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Reactive and Asymmetric Communication Flows: Social Media Discourse and Partisan News Framing in the Wake of Mass Shootings

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Abstract

Marked by both deep interconnectedness and polarization, the contemporary media system in the United States features news outlets and social media that are bound together, yet deeply divided along partisan lines. This article formally analyzes communication flows surrounding mass shootings in the hybrid and polarized U.S. media system. We begin by integrating media system literature with agenda setting and news framing theories and then conduct automated text analysis and time series modeling. After accounting for exogenous event characteristics, results show that (a) sympathy and gun control discourses on Twitter preceded news framing of gun policy more than the other way around, and (b) conservatives on Twitter and conservative media reacted to progressive discourse on Twitter, without their progressive counterparts exhibiting a similar reactiveness. Such results shed light on the influence of social media on political communication flows and confirm an asymmetry in the ways partisan media ecosystems respond to social events.

Keywords

communication flows, hybrid media, partisan media, asymmetry, social media, intermedia agenda setting, news framing

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The flows of information, ideas, and debates among various actors, such as news media, political elites, and ordinary people (Thorson and Wells 2015) are complicated by a hybrid and polarized media system. Two-step flow (Katz and Lazarsfeld 1966), one-step flow (Bennett and Manheim 2006), and even multi-step and network flow models (Hilbert et al. 2017) struggle to explain "who leads and who follows" (Barberá et al. 2019; Lo et al. 2021) within the contemporary communication ecology. This is because although elites and traditional media used to set issue agendas (e.g., Guo and McCombs 2015) and frame public debates (e.g., Entman 1993), communication flows have become less predictable, particularly in the current media system in the United States that is marked by both deep interconnectedness and polarization.

The U.S. media system is hybrid, blending older and newer media forms together in a web of inter-referencing, linking, and sharing (Chadwick 2017; Wells et al. 2020). It contains multiple players who operate on different logics, simultaneously competing and collaborating for audience attention (Klinger and Svensson 2015). This media system is also marked by partisan cleavages: news composition and audiences on the political right are quite distinct from those on the political left (Baum and Groeling 2008; Faris et al. 2017; Stroud 2011), and liberals and conservatives largely, though by no means exclusively, gravitate toward their ideological networks on social media like Twitter (Colleoni et al. 2014; Yarchi et al. 2021). The co-presence of interconnectedness with polarization raises the question: how do information, ideas, and debates flow through an interlinked system featuring news and social media responding to the same social events yet fractured along partisan lines?

In this article, we study communication flows in the hybrid and hyper-partisan U.S. media system, asking how contentious discourses in social media and framing decisions by news media respond to mass shootings and shape one another in the wake of those events. In doing so, we integrate agenda setting and news framing literature with research on the hybrid media system, media fragmentation, and asymmetry. We pay particular attention to language use across different parts of the hybrid media system and different spheres of the political media landscape, which have significant content variation and entangled communication streams (Jungherr et al. 2019).

Our empirical analysis is focused on communication flows spurred on Twitter and in news media across the political spectrum by mass shootings between 2012 and 2014 (a period marked by events such as the Aurora Theater Shooting, the Sandy Hook School Shooting, the Washington Navy Yard Shooting, and the Fort Hood Shooting), while accounting for the influence of specific features of mass shooting events on responses across the media system. Mass shootings and the ensuing social media response and news coverage provide an apt context to study these complex temporal relationships using advanced time series modeling. In contrast to past efforts which examine how event features shape language use in social media or news media (Pelled et al. 2021; Zhang et al. 2019), this article examines the interplay between different parts of the media system, considering relationships between social media discourses and news framing decisions. The tragic nature of mass shootings often draws intense public and media attention, which is tied to the heated debate

over gun policy in the United States (Lawrence and Birkland 2014; Schildkraut and Elsass 2016). Such a context enables us to explore how the hybrid and polarized media system is prompted by exogenous factors to respond to a contentious and ongoing issue regime, which then triggers a complex endogenous process within the system. For social media, that battle increasingly takes place on Twitter, due to its dominance as a space for public discourse and its prominent role in journalistic routines (Lasorsa et al. 2012; Molyneux and Mourão 2019). For news media, these events and the immediate social media discourses have the potential to shift already-slanted partisan coverage further away from a tendency toward issue dualism—presenting issues as a debate between two familiar, predictable, and legitimate groups or actors (Bennett, 2016; Lee et al. 2008)—toward language emphasizing one side over the other.

Taking advantage of the availability of large volumes of social and news media data (Shah et al. 2015), computational methods of text processing (Schwartz and Ungar 2015), and advanced time series techniques (Wells et al. 2019), our analyses proceeded in three stages. First, we modeled how characteristics of mass shooting events are correlated with different Twitter discourses and news framing decisions concerning gun policy across conservative, moderate, and progressive outlets in the United States. Second, we tested flows between news framing decisions and Twitter discourses, while controlling for event characteristics. Finally, we simulated how one part of the hybrid media system responded to another.

The Hybrid Media System, Intermedia Agenda Setting, and Framing

A range of factors have contributed to the displacement of the late 20th-century concentrated media system by a hybrid and fragmented 21st-century version, defined by both the interplay between older and newer media and the divisions between outlets along partisan lines. Among the most notable is the entrance of cable news, online news, and social media platforms to the media ecosystem previously dominated by print and broadcast media (Blumler and Kavanagh 1999). With channel multiplicity and information overload, capturing audience attention has become increasingly challenging (Webster 2014), intensifying the competition and collaboration between older media and newer media (Chadwick 2017).

