1995).

A number of studies suggest that psychological distress and anxiety increase after major traumatic events such as the 9/11 attacks on the World Trade Center (Huddy and Feldman 2011) and natural disasters such as the Sierra Madre earthquake (Freedy et al. 1994) and Hurricane Katrina (Huddy and Feldman 2006; Mills, Edmondson, and Park 2007). In the face of perceived threat and insecurity after major events, people are motivated to protect themselves and support policy measures to ensure future safety (Huddy et al. 2007). Newman and Hartman (2019) examined the experience of threat perception specifically after a mass shooting, demonstrating that proximity to a mass shooting event “focuses” people on issues of gun violence and increases public support for gun control. These crises are most salient if threats are perceived on a personal level with a chance for future victimization (Newman and Hartman 2019). Heightened perceptions of future victimization can also increase awareness that something needs to be done to decrease the risk of future events to ensure collective safety (Ferraro 1995). Thus, significant mass shooting events may highlight the larger issue of mass shootings as a collectively defined social problem while also increasing the public’s threat perception of future violence.

### *Event Attributes of Mass Shootings*

Certain event attributes of a mass shooting may influence the public’s conception of these shootings as a social problem and heighten collective threat perception, resulting in greater response. First, in the same way that large-scale events such as attacks on the World Trade Center on 9/11 or Hurricane Katrina increase the perception of future threat through sheer magnitude of injury and loss of life, particularly injurious shootings may have a similar effect on collective stress and anticipation of greater violence (Schuster et al. 2001; Marshall et al. 2007). Ultimately, the magnitude of violence as measured by the total number of victims may render the issue more salient in the public eye and lead to increased collective distress, which can in turn influence public interest in a solution.

Second, the quantity and type of weapon used in a shooting may signal greater violence. It is possible that a weapon like a shotgun or assault rifle used in a shooting may prompt greater public fear than the use of handguns since these weapons may be perceived as more powerful or deadly. This threat may prompt people to look into more information about gun control, restrictions on access to particular types of weapons, or purchasing their own gun for protection

(Menachemi et al. 2017; Wallace 2015). Menachemi and colleagues (2017) define mass shootings as social crises that are typically accompanied by collective anxiety and often lead to public outcry. It follows, therefore, that the greater the magnitude of the shooting event as measured by injury, loss of life, and weapon type, the greater the reaction of threat will be among the general public.

Finally, the venue of a mass shooting may influence the public's conception of the event as part of a larger social problem. Although all mass shootings are undoubtedly tragic, they may be perceived as particularly devastating when they occur in schools or places where children are killed (e.g. daycares, hospitals). The presence of children as victims may elevate the event to a form of incomprehensible tragedy and thus an exemplar of why mass shootings are a larger social concern. Examples of these types of events include the shooting of five Amish girls in Pennsylvania in 2006, the Sandy Hook massacre of first graders in Connecticut in 2012, and the tragedy at Marjory Stoneman Douglas High School in Florida in 2018. Thus, in addition to the number injured or killed and the weapons used, the venue of the shooting itself may be an indicator of particularly severe tragedy that reinforces the notion of mass shootings as a social problem and increases perceptions of threat. Importantly, we argue that these various attributes may function alone or in combination with one another to elicit greater information-seeking responses for different solutions to reduce mass shootings.

## Current Study

In this study, we focus on how attributes of mass shootings correspond to public information-seeking related to both gun control and gun rights after a shooting (Barry et al. 2013; Fox and DeLateur 2014; Niforatos et al. 2019). Given the divisiveness of the issue of firearms in the United States, it is possible that people responding to the increased salience of mass shootings as a social problem and threat to collective well-being will seek out different solutions to the same problem. Although we do not directly test public opinions, reform in favor of gun control may be viewed as a means to decrease mass shootings through reduced access to guns for those that mean to do harm, improved background checks, or increased security measures in public places (Fox and DeLateur 2014). Conversely, people may see an increase in gun rights as a means of collective protection against mass shooting threats as a viable solution (Lott 2013). For instance, greater access to firearms and reduced restrictions on public carrying may serve to arm a greater number of citizen protectors that can defend the public in the event of a shooting situation (Carlson 2015). Ultimately, those that support gun control measures argue that limited firearm access will correspond to fewer shootings, whereas those in support of expanded gun rights argue that greater access to guns will help to deter and stop shootings from taking place.

Thus, regardless of political persuasion, we propose that discussion around gun control and gun rights in the wake of a shooting represents a form of public discourse to cope with a shared sense of threat while also providing an opportunity to consider solutions to the broader issue of mass shootings. We also posit that certain event attributes of mass shootings will interact with one another to increase perceptions of collective threat and shootings as a social problem, leading to heightened public information-seeking for solutions. In particular, shootings that entail greater loss of life, include the use of deadlier weapons, and take place in particular locations may increase information-seeking for solutions, yet people may respond with very different ways of addressing the issue. As such, we offer two research questions to guide our analysis of how mass shooting event attributes correspond to public interest in gun control and gun rights:

1. How does the number of victims, type and number of weapons used, or the venue of a mass shooting influence public interest in *gun control* and *gun rights* among Google search users in the United States?



