

Dynamic Debates: An Analysis of Group Polarization over Time on Twitter

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Abstract

The principle of homophily says that people associate with other groups of people who are mostly like themselves. Many online communities are structured around groups of socially similar individuals. On Twitter, however, people are exposed to multiple, diverse points of view through the public timeline. We captured 30,000 tweets about the shooting of George Tiller, a late term abortion doctor, and the subsequent conversations among pro-life and pro-choice advocates. We find that replies between like-minded individuals strengthen group identity whereas replies between different-minded individuals reinforce ingroup and outgroup affiliation. Our results show that people are exposed to broader viewpoints than they were before, but are limited in their ability to engage in meaningful discussion. We conclude with implications for different kinds of social participation on Twitter more generally.

Keywords: Twitter, social media, group dynamics, political beliefs

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Diversity and discussion are cornerstones of democracy in many countries around the world; a democratic society requires freedom of speech, diversity of views, exchange of information, and active citizenship. Yet, these principles are challenged when like-minded people form homogenous groups and enclaves (McPherson, Smith-Lovin, & Cook, 2001; Sidanius & Pratto, 2001; Sunstein, 2008). Although scholars have examined group polarization, extremism, and hate speech in early online communities (Daniels, 2009; PB Gerstenfield, 2003; Schafer, 2002), little is known about how these take hold in new social media genres like Twitter. Do like-minded people talk to one another or to people who they disagree with? For example, would Republicans or Democrats who followed only other Republicans or Democrats, respectively, be more likely to become more extreme? Or would those who followed hashtags on the public timeline—and who were thus exposed to a diversity of viewpoints—be likely to become more extreme? How do ingroups and outgroups form, and how do individual opinions grow and change?

Cass Sunstein has claimed that contemporary media and the Internet have abetted a culture of polarization, in which people primarily seek out points of view to which they already subscribe (Sunstein, 2001). Indeed, people's opinions have been shown to become more extreme simply because their view has been corroborated, and because they grow more confident after learning of the shared views of others (Sunstein, 2008). In a study of voting patterns of U.S. Democrats and Republicans, for example, Sunstein showed that the difference in voting patterns between the two groups will be amplified when comparing Democrats on all Democrat panels to Republicans on Republican panels versus both members of both parties in a single panel (Sunstein, 2008).

GROUP POLARIZATION ON TWITTER

We examine a particular case—the shooting and subsequent death of Dr. George Tiller that took place on May 31, 2009 in Wichita, Kansas (Stumpe & Davey, 2009). Dr. Tiller was one of the few late-term abortion doctors in the U.S. He had been the subject of debate and controversy among pro-life and pro-choice advocates for many decades and had been targeted many times by individuals and groups who opposed his practice. His shooting was controversial and divisive (Abcarian, 2009). Although early tweets about his death were informational—sharing news that he had been shot—the issue quickly became bigger than the event itself. We captured over 30,000 tweets about the shooting and subsequent discussion from the time of the shooting over the next 60 days. While the event garnered worldwide attention, the majority of discussion and debate was centered around the U.S.

Twitter users began to voice strong and polarized views about abortion. Both pro-life and pro-choice advocates used a shared set of neutral hashtags (e.g. #Tiller) as well as common sets of non-neutral hashtags (e.g. #pro-choice or #pro-life). In many cases, users listed pairs of hashtags in their tweets to both support the side of the argument that they agreed with and to provide a counterpoint to the side they did not agree with. Thus, instead of seeing tweets from a follower network of mostly like-minded people, people who followed the public search stream (via sites like search.twitter.com) were exposed to a diverse set of viewpoints about the story. In this paper, we examine the effects of Twitter use on group polarization and extremism. This work builds off three assumptions based on prior work. First, access to news and information is important for promoting social equality (Hargittai, 2008). Exposure to multiple points of views promotes diversity; lack of exposure can lead to narrow-minded views (Ibarra, 1992; McPherson, et al., 2001; Sunstein, 2001). Finally, homophily—connecting with like-minded people—can lead to polarization, inequality, and extremism (Baron, Hoppe, Linneweh, & Rogers, 1996; McPherson, et al., 2001; Sunstein, 2001). Thus, the questions we explore here are:

GROUP POLARIZATION ON TWITTER

- 1) How do people find and share news about the event?
- 2) What kinds of viewpoints are people exposed to and who do they share it with?
- 3) How do people respond to others who have differing viewpoints, as well as to people who share the same viewpoints as their own?