The blurry and permeable boundaries between traditional news media and social media lead to increasingly dynamic communication flows between them. Focusing on the transfer of content across different media offerings, intermedia agenda-setting research shows "a complex and dynamic interaction" between news and social media (e.g., Conway et al. 2015; Neuman et al. 2014: 193). Recent work finds that traditional media possess great power in setting the agenda and sustaining communication flows on social media by legitimizing, amplifying, and maintaining the steam of issues originating from emerging actors (Langer and Gruber 2020). Nevertheless, as journalists have turned to social media like Twitter to look for story ideas, represent public opinion, and produce engaging content

(Broersma and Graham 2016; McGregor, 2019), social media are gaining traction as a proxy of public interest, thereby influencing news media agendas. Research reveals the significant discursive power of adept Twitter actors, especially media elites on the platform (Harder et al. 2017). When understood at scale, the amplification power of social media through retweeting or hashtags has been shown to shape subsequent news attention (Freelon et al. 2018; Wells et al. 2016). Further evidence shows that Donald Trump tweeted more when his amplification advantage in news was ebbing, reflecting his recognition that Twitter could trigger coverage, whether for attention or distraction (Lewandowsky et al. 2020; Wells et al. 2020). Even clickbait content can attract attention from established news media by spreading through partisan networks on social media and accumulating engagement metrics that serve as social recommendation cues (Munger 2020).

Along these lines, some argue that agenda-setting research should consider the full spectrum of actors involved in a communication process, including social media platforms and different types of news media (Langer and Gruber 2020; Vargo and Guo 2017). Others also advocate a more granular measurement of agenda at the level of stories or events so as to present a more accurate picture of communication flows and journalistic practices (Guo and Vargo 2020; Harder et al. 2017). This article adopts these suggestions; yet while informed by agenda setting, our focus goes beyond the transfer of issue salience and issue attributes, the focus of first and second level agenda-setting work (McCombs and Ghanem 2001).

Rather, the framework we advance is also informed by news construction and framing research, as it (a) attends to the process of news work (Kosicki 1993), particularly journalists' reliance on Twitter to gauge public opinion and gather story ideas (Beckers and Harder 2016; McGregor 2019; Mourão and Harlow 2020), (b) considers that news framing tends to follow patterns of issue dualism, distilling policy issues to two competing views (Lee et al. 2008), and (c) accounts for how external events drive news attention and social media discourses. Linguistic choice is essential to message framing, from elite issue labels to journalistic language emphasis (Entman 1993). The contestation over symbolic forms—getting certain labels and terms adopted by journalists as a way to advance a preferred interpretation—is especially acute for contentious issues after events drive them into public consciousness (Edelman 1993; Jungherr et al. 2019). Likewise, Walter and Ophir (2019) and Ghosh and colleagues (2020, p.5) argue that "frame devices," including word choices, issue labels, and phrases, "when appearing repeatedly across time, can indicate framing choices of journalists." Intermedia framing research suggests that social media can shape such news framing (Lo et al. 2021; Wang and Guo 2018). Integrating these approaches, we attend to the relative visibility of contending issue positions in news coverage over time and examine the interplay between Twitter discourses and these sorts of news framing decisions. However, we must also consider political partisanship and ideological asymmetry when tracing such communication flows.

Partisanship and Ideological Asymmetry

The U.S. media ecology is characterized by increasingly noticeable partisan cleavages. Traditional journalistic values such as objectivity, neutrality, and factuality are being

challenged by an emphasis on advocacy for issue coverage and overt ideological conflict (Mutz 2015). Partisan media, competing with legacy news media for attention, target niche audiences by producing ideologically palatable content or critical content that stokes partisan outrage (Baum and Groeling 2008; Berry and Sobieraj 2013). Fox News, for example, has demonstrated a clear, favorable slant toward Republicans by suppressing negative stories about them (Iyengar and Hahn 2009). On social media, people tend to connect and interact with like-minded others, reinforcing positions and emotions and increasing polarization over time (Heiss and Matthes 2020; Song and Boomgaarden 2017). Through partisan filtering, media discourses on the left and right diverge, producing competing narratives.

However, partisanship does not mean that the conservative and progressive media ecosystems are the mirror opposite of each other. Increasing evidence points to their asymmetry, as exemplified in the cloistering of conservative media into a distinct, structural sub-cluster apart from, yet responding to, the larger media system. First, the asymmetry manifests in media consumption patterns. Conservatives consume a much narrower range of media offerings than liberals do (Mitchell et al. 2014), with the extremity of conservative beliefs better explaining conservative media use than the extremity of liberal beliefs does for progressive media use (Hmielowski et al. 2020). Similarly, conservative news sources, clustered around Breitbart and Fox News, were widely shared by right-wing networks on Twitter and Facebook, whereas a greater variety of sources from mainstream to left-leaning news were widely circulated in liberal social media networks (Faris et al. 2017).

Additionally, patterns of information diffusion exhibit partisan asymmetry. The conservative media ecosystem is more susceptible to disinformation operations (Benkler et al. 2018). During the 2016 U.S. presidential election, Trump supporters propelled the spread of fake news on Twitter (Bovet and Makse 2019). Moral-emotional tweets posted by conservative elites on Twitter diffused more broadly than those made by liberal elites (Brady et al. 2019). Furthermore, progressive and conservative activists use different tactics to promote their causes, as evidenced in hashtag activism and offline protests on the left, and legacy media manipulation and partisan media coordination on the right (Freelon et al. 2020).

Such media asymmetry likely stems from the ideological asymmetry of conservatives and liberals, manifested in their diverging psychological traits and political behaviors (Jost 2017; Morisi et al. 2019; Young 2019). For example, conservatives are more oriented to threat, order, closure, and dogmatism, whereas liberals are more tolerant of ambivalence and complexity. Asymmetry can also be attributed to the skew of the political parties, with the GOP anchored by ideological values and hierarchical organizations and the Democrats seeking diverse coalitions and distributed governance (Grossmann and Hopkins 2016; Lelkes and Sniderman 2016).