2. How do measures of the number of victims, weapons used, or the venue of a mass shooting interact with one another to influence public interest in *gun control* and *gun rights* among Google search users in the United States?

## Method

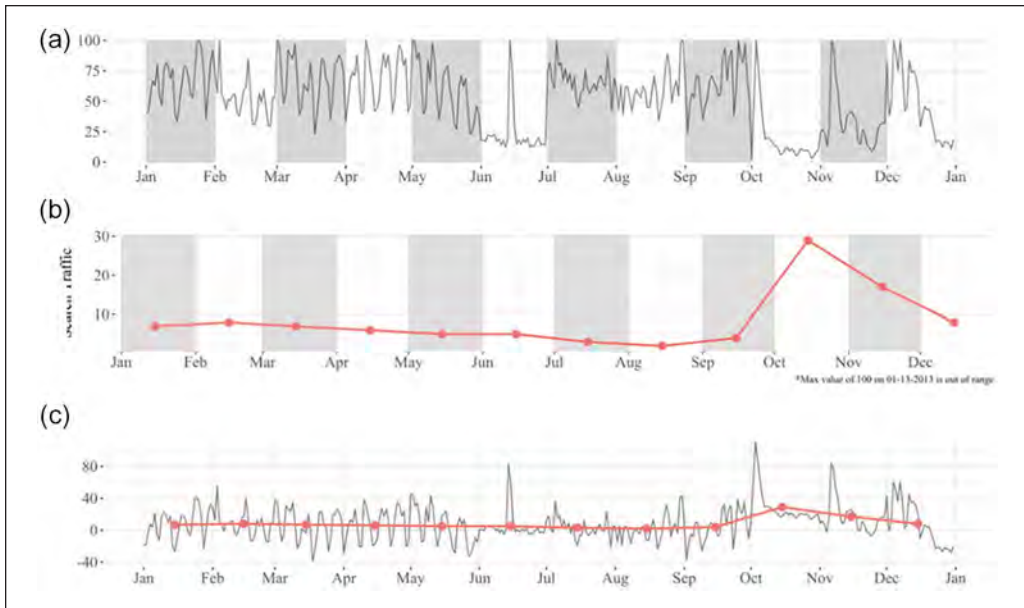
### Data

To explore our research questions, we use data from two main sources. First, we use data from the Mother Jones Mass Shootings Database (1982–2018) to measure shooting-related factors for all mass shootings since 1982 (Follman et al. 2018). The database is publicly available to download on the *Mother Jones* Web site.<sup>2</sup> In 2013, the FBI revised the definition of mass shooting to include three or more victims in response to a federal mandate, changed from its previous definition where four or more victims are killed. As a result, the database includes all mass shooting events with four or more victims killed from 1982 to 2013 and all mass shooting events with three or more victims killed from 2013 to 2018. Shootings during robberies, burglaries, drug disputes, and gang altercations are not included in this database because they are considered to be interrelated with another type of crime. Given this, analysts at *Mother Jones* suggest the database is a conservative estimate of mass shootings in the United States since there have been many public shootings with fewer victims killed (Follman et al. 2018). The database includes information on the shooter's profile as well as attributes of the shooting event. All information was collected by analysts at *Mother Jones* from public news outlets.<sup>3</sup>

Second, we use Google search data to measure public interest in gun control and gun rights after a mass shooting. Google is the most popular search engine on the Internet with a roughly 65 percent share of all search engine traffic (Meyer 2013). Research indicates that people are willing to share remarkably sensitive information with Google, suggesting that Google search data suffer less from the reporting and social desirability biases that often hamper survey data collection methods (Stephens-Davidowitz 2014, 2017). As a means of illustration, Stephens-Davidowitz notes that there are more searches for “porn” than “weather” in the United States, despite the fact that only about 20 percent of respondents to the General Social Survey indicate having watched a pornographic film in the past year (Stephens-Davidowitz 2014).

Researchers have recently begun to study issues of violence in the United States using these Google data. Neil Gross and Marcus Mann (2017) used Google data to demonstrate how public attitudes toward police significantly predict violent crime and homicide rates in 86 U.S. cities. In another study, Menachemi and colleagues (2017) employed Yahoo! search data to measure public interest in gun-related topics in the aftermath of the Sandy Hook shooting. Search query data are a valuable resource for measuring public reactions to social crises like mass shootings since trends can be measured immediately after a mass shooting event and in the days following, capturing public sentiment in a way that is largely inaccessible through traditional surveys.