We examine these by looking at how people found and propagated news about the shooting of Dr. Tiller, who they discussed the shooting with, and how extreme their views were. The pro-life/pro-choice debate is deeply personal, cultural, and historical in nature. We did not anticipate that people's views would change drastically based merely on what other people posted, especially given the severe technical limitations of Twitter for engaging in meaningful dialogue. Twitter is hardly a medium for deliberative democracy. We were simply interested to know, do people who tweeted about the shooting of George Tiller become more extreme in their posts, and can we detect patterns in behavior and network externalities that may have influenced the kinds of things they said?

We first describe related work in the diffusion of information, group behavior, and polarization. We then describe the details of Dr. Tiller's shooting and the methods we used to collect our data. In the results section, we describe who tweeted, what kinds of things they said, who they replied to, and what news sources they interacted with. We then discuss the implications of Twitter use on group polarization, and conclude with implications for social media use more generally.

This research differs from prior work on homophily and group polarization in other kinds of communication media in a few ways. First, Twitter conversations differ from discussion boards like alt.abortion on Usenet (see (Kelly, Fisher, & Smith, 2005)) where people come to the discussion intentionally; on Twitter people witness a conversation and are drawn into it. Twitter conversations differ from blogs because the 140 character constraint and the speed with which topics ebb and flow on

GROUP POLARIZATION ON TWITTER

Twitter makes meaningful discussion difficult. Last, they differ from SMSing and texting as well as Facebook news feeds, all of which are public only to a local neighborhood within one's network; Twitter conversations (excluding protected accounts) are public to anyone who looks. Through hashtags and the public timeline, people can witness public conversations they otherwise might not, and can participate in conversations they otherwise may not have, but the environment's constraints limits their ability to do this well. This has implications for access to resources and diversity of information.

Related Work

Changes in media technologies have altered how people first learn of major news events. When President Franklin D. Roosevelt died in 1945, people were the first sources of information, followed by radio (Miller, 1945). When President Dwight Eisenhower had a stroke in 1957, television was the primary source of information, followed by radio, and then people (Deutschman & Danielson, 1960), and after the assassination of John F. Kennedy in 1963, word of mouth was the primary source (Banta, 1964). More recently, people used Google maps, Facebook, and wikis to spread news about disasters (e.g. (Palen & Liu, 2007)). People have also turned to Twitter to seek and share information and social support. During time-sensitive events that are global in scale like the Mumbai bombing, President Obama's visit to Cairo, or Air France's plane crash near Brazil, people's use of Twitter bursts with an astonishing frequency and intensity (e.g. (Golder, 2009)).

Gantz and Trenholm (Gantz & Trenholm, 1979) identified four reasons why people pass on news about critical events: (1) to satisfy informational and interest needs; (2) to establish social status, that they are superior to other people in some manner; (3) to express affection; and (4) to initiate social contact, to talk with others. Emotional response triggers a range of behaviors: the need for comfort and social support is also a reason for talking with others about threatening or tragic events. Kubey and

GROUP POLARIZATION ON TWITTER

Peluso reported that people who shared news of the Challenger explosion were more likely to say that talking with others made them feel better (Kubey & Peluso, 1990). Ibrahim et al. found that individuals who contacted others on September 11 were more likely to report that they sought social support and coped by discussing the events (Ibrahim, Ye, & Hoffner, 2008).

Group Behavior and Social Corroboration

Homophily is the principle that interactions between similar people occur more often than among dissimilar people (Lazarsfeld & Merton, 1954; McPherson, et al., 2001). The presence of homophily can limit people's social worlds in ways that have implications for the information they receive, the attitudes they form, and the interactions they experience. Group polarization happens when the members of a deliberating group move toward more extreme views.

Group polarization has been shown to exist in a number of real-world contexts. Members of a deliberating group usually end up at a more extreme position in the same general direction as their inclinations before deliberation began (Sunstein, 2008). Caldeira and Patterson found that joint committee memberships had powerful effects inducing friendship, shared attitudes and information, shared understandings of the legislative role, and behavioral homophily (voting together) in a state legislature (G.A. & S.C., 1987). Survey evidence shows that dramatic social events, such as the assassination of Martin Luther King or the attacks in New York City on 9/11, tended to polarize attitudes, with both positive and negative attitudes increasing within demographic groups (Sunstein, 2008). Among college students, religious attitudes and beliefs became salient only when they were activated by a social movement or formal organization (Bainbridge & Stark, 1981). Fundamentalist students were more likely to make this dimension a keystone of their friendships (Bainbridge & Stark, 1981).