These documented asymmetries suggest that conservative media and social media users react to events quite differently than their progressive counterparts. Intermedia agenda-setting suggests that one side of the political spectrum may set the agenda for the other. However, even if one side possesses greater agenda-setting power in driving issue salience, news outlets and social media users on opposing sides can

adopt certain language like "metaphors, catchphrases, visual images, moral appeals, and other symbolic devices" to highlight different concerns and emphasize some aspects of reality over others (Entman 1993; Gamson and Modigliani 1989: 2). For example, while conservative media may follow the progressive and mainstream media in reporting the gun policy debate, they can produce counterclaims and provoke outrage by emphasizing gun rights concerns. Journalists do not simply relay frames provided by others; they add their own interpretations and emphases (Brüggemann 2014). This suggests the need to consider how social media influence journalistic framing decisions. In the following section, we describe how mass shootings can shape news coverage and Twitter discourses while introducing research questions regarding communication flows between news media and Twitter across the political spectrum.

Mass Shootings, Twitter Discourses, and News Framing

Mass shootings provide an exogenous shock to which the media system responds. When firearms are involved in mass murder, it not only has the potential to trigger attention to the victims and the problem of gun violence, but also spurs debate between gun control advocates and gun rights supporters over whether we should tighten gun laws or maintain guaranteed protections to firearm access (Schildkraut and Elsass 2016). The battle between public safety and individual liberty fits the news value of conflict and ethics (Price and Tewksbury 1996; Shah et al. 1996), driving coverage of mass shootings.

News media's framing decisions can be influenced by discourses on Twitter and vice versa (Guggenheim et al. 2015). Social media provide a platform for various social actors to bypass news gatekeepers, directly making their voices heard and engaging in conversations (Tufekci 2013). In the face of public tragedies like mass shootings, Twitter functions as a space for public mourning and policy contestation (Zhang et al. 2019). An outpouring of sympathy toward the victims exemplifies an effort to "come together" to acknowledge the violence, though others have critiqued these expressions of sympathy as falling short, instead calling for gun control measures. Such demands are countered by efforts to defend gun rights.

It is noteworthy that the two sides of the gun policy debate are not on an equal footing. Gun control advocacy demands significant organizational efforts to push for change, whereas gun rights advocacy only requires maintaining the status quo (Conley 2019). Gun control activists lack a central organization to mobilize a national movement, while gun rights activists rally around a powerful national organization, the National Rifle Association (Goss 2010). Furthermore, with the increasing coupling of the Republican Party with gun rights voters, gun rights advocacy has taken center stage in right-wing politics (Conley 2019).

Although existing evidence points to Twitter driving news media in terms of policy framing (Guggenheim et al. 2015), the asymmetry between gun rights and gun control advocates and between the partisan media ecosystems makes it difficult to predict specific relationships between discourse on Twitter (e.g., sympathy, gun control, and gun

rights) and news framing of gun policy across conservative, moderate, and progressive outlets. This is especially true given that we first must account for how Twitter discourses and news framing decisions were shaped by characteristics of mass shooting events before examining communication flows between Twitter and news media and between the partisan media ecosystems. Accordingly, we use the following three research questions to guide our analysis:RQ1:

How did social media discourses and news framing decisions respond to mass shooting characteristics within a hybrid and polarized media system?RQ2:

How did social media discourses and news framing decisions relate to each other when responding to mass shootings?RQ3:

How did the conservative and progressive media ecosystems relate to each other when responding to mass shootings?

Methods

Data and Measures

Three datasets were compiled for this analysis: 1) an event database of 60 mass shootings across the U.S. between 2012 and 2014; 2) a database on Twitter discourses in response to mass shootings during the same period — "thoughts and prayers," calls for gun control, and defense of gun rights — measured by a supervised machine learning approach; and 3) a dataset on news stories during the same period mentioning terms related to gun control, gun rights, and gun violence pulled from Media Cloud, an open-source platform for media analysis, for three sets of news media: progressive outlets, moderate outlets, and conservative outlets.

Mass shooting events. According to the FBI, any shooting events with four deaths or more, excluding the assailant(s), are considered mass murder. To compile a list of these mass shooting events, we referred to three sources: the Stanford Mass Shootings in America (MSA) project, the Gun Violence Archive (GVA), and the USA Today Behind the Bloodshed Project (USA Today). As each archive relied on different data records (e.g., news reports vs. police records), they complement each other, providing a comprehensive set of mass shooting events.

We focused on six mass shooting event features in our analyses: total number of victims, children killed, African-Americans killed, shooter race, public shooting, and school shooting. The first four variables concern, respectively, the number of people killed and injured, the number of people under the age of 18 killed by the shooter, the number of African-American deaths caused by the shooter, and whether the shooter was white. A random and indiscriminate shooting, where the shooter and the victims had no relationship with each other, was coded as a public shooting. A shooting that occurred at primary or secondary schools was coded as a school shooting. See Supplementary Information file, Appendix I for detailed information about variable definitions and the coding process.

Twitter discourses. We focused on three prominent Twitter discourses in response to mass shootings — the offering of "thoughts and prayers," calls for gun control, and defense of gun rights — that reflect immediate reactions to tragic events and the debates that follow (Zhang et al. 2019). The "thoughts and prayers" discourse captures expressions of sympathy in the immediate wake of mass shootings. The gun control discourse encapsulates calls to support stricter gun control measures, a direct response to mass shootings presumably among progressive Twitter users. Meanwhile, the gun rights discourse relates to the defense of Second Amendment rights, a typical reaction from conservative Twitter users. Among many reactions to mass shootings on Twitter, these three are most directly relevant to policy debate and media coverage.

We used existing Twitter data collected and analyzed in a previous study (Zhang et al. 2019). From an archive that stores a random 10% of the Twitter stream from the Twitter REST API, 13,156,564 tweets were collected containing any one of the following search strings: "gun," "shooter," "shooting," "firearm," "second amendment," "2nd amendment," and "nra." Supervised machine learning was applied to first determine whether a tweet was relevant to mass shooting or gun policy discussion, and then relevant tweets were classified into one of three discourse categories ("thoughts and prayers," gun control, and gun rights) using logistic regression (Supplementary Information file, Appendix II). The total number of tweets by day within each discourse was tabulated, after all tweet timestamps were converted to Eastern Standard Time (Supplementary Information file, Appendix III). Correlations between discourses are low, 0.42 between "thoughts and prayers" and gun control, 0.16 between "thoughts and prayers" and gun rights, and 0.34 between gun control and gun rights, suggesting that they are discrete variables.