To measure public information-seeking regarding gun control and gun rights after mass shootings, we use Google Trends data for all American Google Search users. Going back to 2004, Google records every search query along with its timestamp and geolocation tag. Despite its advantages, Google Trends comes with certain limitations (Stephens-Davidowitz and Varian 2015). The biggest limitation is what we call range-dependent scaling (RDS). Google Trends does not report raw data—overall volume of search traffic for a given term—but instead the percentage of overall search traffic scaled according to the maximum value within the search parameters (Stephens-Davidowitz and Varian 2015).<sup>4</sup> Furthermore, these search parameters determine the fidelity of the data: minutes, hours, days, weeks, or months. In essence, the larger the time span, the lower the fidelity data. Figure 1 depicts these relationships using searches for *gun control* in 2017 as an example. Setting the search parameter to an individual month (Figure 1a)



**Figure 1.** Example of standardizing process for Google search traffic for *gun control*, 2017. (a) Individual month searches return daily values scaled 0 to 100. (b) Entire date range search (2004–2018) returns monthly averages scaled 0 to 100. (c) Mean replacement preserves variation at both levels.

returns daily values (the desired fidelity) but scales each month separately according to the local monthly maximum. This prohibits any cross-month comparison of absolute search traffic volume. Setting the search parameter to the entire date range (Figure 1b) returns monthly values scaled to the global 14-year maximum but loses the fidelity of daily values needed to compare short-term daily variations.

As a solution to Google's RDS, we standardize daily search traffic across the entire date range with the following transformation:

$$x_{dmy} = (\alpha_{dmy} - \bar{\alpha}_{my})_a + (\bar{\beta}_{my})_b$$

where  $(\dots)_a$  represents local values from individual month data sets (i.e., January 2005, March 2012) and  $(\dots)_b$  represents global values from the entire date range data set (2004–2018). Starting with daily search traffic values ( $\alpha_{dmy}$ ), we subtract local monthly averages ( $\bar{\alpha}_{my}$ ) and add global monthly averages ( $\bar{\beta}_{my}$ ). This method preserves daily variation reported at the monthly level while taking into account the absolute month-to-month differences reported across the entire date range (Figure 1c). This process was iterated over each day ( $N = 5,110$ ) and month ( $N = 168$ ) where Google Trend data are available.<sup>5</sup> Thus, our dependent variables range from 0 to 100, with 100 signaling the daily maximum search traffic for a given term between 2004 and 2018, and 0 signaling the daily minimum in this time span.

## Measures

**Dependent variables.** In selecting search terms to measure public interest, we follow Seth Stephens-Davidowitz (2014) in choosing unambiguously salient words to measure a thematic issue, in our case: (1) *gun control* and (2) *gun rights*. While other studies have employed theme-based

collections of terms (Gross and Mann 2017; Menachemi et al. 2017), singular terms can serve to sufficiently orient collective conversations. If anything, the use of single phrases is a more conservative operationalization than a collection of terms with various interpretations and contextually dependent meanings. It is also important to balance the need for generality and specificity when examining multiple events over multiple years. “Shooting” lacks the specificity to minimize false positives, whereas “Sandy Hook” lacks the generality to speak to all mass shootings since 2004. For these reasons, we measure Google trends for “gun control” and “gun rights”—two terms that have proved to be central in the contemporary conversations around mass shootings.

As evidence for this centrality, we compare “gun control” as a single search term trend against Google’s *gun control* “topic”—an aggregate measure of all related search terms (Google 2018). These trends are near-identical (see Figure A1 in the Supplemental Appendix). We find further evidence of this centrality by examining Google’s “related queries” data. Of the top 25 queries related to *gun control*, only five of these related searches did not contain the phrase “gun control.”<sup>6</sup> For these reasons, we feel confident in the unambiguous centrality of *gun control*.

Despite the centrality of this term, it is important to be clear about what Google searches for *gun control* tell us. *Prima facie*, it might seem like this trend captures pro-gun-control users, but it is just as conceivable that anti-gun-control users would have similar search behavior. Thus, our emphasis on the centrality of the search term in national discourse should not be taken as a measure of public support or condemnation of gun control reform. Rather, we conceptualize these data as evidence of information-seeking behavior. Despite its discursive centrality, *gun control* as a solution to the social problem of mass shootings occupies a particular side of the political spectrum. For this reason, we also analyze Google trends of *gun rights* as a countervailing political term in national discourse around mass shootings. Together, we argue, these terms cover a significant part of American discourse in the wake of mass shootings. Our two dependent variables are thus search traffic for *gun control* and *gun rights*, measured as a percentage of each term’s 14-year maximum between 2004 and 2018.

**Independent variables.** We use data from the *Mother Jones* data set to measure event attributes across seven key independent variables. We coded the six-category venue attribute into a dichotomous variable for school (1)/nonschool shooting (0). We coded a variable for number of weapons used (one weapon; two weapons; and three or more weapons) and another variable for the type of weapon used in the course of the shooting (handgun; shotgun; and rifle, which includes assault-style weapons). While *Mother Jones* provides data on number of fatalities and number of injuries, we use the sum of these variables—“total victims”—which captures all those directly and physically affected by the event. We account for the region where the shooting took place, coding a four-category U.S. region variable based on the Census Bureau’s statistical divisions: Northeast, Midwest, South, and West. We coded the race of shooter as a dichotomous variable: nonwhite (1)/white shooter (0). We control for the shooter’s race to ensure that this does not confound the influence of event characteristics on interest in gun control or gun rights, especially given that the race of the shooter has been shown to influence media coverage (Duxbury et al. 2018). We do not include a measure of gender in the analyses since almost all perpetrators of mass shootings have been male (Follman et al. 2018). Finally, we include the year of the shooting to investigate longitudinal trends in search behavior over time.

In addition to these event attributes, we account for the role of media coverage on search behavior by including a measure of the number of articles in the *New York Times* that include the phrase “mass shooting” for each day between 2004 and 2018. This paper’s national audience and general-interest emphasis is uniquely qualified to provide a sample with significant coverage and longevity and is routinely used by social scientists (Baumann 2001; Janssen, Kuipers, and Verboord 2008; Silva and Capellan 2019). By including this measure of coverage quantity, we



are better able to examine the influence of different types of mass shooting attributes on search behavior while controlling for the effects of general exposure to news coverage of the shootings. Table 1 provides descriptive statistics for all variables included in our analysis.

**Table 1.** Descriptive Statistics of Shooting Event Attributes.

Variable	Minimum	Maximum	<i>M</i>	<i>SD</i>	<i>N</i>	(%)
Event attributes						
Year	2004	2018	2013.18	4.07	71	100
Total victims	3	604	22.85	71.95	71	100
School shooting	0	1	0.15	0.36	71	100
Nonwhite shooter	0	1	0.52	0.5	71	100
U.S. region						
Midwest		—	—	—	14	19.72
Northeast		—	—	—	8	11.27
South		—	—	—	22	30.99
West		—	—	—	27	38.03
No. of weapons						
1		—	—	—	33	46.48
2		—	—	—	20	28.17
3+		—	—	—	18	25.35
Weapon type						
Handgun		—	—	—	29	40.85
Shotgun		—	—	—	19	26.76
Rifle		—	—	—	23	32.39
Daily variables						
News articles	0	11	0.61	1.33	1,065	100
“Gun control” search traffic	4.95	84.20	30.55	11.72	1,065	100
“Gun rights” search traffic	3.33	86.75	35.94	13.34	1,065	100

Note. Although the full Google date range ( $N = 5,110$ ) includes the minimum and maximum search traffic values (0–100), our subsample of days in the two weeks after mass shootings ( $n = 1,065$ ) does not include these two specific days, resulting in the reported dependent variable ranges between 0 and 100.

### Analytic Strategy

To examine the effect of mass shooting attributes on search traffic, we extract a sample of search traffic data for each shooting that includes the event date and the following 14 days.<sup>7</sup> With each of the 71 events observed over a 15-day window ( $n = 1,065$ ), our study resembles a panel design. However, traditional approaches to panel studies are inappropriate for both substantive and statistical reasons (Allison 1990; Halaby 2004). We are interested in the net effect of shooting event attributes on the volume of search traffic, rather than the daily fluctuations. Statistically, the use of fixed-effects estimations would discount all variables of interest and the use of random-effects estimations would assume unmeasured heterogeneity is uncorrelated with event attributes (Vaisey and Miles 2017). Nonetheless, to account for this data structure, we include search traffic from the day before the shooting as a pseudo-fixed-effects control for each event and cluster standard errors by event, and run a pooled ordinary least squares (OLS) model.<sup>8</sup>

We also include three interaction terms to probe the relationship between predictors of public interest in gun control and gun rights after a mass shooting. We include these given the expectation that shootings perceived to be more deadly or threatening to collective well-being will elicit greater information-seeking for potential solutions related to either gun rights or gun control. We anticipate this to be particularly salient for the number of victims, the location of shootings,

media coverage, and the weapons used in these shootings. First, we examine whether the effect of school shootings depends on the total number of victims. Second, we test whether the effect of school shootings depends on the volume of media coverage. Finally, we assess whether the effect of weapon type depends on the volume of media coverage.

## Results

Table 2 presents results from four pooled OLS models: the first two predict search traffic for *gun control* with and without interactions, and the last two do the same for *gun rights*. First, we find that during the two weeks after the shooting, search traffic for all terms increases by an average of 0.2 to 0.3 percent. While used primarily as a control to account for the nested data structure, this small but significant effect provides evidence of increased information-seeking behavior controlling for all independent variables. The year of the shooting event had no statistical impact on search traffic, suggesting neither a “desensitization” effect nor a heightened interest in mass shootings, after controlling for all event attributes. Similarly, number of victims, race of shooter, and number of weapons used each had no significant effect on search traffic.