News coverage. Given our focus on the different language labels that journalists might circulate to highlight certain interpretation of events, we used a keyword based approach to track framing devices (Guggenheim et al. 2015; Lo et al. 2021). This is consistent with the lexical approach adopted in framing studies that emphasize how the subtle selection of language markers can shape understanding. Our news data came from Pelled and colleagues' study (2021) that collected news stories mentioning gun control ("gun control," "gun laws," and "background check") and gun rights ("second amendment," "gun rights," "nra," and "national rifle association") through MediaCloud using its public API from three sets of news media: progressive (*New York Times* and *Washington Post*), moderate (CNN and *Chicago Tribune*), and conservative (Fox News and *New York Post*). The categorization of news outlets was based on Faris and colleagues' (2017) media slant estimates. Though *New York Times* and *Washington Post* are not the exact left-wing counterparts of Fox News and *New York Post*, we are interested in not so much absolute media slant as relative media slant. The daily story count by topic from each outlet was then tabulated after publication times were standardized to Eastern Standard Time.

Given journalists' tendency to present policy disputes in terms of issue dualism, reducing issues to a contest between two contending views both of which merit roughly equal consideration, they rarely cover gun control without also gesturing to gun rights, or vice versa. As such, a news story about gun policy might contain

competing frame devices while putting greater emphasis on one over another. Accordingly, we measured gun policy framing by subtracting the daily number of stories mentioning gun control by the daily number of stories mentioning gun rights within each outlet, recognizing these often occurred within the same story. By tracking the relative amount of emphasis on one set of frame devices over the other competing frame devices, we can more accurately represent news framing of the gun policy debate. Also, this measure is more parsimonious and can lower multicollinearity. The correlations of gun policy difference between all three media types are modest, ranging from 0.40 to 0.44, suggesting that progressive, moderate, and conservative media have different though interrelated attention dynamics when covering gun policy. To validate this measure, we conducted two additional analyses: (1) we compared the daily counts of gun policy framing (gun control – gun violence) across media outlets and found progressive outlets (Mean = 1.5) emphasized control over policy at twice the rate of conservative outlets (Mean = 0.7); and (2) we plotted the daily time series and found that over time conservative media ran more stories mentioning gun rights than gun control (Supplementary Information file, Appendix III).

In addition to measuring framing choices, we also tracked news attention to gun violence (using the search terms "mass shooting" and "gun violence") as a reflection of general coverage surrounding mass shootings events. This is because gun violence coverage focuses on events themselves, such as the number of the victims and the fate of perpetrators alongside the broader problem of gun violence, representing the most direct and common news media response to mass shootings (Guggenheim et al. 2015; Silva and Capellan 2019). The "gun violence" measure was created by aggregating daily gun violence stories from all progressive, moderate, and conservative outlets due to relatively high correlations of daily gun violence stories from the three types of media (see Supplementary Information file, Appendix III for the daily story counts of news stories by media type). The correlations range from 0.62 to 0.75, suggesting that news attention to gun violence was synced across the media ideological spectrum and driven by exogenous factors.

Time Series Modeling

Due to the highly autoregressive nature of the Twitter and news media variables, we applied time series modeling to examine their relationship (see also Barberá et al. 2019). Interested in how Twitter discourses and news media framing influenced each other, we treated the Twitter discourse variables (i.e., the "thoughts and prayers," gun rights, and gun control discourses) and news media coverage variables (i.e., attention to gun violence and framing of gun policy in progressive, moderate, and conservative media) as endogenous to each other. As these seven variables can be influenced by mass shooting events, we treated event features as exogenous variables. By considering both exogenous and endogenous factors in this modeling, the approach provides a more conservative test than past analyses (Pelled et al. 2021; Zhang et al. 2019). This also helps ensure that our measures of Twitter activity and media coverage are not measuring mass shooting event characteristics themselves.[1]

To model these endogenous relationships, we used Vector Autoregression (VAR) techniques. Initial tests, using information criteria, suggested a lag of one for endogenous variables. This is not surprising given fast news cycles and short social media attention span.[2] Our VAR estimates can then be used to perform Granger causality tests, which estimate whether lags of one variable can be used to predict another variable longitudinally (Groshek 2011), although our single lag structure makes Granger tests equivalent to evaluating the t-statistics from the model estimates. Our estimates can also be used to generate Impulse Response Functions (IRFs), which show the influence (magnitude, significance, and temporal response) of one endogenous variable on another when subjected to a one standard deviation "shock" of a variable (Swanson and Granger 1997).

Results

Twitter Discourses, News Framing Decisions, and Mass Shooting Events

RQ1 asks how Twitter discourses and news framing of gun policy are correlated with specific characteristics of mass shooting events, while controlling for the mutual influence between news media and Twitter. As shown in Table 1, the number of total victims and the number of child victims were both positively correlated with "thoughts and prayers," gun control, and gun rights discourses on Twitter as well as news attention to gun violence and progressive media's gun policy framing (emphasizing gun control over gun rights, suggesting a shift in issue dualism framing in those outlets).

The race of the shooter and of the victims killed, however, had an opposite relationship with all three Twitter discourses and news attention to gun violence, a pattern consistent with previous research that examines Twitter responses alone (Zhang et al. 2019). When more African-Americans were killed, or when the shooter was white, there were fewer tweets expressing sympathy, calling for gun control, and defending gun rights.