**Table 2.** Pooled Ordinary Least Squares Estimates of Search Traffic after Mass Shooting Events.

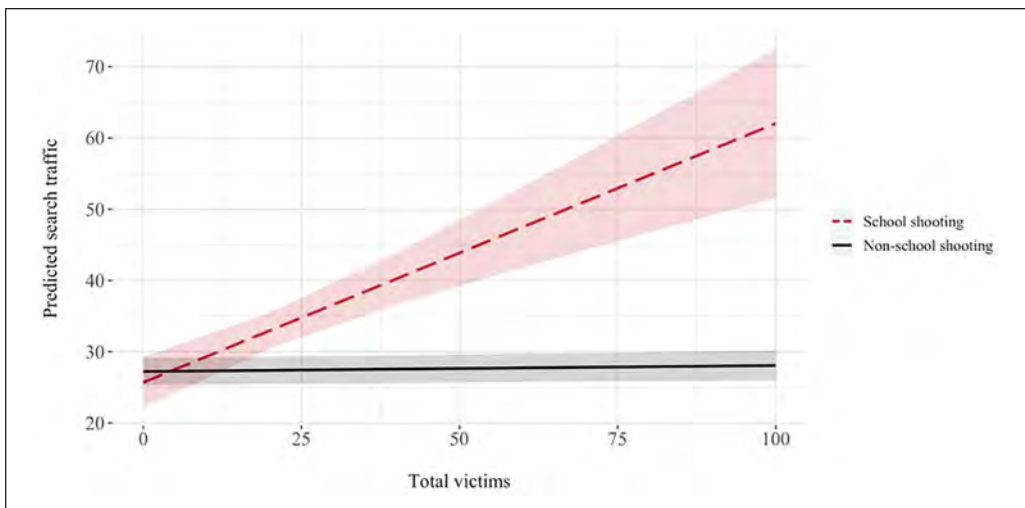
Dependent variable = search term	Search traffic			
	(a) Gun control	(b) Gun control	(c) Gun rights	(d) Gun rights
Baseline traffic	0.298** (0.093)	0.243** (0.081)	0.204** (0.070)	0.160* (0.067)
Year	-0.062 (0.144)	-0.066 (0.126)	0.240 (0.172)	0.243 (0.166)
Total victims	0.009 (0.006)	0.008 (0.006)	0.002 (0.006)	0.002 (0.006)
School shooting	6.714** (2.364)	-3.561 (2.229)	4.112 (2.430)	-1.644 (4.015)
Nonwhite shooter	1.604 (1.361)	0.594 (1.211)	0.423 (1.248)	-0.164 (1.204)
No. of news articles	3.679*** (0.345)	3.572* (1.603)	2.947*** (0.323)	0.025 (0.840)
U.S. region (ref. = Midwest)				
Northeast	5.104* (2.567)	5.137* (2.128)	4.323 (2.557)	3.976 (2.254)
South	4.612** (1.789)	2.654 (1.727)	1.974 (1.573)	1.041 (1.673)
West	3.694* (1.677)	3.768* (1.520)	3.059 (1.632)	2.967 (1.569)
No. of weapons (ref. = 1)				
2	-0.189 (1.539)	-1.351 (1.606)	-1.496 (1.736)	-1.914 (1.832)
3+	-2.956 (1.652)	-3.025* (1.33)	-1.501 (1.652)	-1.302 (1.507)
Weapon type (ref. = handgun)				
Shotgun	-2.565 (1.435)	-1.705 (1.265)	0.197 (1.690)	-0.178 (1.732)
Rifle	2.091 (1.540)	2.474 (1.535)	3.345* (1.635)	2.455 (1.652)
School Shooting × Total Victims		0.355** (0.113)		0.148 (0.157)
School Shooting × News Articles		3.356*** (0.826)		3.517*** (0.938)
News Articles × Shotgun		-0.528 (1.648)		2.490* (1.037)
News Articles × Rifle		-0.384 (1.623)		2.810** (0.875)
Constant	141.331 (290.843)	151.955 (252.924)	-458.287 (346.533)	-462.237 (334.310)
Observations	1,065	1,065	1,065	1,065
R <sup>2</sup>	.308	.348	.191	.213
Adjusted R <sup>2</sup>	.300	.338	.181	.201
Residual SE	9.808	9.537	12.071	11.927
	(df = 1,051)	(df = 1,047)	(df = 1,051)	(df = 1,047)
F statistic	36.015*** (df = 13; 1,051)	32.936*** (df = 17; 1,047)	19.111*** (df = 13; 1,051)	16.708*** (df = 17; 1,047)

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ ; two-tailed test.