Although the features of victims and shooter were related to Twitter discourses and news attention to gun violence, types of shootings were not, with the exception of the relationship between public/school shootings and "thoughts and prayers" discourse. Also, framing of gun policy across progressive, moderate, and conservative news media outlets was not as correlated with those features. Only the number of victims and children killed shifted progressive media's framing toward gun control and school shootings predicted conservative media's framing toward gun control in their issue dualism coverage.[3]

Communication Flows Between Twitter and News Media

Turning to the relationship between the endogenous variables while controlling for event characteristics, Table 2 presents results from Granger causality tests (see Supplementary Information file, Appendix IV for more analyses). Figure 1 visualizes these relationships.

Table 1. Mass Shooting Event Features' Relationship with Social and News Media Response.

	thoughts and prayers (Twitter)	gun control (Twitter)	Gun rights (Twitter)	gun violence (all news media)	gun policy framing (progressive media)	gun policy framing (moderate media)	gun policy framing (conservative media)
number of victims	387.002 (14.503)***	11.080 (5.571)*	1.776 (0.824)*	0.579 (0.079)***	0.121 (0.048)*	0.009 (0.039)	-0.040 (0.030)
number of children killed	1688.072 (46.672)***	235.615 (17.929)***	17.499 (2.653)***	0.679 (0.255)**	0.316 (0.156)*	0.098 (0.125)	-0.016 (0.098)
number of African-American victims	-1049.743 (64.828)***	-110.030 (24.903)***	-8.581 (3.685)*	-1.504 (0.355)***	-0.136 (0.216)	-0.134 (0.174)	-0.067 (0.136)
shooter race (1 = white)	-4148.884 (236.499)***	-389.277 (90.849)***	-26.500 (13.443)*	-3.007 (1.293)*	-0.374 (0.789)	-0.531 (0.635)	0.276 (0.497)
public shooting	980.130 (313.030)**	225.634 (120.248)	23.191 (17.794)	-0.860 (1.712)	-1.202 (1.045)	0.112 (0.840)	-0.905 (0.658)
school shooting	-1114.595 (502.900)*	57.486 (193.185)	44.066 (28.587)	-2.698 (2.750)	1.367 (1.678)	1.328 (1.349)	2.153 (1.057)*
constant	-39.264 (33.218)	0.617 (12.761)	-0.446 (1.888)	1.088 (0.182)***	0.371 (0.111)**	0.095 (0.089)	0.137 (0.070)

Notes. In a one-lag VAR model, the t-statistics (or z-score) on the one coefficient is identical to the Granger test. Standard errors are in parentheses.
*p <.05, **p <.01, ***p <.001.

First, "thoughts and prayers" discourse was only Granger caused by gun control discourse on Twitter. This means that news coverage had no relationship with this discourse, a reasonable pattern given that expression of sympathy was an immediate reaction to mass violence. Gun control discourse on Twitter was Granger caused by both "thoughts and prayers" on Twitter and news media coverage. Specifically, gun control discourse on Twitter rose after a) people expressed "thoughts and prayers" on Twitter, b) news media covered gun violence, and c) progressive media shifted gun policy framing toward emphasizing gun control. This is suggests that news media partially set the tenor for gun control discourse on Twitter. In contrast, gun rights discourse on Twitter was decoupled from news media coverage, reacting only to gun control discourse on Twitter. This isolated and reactive relationship merits further attention.

In terms of news media, news attention to gun violence was Granger caused by Twitter discourse and news media's shift in gun policy framing. Specifically, gun violence reporting increased after volumes of "thoughts and prayers" expression and calls

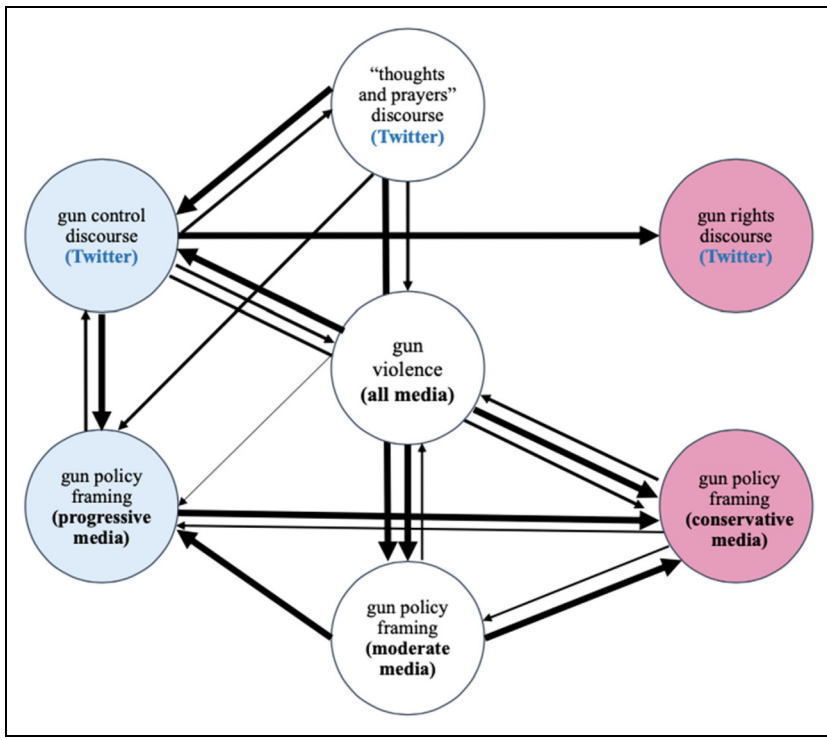

Figure 1. Granger Causality Tests. The thickness of the arrows represents significance level, with the thickest arrow representing "*** p <.001" and the thinnest arrow representing "* p <.05." To understand the size/strength of effect, we presented IRFs results.

Table 2. Granger Causality Tests (based on VARs with lag of 1).