Regarding media effects, we find that each additional news article about a mass shooting increases search traffic for *gun control* and *gun rights* by 3.7 and 2.9 percent, respectively. We examined variable correlations and variance inflation factor (VIF) values to make sure these results were not driven by multicollinearity (see Figures A2 and A3 in the Supplemental Appendix for more detail). In addition, we find significant regional effects for *gun control* search traffic in the United States. Compared to a similar event in the Midwest, a mass shooting in the Northeast drives 5.1 percent more traffic, in the South 4.6 percent more traffic, and in the West 3.7 percent more traffic. However, these results were not robust to alternative modeling strategies and thus do not figure prominently in our discussion. See the Supplemental Appendix for more detail.

Model (a) demonstrates that school shootings prompted 6.7 percent more search traffic for *gun control* than nonschool shootings; however, this effect does not hold for *gun rights* search traffic (Model (c)). Similarly, the use of a rifle prompted a 3.3 percent increase in search traffic for *gun rights*, but had no significant effect on search traffic for *gun control*. This indicates that information-seeking behavior is influenced by particular event attributes related to the venue of the shooting and the weapons involved. School shootings prompt looking for information on *gun control*, whereas shootings with particular weapons prompt information-seeking related to *gun rights*.

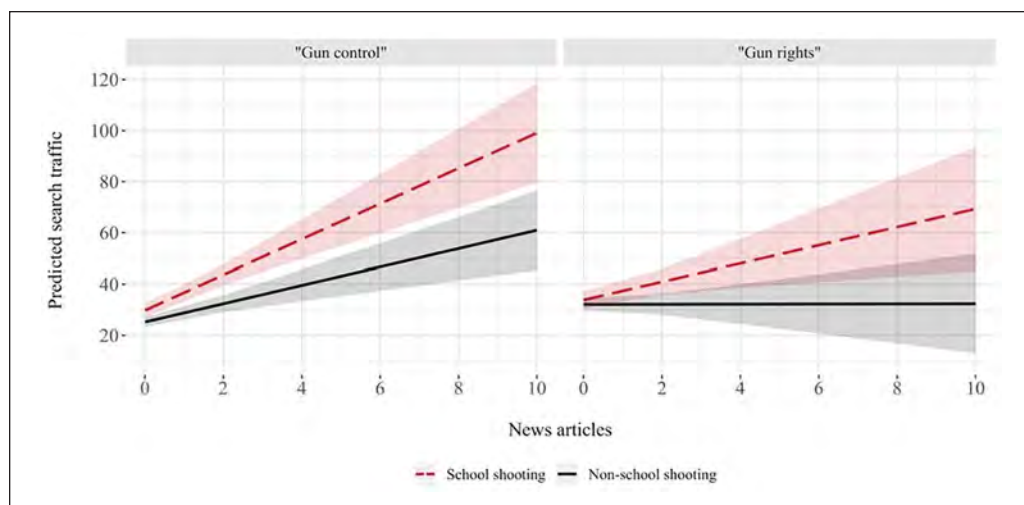
Turning to the interaction terms in Models (b) and (d), the results suggest that the inclusion of these multiplicative effects increases the model fit according to both  $R^2$  and adjusted  $R^2$ . Substantively, we find that for *gun control*, the increased search traffic as a result of a school shooting is compounded by the total number of victims. In other words, the deadlier a school shooting, the greater the increase in search traffic. While somewhat intuitive, it is important to note that this relationship holds despite controlling for media coverage, and that similarly deadly nonschool shootings result in much less search traffic. See Figure 2 for an illustration of this relationship.



**Figure 2.** Predicted search traffic for *gun control* by total victims and location.

We also find that the increased search traffic after school shootings is dependent on the amount of media coverage. This suggests that news articles about a school shooting prompt more people to search than the same number of news articles about a nonschool shooting. This relationship holds for both *gun control* and *gun rights* and is depicted in Figure 3. Finally, we find that the

increased search traffic for *gun rights* that happens as a result of a mass shooting with particular weapons is compounded by media coverage. News articles about mass shootings with a shotgun or a rifle drive more search traffic for *gun rights* than similar coverage about handgun-related shootings. However, it is important to note that this finding was not robust to alternative modeling strategies, as discussed in the Supplemental Appendix. While not presented in our final models, it is also important to note two interaction terms that were not significant in our models: (1) School  $\times$  Year and (2) News  $\times$  Year. The lack of a significant relationship for either interaction suggests little support for the idea that people have become desensitized to mass violence since both the occurrence of school shootings and the amount of mass shooting news coverage had a uniform effect on search traffic over time.