Dependent Variable	Independent Variable	p-value
thoughts and prayers discourse (Twitter)	gun rights discourse (Twitter)	0.342
	gun control discourse (Twitter)	0.007 **
	gun violence (all news media)	0.303
	gun policy framing (conservative media)	0.891
	gun policy framing (moderate media)	0.236
	gun policy framing (progressive media)	0.096
gun control discourse (Twitter)	gun rights discourse (Twitter)	0.935
	thoughts and prayers discourse (Twitter)	0.000 ***
	gun violence (all news media)	0.000 ***
	gun policy framing (conservative media)	0.564
	gun policy framing (moderate media)	0.551
	gun policy framing (progressive media)	0.004 **
gun rights discourse (Twitter)	thoughts and prayers discourse (Twitter)	0.933
	gun control discourse (Twitter)	0.000 ***
	gun violence (all news media)	0.136
	gun policy framing (conservative media)	0.409
	gun policy framing (moderate media)	0.737
	gun policy framing (progressive media)	0.085
gun violence (all news media)	gun rights discourse (Twitter)	0.339
	thoughts and prayers discourse (Twitter)	0.002 **
	gun control discourse (Twitter)	0.004 **
	gun policy framing (conservative media)	0.005 **
	gun policy framing (moderate media)	0.001 **
	gun policy framing (progressive media)	0.358
gun policy framing (moderate media)	gun rights discourse (Twitter)	0.072
	thoughts and prayers discourse (Twitter)	0.000 ***
	gun control discourse (Twitter)	0.932
	gun violence (all news media)	0.000 ***
	gun policy framing (conservative media)	0.002 **
	gun policy framing (progressive media)	0.500
gun policy framing (progressive media)	gun rights discourse (Twitter)	0.120
	thoughts and prayers discourse (Twitter)	0.006 **
	gun control discourse (Twitter)	0.000 ***
	gun violence (all news media)	0.010 *
	gun policy framing (conservative media)	0.004 **
	gun policy framing (moderate media)	0.000 ***
gun policy framing (conservative media)	gun rights discourse (Twitter)	0.321
	thoughts and prayers discourse (Twitter)	0.072

(continued)

Table 2. (continued)

Dependent Variable	Independent Variable	p-value
	gun control discourse (Twitter)	0.001 **
	gun violence (all news media)	0.000 ***
	gun policy framing (moderate media)	0.000 ***
	gun policy framing (progressive media)	0.000 ***

*p <.05, **p <.01, ***p <.001

for gun control rose on Twitter, and after the moderate and conservative media shifted their framing of gun policy to emphasize gun control relative to gun rights. Second, moderate media's shift in gun policy framing was Granger caused by the outpouring of sympathy on Twitter, gun violence news, and conservative media's framing. Third, progressive media's gun policy framing seems most susceptible to influence from both the Twitter sphere and other corners of the news media landscape. All factors except for gun rights discourse on Twitter Granger caused progressive media to put more emphasis on gun control than gun rights. Lastly, while conservative media did not take cues from the voices of gun rights advocates on Twitter, they did pay attention to the voices of gun control advocates on Twitter, progressive and moderate media's gun policy framing, and gun violence coverage. This reaction, like that of gun rights discourse on Twitter, merits further attention, which we examine below.

These results reveal that news media issue dualism framing and news attention to gun violence were more susceptible to influence from Twitter (i.e., "thoughts and prayers" and gun control discourses) than vice versa, answering RQ2. The predominant communication flows from Twitter to news media are robust even after accounting for the presence of media accounts on Twitter, suggesting that for mass shootings, citizen expression of sympathy and calls for gun control on Twitter preceded news attention to gun violence and news framing of gun policy (see Supplementary Information file, Appendix V).

Simulating Conservative Media Ecosystem Responses

Our results point to the conservative media ecosystem reacting to its progressive counterpart on Twitter. Such reactiveness is asymmetric: gun control discourse on Twitter and progressive media's shift in gun policy framing were not Granger caused by gun rights discourse on Twitter, yet gun rights discourse on Twitter and conservative media's shift in gun policy framing were Granger caused by gun control discourse on Twitter.[4] In Figure 2, we present IRFs to simulate this reactive dynamic. IRFs help us unravel how one endogenous variable reacts to another by simulating the effect of increasing any variable by one standard deviation, then assessing how that effect reverberates throughout each equation over time. Thus, one can assess how this one-time shock in a specific variable influences each other variable over several days.

IRF shows that a one standard deviation increase in gun control tweets (SD = 482) would lead to an estimated drop in gun rights discourse by around -7.9 the next day,[5] but with quick rebound the day after. This could indicate that, in the aftermath of a mass shooting with an outpouring of tweets calling for stricter gun control, tweets defending gun rights temporarily declined, only to resume their near-normal rate soon after (note that this negative relationship is based on VARs with a one-day lag). The reactive nature of conservative media's gun policy framing is also evident, especially responding to signals from progressives on Twitter. A shock in one standard deviation of the gun control tweets (SD = 482) would increase by 0.3 the net number of gun control stories (minus gun rights stories) from conservative media. This effect sustains itself over a relatively long period of time. Those advocating for gun rights appear to "lower their voices" immediately following mass shootings.

Discussion

In the current media system, the top-down, mass-media logic has been replaced by a hybrid, fragmented, multi-flow logic, in which news outlets and social media platforms are bound together, mutually reinforcing each other while also operating along deeply divided ideological lines. In this article, we investigate who leads and who follows in