**Figure 3.** Predicted search traffic after a mass shooting by news coverage and location.

In a sensitivity analysis, we repeated the analyses for both *gun control* and *gun rights* using a measure of fatalities instead of total victims (which includes those injured in the shooting, not just those killed). By counting only those killed in a mass shooting, this measure provides a more conservative estimate of public injury. The most important consequence of this decision is the attenuation of the Las Vegas shooting on October 1, 2017. This event led to more than 600 total victims and 58 fatalities. Results were consistent with those reported in the main results and can be found in Table A1 in the Supplemental Appendix. Finally, we repeated these analyses using only event-days with nonoverlapping shooting event windows. Of the 71 mass shootings, 24 occurred within a 16-day window of one another. In these cases, all overlapping days were removed. The substantive results remained consistent with reported models, as seen in Table A2 of the Supplemental Appendix.

## Discussion

In this study, we leveraged literature regarding social problems and collective threat perception to frame an analysis of public information-seeking after mass shootings using data on every Google-using American between 2004 and 2018. We evaluated public interest in Google searches related to *gun control* and *gun rights* during the two weeks after 71 mass shootings in the United States. We argue that mass shootings of a greater magnitude, as measured by the number of victims, weapons used, and shooting venue, may serve to reinforce a collective understanding of

mass shootings as a social problem and heighten collective threat perception. This corresponds to increased interest in solutions to mass shootings as a social problem and source of future collective threat, as measured by Google search behavior.

We found that school shootings and news coverage of mass shootings significantly influence subsequent interest in *gun control*. We also found an independent effect of the use of a rifle during a shooting on subsequent search traffic for *gun rights*. We did not find support for an independent effect for the number of victims for search traffic related to either *gun control* or *gun rights*. Importantly, we discovered that certain characteristics of mass shootings interact in significant ways to influence public interest in both *gun control* and *gun rights*. This was especially the case for school shootings, which were found to increase search traffic for *gun control* when interacted with the total number of victims and both *gun control* and *gun rights* when interacted with the total news coverage of mass shootings. Particularly tragic school shootings may therefore have a substantial influence on the public's interpretation of mass shootings as a social problem and potential collective threat. Taken together, the results highlight important relationships between attributes of mass shootings and increases in public interest for solutions in the wake of these events.

One unexpected finding relates to the year of mass shootings included in our analysis. We found that search traffic for both *gun rights* and *gun control* in the wake of mass shooting events has not changed in any statistically meaningful way over time. While this study considers both types of search as forms of information-seeking for solutions to gun violence, these results indicate that people have not necessarily become desensitized to the occurrence of mass shootings or reduced their collective interest in potential responses over the years of our study (2004–2018). On the contrary, the results suggest that the public has not significantly increased these search terms in response to shootings. It appears that people are most likely to seek out information after mass shooting events when they take place in a school, receive heavy news coverage, and are carried out with particular weapons, rather than as a result of whether they take place during a particular time period.

Although it is not novel that most mass shootings are likely to result in public outrage and fear, our analysis of search behaviors using Google data indicates that people may be more inclined to investigate solutions when these extreme events occur given particular conditions. Furthermore, people may respond to the collective threat and heightened salience of mass shootings as a social problem brought on by these events in very different ways. Some may search for answers related to gun control and reducing access to firearms to decrease shootings, whereas others may take a decidedly different approach and explore ideas related to gun rights that increase firearm access among the public to deter further shootings. Although the search terms analyzed here do not translate directly into action, the results are notable in showing that opposite sides of the gun debate may respond differently to the same shootings. Ultimately, most of the general public may perceive the threat of mass shootings as a collective, yet responses to that threat are likely to be fragmented. We speculate that people might therefore be largely united in their conception of mass shootings as a social problem and the perception of collective threat, yet fall back on potential responses and solutions that align more closely to previously held political or ideological identities.

The results also have implications for the role of news coverage in exposing the public to information about mass shootings. Although the amount of news coverage increases search behavior for both *gun control* and *gun rights*, this relationship is amplified for school shootings (Figure 3). It is possible, therefore, that tragic shooting events that occur in schools can act as “sparkling events” that lead to greater collective action around school shootings as a social problem and collective threat (Olzak 1989; Staggenborg 1998). This has been the case over the past two decades in the event of particularly devastating school shootings such as those at Sandy Hook, Parkland, and Columbine. In the weeks and months after these instances, and others like



them, students, parents, journalists, and advocates have collectively demanded action from lawmakers to reduce gun violence in America (Alter 2018; Franks 2019). Thus, it appears that both the amount of media coverage and the particular attributes of a mass shooting together have the potential to influence public response in the wake of tragedy.