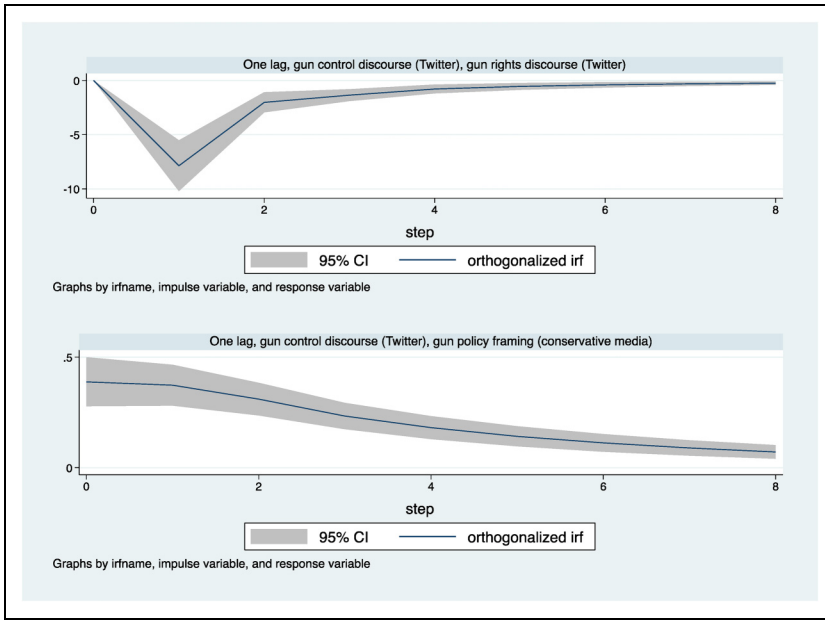

Figure 2. Impulse Response Functions for the impact from gun control Twitter discourse on gun rights Twitter discourse (top) and on conservative media's gun policy framing (bottom). 95% bootstrap confidence interval is shown in shadowed band.

the hybrid and fragmented media system by modeling responses to mass shootings in the United States, a highly salient partisan issue with major policy implications. Specifically, we examine how different discourses on Twitter — "thoughts and prayers," calls for gun control, and the defense of gun rights — both influence and are influenced by news framing of gun policy across the partisan news environment, all while accounting for characteristics of the victims, shooter, and shooting type for 60 mass shooting events in the United States from 2012 to 2014. Our results advance the literature on the U.S. media system and intermedia agenda setting and framing.

First, we demonstrate that different parts of the media system share similarities and differences when responding to mass shootings. The volume of violence and the innocence of victims have powerful effects on Twitter responses and news attention to gun violence. Yet the race of the victims and shooter tells a different story, with the loss of black lives and attacks by white shooters reducing responses, indicating a racial undercurrent to how the media system responds to mass violence. The diverging responses might be related to broader media representations of violence and criminality. Since African-Americans are over-represented as perpetrators of crime and white people as victims in news media coverage (Dixon et al. 2003), the public appears less likely to show sympathy when features of mass shootings coincide with such stereotypes. When it comes to news framing of the gun policy debate, media responses are more varied, suggesting factors other than event features, such as political leanings of the outlets, are associated with how news media cover controversial topics like gun policy. The tendency of conservative media to generally favor gun rights over gun control language supports this view.

Second, we find that the direction of communication flows is primarily from Twitter to news, as seen in how Twitter expressions of sympathy and calls for gun control drive news attention to gun violence and impact news framing of gun policy. This is consistent with earlier studies on how platforms such as Twitter can initiate communication flows and influence traditional channels (Valenzuela et al. 2017). The rising prominence of social media in influencing news framing decisions directly attests to the ability of non-media actors to leverage social media to gain discursive power— the power to "introduce, amplify, and maintain topics, frames, or speakers" (Freelon and Karpf 2015; Gruszczynski and Wagner 2017; Jungherr et al. 2019: 409). This can be explained by new journalistic practices shaped by social media, reflected in how journalists use social media to access both powerful and ordinary users, monitor public conversations, and represent public opinions (McGregor 2019; Molyneux and McGregor 2021; Mourão and Harlow 2020).

Most strikingly, our results reveal an asymmetric reactiveness in the U.S. media system, increasing our understanding of the uneven media environment across political ideologies. In contrast to the integrated progressive media ecosystem, evidenced in how Twitter discourses and news framing on the left mutually influence each other, the conservative media ecosystem seems more reactive. Conservative media and conservatives on Twitter react to progressives on Twitter. In other words, whenever progressives push for gun control on Twitter, conservatives on Twitter and conservative

media will lower their voices briefly and then follow with gun rights claims and news coverage shortly after.

This reactive asymmetry for conservatives on Twitter and conservative media suggests that the discursive power of gun control progressives on Twitter is limited. Conservatives on Twitter and in news media are quick to respond by counteracting progressive framing. After briefly reducing their activity level, they can redirect attention from gun violence and emphasis on gun control to a return to their defense of gun rights, likely to provoke a response among conservative audiences. This also indicates an adversarial style of politics on the political right that is more interested in responding to the left than to the features of events. Under the attention economy, the ability to make oneself visible in the public discourse by reacting to existing objects of attention and deflecting attention from competitors onto oneself confers power. In this regard, conservatives on Twitter and conservative media, which react to their progressive counterparts' effort to gain attention through Twitter, seem to be no less powerful in the race for attention and narrative control. This pattern shows that although some actors can influence of the salience of an issue through agenda-setting, this power can be counteracted by a reactive posture of others who seize on the opportunity to advance their preferred framing.

This result aligns with a recent study showing that conservative audiences perceived gun violence to be less important an issue after exposure to episodically framed news from conservative media (Guo et al. 2021). The reactive gesture of conservative media to progressive media might shift conservative audiences' attention to right-wing perspectives on these issues, advance views that evoke "liberal tears," and critique arguments from progressives. This result is also consistent with prior evidence showing the long tradition of U.S. conservative media criticizing the so-called mainstream media (Berry and Sobieraj 2013) and the tendency of conservatives to react to all sorts of news on social media (Bovet and Makse 2019; Freelon et al. 2020). It further speaks to the intrinsic differences between the conservative and progressive media ecosystems and the underlying difference between the two political parties and ideologies. With conservatives on the constant lookout for signals threatening their ideological convictions, the Republican party unified by conservative doctrines, and the right-wing media playing a central role in enforcing those values (Benkler et al. 2018; Grossmann and Hopkins 2016; Jost 2017), the conservative media ecosystem is well-positioned to counter progressives' efforts to demand gun control by responding against it. However, different than the existing literature showing the asymmetric properties of the two partisan media ecosystems, our results illustrate another dimension of the asymmetry: interaction and reaction. This finding provides empirical evidence explaining the seemingly contradictory interconnectedness and fragmentation in the media system; instead of creating parallel universes of mediated realities, conservative and progressive media ecosystems are connected, yet in a reactive and asymmetric fashion, which very well might further exacerbate political polarization and reduce the potential for deliberation.

Such reactive asymmetry is only possible when different parts of the media system are visible and attentive to each other (Webster 2014). Hashtags, trending topics, and viral posts enable social media users, journalists, politicians, activists and ordinary

people alike to find, amplify, and respond to each other (Sunstein 2018; Yang and Peng 2020; Zhang et al. 2018). Media outlets also monitor each other and their audience through algorithmic tracking and digital footprint analysis (Webster 2014). These mechanisms facilitate and intensify the multi-faceted communication flows across the media system.

The reactive asymmetry further reflects the asymmetry in communication flows within the gun policy debate. Gun rights advocacy is backed by a powerful national organization, the NRA, and has become a core issue in the Republican Party platform, maintaining public opinion support (Conley 2019). In contrast, gun control advocates do not have a corresponding organization with equivalent lobbying power (Goss 2010), which is also unlikely to occupy as central a position in the more distributed Democratic Party politics. This imbalance of power between the two sides may be part of the reason why the conservative ecosystem is quick to react and counteract to its progressive counterpart on the issue of gun policy.

This article also demonstrates the need to integrate agenda-setting and framing theories to track communication flows in a complex media system. Intermedia agenda-setting concerns how different media outlets and platforms influence each other in issue or attribute salience, typically without considering the impact of external events in a dynamic fashion; framing analysis focuses on the contestation over the labels, terms, and perspectives adopted by journalists to advance a preferred interpretation, often absent attention to intermedia influence. In such an open and fluid media system, we expect that attention and communication can flow in multiple directions between news media and social media, with the less contested spaces advancing preferred framing of events. By situating agenda-setting and framing theories within a media system framework, we observe how event framing in the conservative media sphere can be affected and affect progressive social media discourse and news media framing. These results highlight (a) the effectiveness of a granular-level analysis that accounts for event characteristics, (b) the heterogeneity and complexity of flows within and across different media spaces, and (c) the complex relationships between social media discourses and news media framing, adding to conventional indexing, agenda-setting, framing, and media systems theorizing.

From a methodological perspective, we demonstrate one way in which computational methods of text processing and advanced time series modeling approaches can be combined to explore complex communication dynamics. With automated text processing, vast social media data can be analyzed to detect the heterogeneous discourses, enabling researchers to better understand the contention surrounding issue definition and debate. Our measurement of gun policy framing by subtracting the daily number of stories mentioning gun control terms by the daily number of stories mentioning gun rights terms within each outlet recognizes how major events can shift issue dualism. Furthermore, time series modeling helps us identify temporal dynamics across multiple cases, which might not surface in a micro-level analysis.

However, we do recognize the limitations of our study. First, our conclusions are drawn based on a single-issue and single-country context. Future research should examine such dynamics in multiple contexts to test the ecological validity of the

conclusions. Second, we focus on one social media platform, Twitter. Though Twitter might drive news media attention in the context of mass shootings in the United States, other social media platforms might not necessarily share the same temporal pattern of response, requiring future research to consider cross-platform communication flows. Third, though we measure news attention to gun violence through the frequency of keywords, future research should provide a more nuanced examination of how news media frame mass shootings, such as a focus on victims as opposed to shooters or the lens of mental illness, domestic violence, or terrorism. Lastly, a qualitative analysis of how conservative media and conservatives on Twitter reacted to progressives on Twitter is needed. A closer examination of the actual content at the center of this reactive process is a necessary next step.

Overall, the influence of social media responses on news media attention to gun violence and shifts in their framing of gun policy, coupled with the reactive posture of the conservative media ecosystem to the progressive media ecosystem — whether in the form of gun rights tweets or conservative news outlets' gun policy framing— indicates a hybrid media system in which political communication exists within a reactive partisan ecology. This may have consequences for behavioral outcomes like stock values of gun companies and registrations of gun sales in the aftermath of mass shootings. These results also have implications for research on other contentious political issues, their discussion across digital platforms, and the broader partisan news ecology, as these dynamics may reflect deeper patterns of reactivity and asymmetry.

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Data Availability Statement

The data described in this article are openly available in the Open Science Framework at: https://osf.io/thqnb/.

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Notes

1. For the Twitter variables, 26 days have missing data, suggesting a loss of Twitter data stream on those days from the archive. We applied data imputation techniques, including linear interpolation (for 1-3 day gaps) and forecasting (for one 7-day gap) to replace missing data with estimated values.
2. We offer some methodological considerations here. We tested up to 10 lags in our model. We also include, in Supplementary Information file, Appendix IV, a lag of three days (based on information criteria) as robustness check. The results based on lag of one and lag of three are nearly identical. Also, though it is possible that the daily lag obscures faster response time between variables (for example, Harder and colleagues (2017) applied a 6-hour lag), we did not run models with hourly lags because a lag of one day or longer might suggest some lasting impact that transcends the 24/7 news cycle. In addition, tests of stationarity, including the Augmented Dickey-Fuller and the KPSS tests, indicate that all of our series are stationary with the exception of gun rights Twitter discourse. We therefore differed this variable in all subsequent analyses.
3. Note the coefficient estimates of the exogenous variables vary widely in size, specifically those correlating with "thoughts and prayers" Twitter discourse. The larger magnitude of these coefficients suggests that variation in event characteristics has a large substantive effect on "thoughts and prayers." This is not surprising given the large increase in these tweets in the immediate aftermath of mass shootings.
4. This reactive asymmetry can be further validated in Granger test results based on the three-day lag for the endogenous variables, as shown in Supplementary Information file, Appendix IV.
5. The value of -7.9 is the predicted value of the first-differenced series of gun rights tweets, the mean of which is 0.03. This shows that the drop is a large change.

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