There are certain limitations to this study that can inform future research. First, our outcome measures rely on Google search data which have inherent limitations noted above (Stephens-Davidowitz and Varian 2015). While we develop an analytical solution to the RDS of the data, future projects that leverage search data may strive to partner with search engine companies to obtain raw data. This would provide greater clarity into search trends in the aftermath of a shooting. Second, we use single search terms, *gun control* and *gun rights*, to approximate the public's response for information after a mass shooting. While we are confident in the centrality of these terms, future research could attempt to analyze a range of search outcomes in addition to those assessed here. Third, although Google search data provide new opportunities for computational social science, the data are restricted by inherent selection biases for those that have access to the Internet and are most likely to use Google to seek information. Thus, although most Internet-using Americans use Google for their searches, the search data likely reflect the search behaviors of a relatively affluent, young, tech-savvy, and potentially more educated segment of the population. Finally, our analysis was limited to the data available. As a result, we were unable to include certain individual-level characteristics of the shooter such as political affiliation or clinical mental health diagnoses, as well as additional daily-level contextual factors that would have facilitated a multilevel or time series regression analysis.

Despite these limitations, there are significant opportunities for future research on mass shootings and related work that harnesses search query data. First, as scholars build more detailed databases of mass shootings in the United States, it will be important to conduct analyses at multiple ecological levels to parse out risk factors for mass shootings related to the individual perpetrator, the community and setting in which the shooting takes place, and the media environment in which it is reported. Second, although the majority of research on mass shootings has focused on media representations of these events, much of this work is still largely based on single shooting case studies and analyses that include a limited number of media outlets (Chyi and McCombs 2004; Silva and Capellan 2019). Given the recent growth of large-scale text-analysis methods to digest many years of reporting across media outlets of different sizes in various geographical markets, we encourage researchers to take a broad view of mass shooting reporting that accounts for the full history of shootings via diverse media representation in future research (Bail 2014; Bernau 2018). By including measures of media coverage and distortion, researchers will be able to better parse out the relationship between mass shooting events and public response.

Google Trends is an important source of information that provides a real-time finger on the pulse of a substantial portion of the American consciousness while attenuating certain methodological issues that often hamper traditional survey research. For instance, researchers can use Google Trends to examine prevalent search terms in the aftermath of mass shootings related to key topics such as mental illness (McGinty et al. 2013; McGinty et al. 2014) and the influence of violent video games (Ferguson 2008). Understanding how the occurrence of these events predicts different search terms across the United States can provide insight into how people are coping with and reacting to these tragedies. Search data may also provide insight into actual behaviors, such as trends in firearm purchasing after a shooting event (Menachemi et al. 2017). This research can help inform future firearm policy, as well as provide greater detail into how firearms are both legally and illegally accessed. Finally, Google provides regional insight into search behaviors across the country. Geo-specific analyses of search results in the wake of shootings, disasters, and other public tragedies can help researchers and practitioners better understand where the need for resources and assistance is greatest. Although there are important limitations

to its use, Google data provide unique insight into the collective conscious of the public with reduced concern for certain social and reporting biases, rendering it a significant and potentially powerful resource for future social science research.

### Authors' Note

Both authors contributed equally in all aspects of this study including the conceptualization, development, analysis, writing, and editing of this article.

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### Supplemental Material

Supplemental material for this article is available online.

### Notes

1. A total of 73 shootings occurred between 2004 and 2018, but the final analysis was conducted prior to the occurrence of two shootings in Thousand Oaks, CA, and Chicago, IL, at the end of 2018.
2. Full data are updated periodically and available for download at: [https://docs.google.com/spreadsheets/d/1b9o6uDO18sLxBqPw1\\_Gh9bnhW-ev\\_dABH83M5Vb5L8o/edit#gid=0](https://docs.google.com/spreadsheets/d/1b9o6uDO18sLxBqPw1_Gh9bnhW-ev_dABH83M5Vb5L8o/edit#gid=0). Data for the present study were downloaded on October 30, 2018, at 5:54 p.m.
3. The *Mother Jones* database represents an accessible and well-organized option for tracking mass shootings. Researchers supported by the National Institute of Justice are currently developing a robust, standardized data source to fully track all mass shootings since the 1960s (Silva and Capellan 2019).
4. These data are aggregated and made publicly available at [www.trends.google.com](http://www.trends.google.com) or through statistical packages like gtrendsR (Massicotte and Eddelbuettel 2016).
5. Due to variation around low and high global monthly averages, these new values extend beyond 0 to 100. Since Google Trends reports values as percentages of the maximum traffic, we rescaled our values by dividing by the new maximum value.
6. Related queries without the phrase "gun control" include *obama*, *executive order*, *bernie sanders*, *sandy hook*, and *jim jeffries*.
7. We use a 14-day post-shooting window, as opposed to a longer time frame such as 30 days, to reduce potential overlap with later shootings. Of the 71 shootings, 24 occurred within a 16-day window of another shooting. Results remain robust when removing these events (about a third of our sample). See Table A2 in the Supplemental Appendix for more detail.
8. There are multiple ways to account for this data structure, and as such, we include results from an alternative modeling strategy in the Supplemental Appendix. In particular, we leveraged random intercept models using between-within methods to better model the error structure in this alternative method. Overall, our substantive findings remained largely similar across modeling strategies, although we note minor variations where applicable.

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