Group Polarization Online

Kelly et al. warn about the effects of group polarization online. They characterize the Internet as a kind of “anti-commons” which allows citizens to consume information and affiliate with others on the basis of shared values and interests only (Kelly, et al., 2005). Whereas individual preferences are held in check by public institutions in the world around us—information “commons” like public parks or the mainstream mass media—in which citizens are exposed to a range of viewpoints they would not otherwise encounter, the Internet can be less public (Kelly, et al., 2005).

Indeed, Adamic et al.’s study of political blogs found that the NY Post, the WSJ Opinion Journal and the Washington Times receive the large majority of their links from right leaning blogs, while the LA Times, the New Republic and the Wall Street Journal are predominantly linked to by left leaning blogs (Adamic & Glance, 2005). Studies of book sales on Amazon have similarly shown that purchasing patterns are strongly clustered by political party (Krebs, 2000).

However, results of studies of group polarization vary; Gilbert et al.’s study of agreement levels in different genres of blogs found that technology and entertainment blogs inspire less polarization than lifestyle, politics, and blogs about blogs (Gilbert, Bergstrom, & Karahalios, 2009). Hargittai et al.’s subsequent study of political blogs shows that widely read political bloggers are much more likely to link to others who share their political views, but that bloggers across the political spectrum also address each others’ writing substantively, both in agreement and disagreement (Hargittai, Gallo, & Kane, 2008). Similarly, Kelly et al.’s study of political newgroups found that discussion occurred across clusters of like-minded groups, not within them (Gilbert, et al., 2009). They suggest that people go online to argue, rather than to agree. Deliberation and argumentation online are particularly salient around political, emotionally-charged, or controversial issues.

The Death of George Tiller

George Tiller was a physician in Wichita, Kansas who provided late-term abortions (after the 21st week of pregnancy). Dr. Tiller's work had been the subject of debate and controversy among pro-life and pro-choice advocates for many decades (Stumpe & Davey, 2009). Dr. Tiller had been targeted many times by individuals and groups who opposed his practice; in 1993 he was shot in both arms by a protester (Barstow, 2009). On Sunday May 31, 2009, he was shot and killed at his church during service (Stumpe & Davey, 2009). Three hours later, Scott Roeder, an anti-abortion activist, was taken into custody (and subsequently charged with first-degree murder).

The shooting occurred around 10AM CST. At 11:57AM, the first announcement of the shooting was posted on Twitter by @kfdinews, a local news station: "Shooting at a Wichita church near 13th and Rock has left one person dead". The story was quickly picked up and reported on Twitter by other local news stations (e.g. @fox4webteam at 12:47:50pm and @WichitaNews at 12:49pm), and then by the Associated Press and national news sources (e.g. @BreakingNews at 12:49pm, @NYTimes at 1:24pm, @CNN at 2:45pm). As people learned about the news and passed it on, terms like "George Tiller", #pro-choice, and #pro-life became trending topics (popular topics that Twitter boosts by providing links on the homepage) (see Figure 1). After the initial announcements of the news and sharing of links, the majority of the conversation on Twitter revolved around pro-life and pro-choice debates, which became bigger, in a sense, than Dr. Tiller's shooting itself.

Methods

We built a Twitter engine to capture "stories" using multiple whitelisted Twitter accounts. Whitelisted Twitter accounts are accounts that have been approved by Twitter to make up to 20,000 queries per hour via the Twitter API (application programming interface). The engine takes a start and

GROUP POLARIZATION ON TWITTER

end date and search terms and stores details about each tweet returned by the API search function. It can also search through past tweets, although the Twitter API appears to return more tweets when running real-time. We use metrics like link references in tweets, the `in_reply_to` variable in the Twitter API, and qualitative coding of successive tweets by individual users as proxies for measuring patterns of behavior on Twitter.

We turned on the story engine when the Tiller shooting broke out on Twitter, using search terms like “#tiller”, “pro-life”, “pro-choice”, “abortion”, and “George Tiller”. We captured 30,000 tweets in the first week after the announcement of the shooting of George Tiller. We kept the engine running for 60 days. We narrow the scope of our analysis in this paper primarily to the first 24 hours after the announcement of the shooting, from noon Sunday, May 31st, 2009 to noon on Monday, June 1st, 2009. We focus on the first 24 hours because traffic is heaviest at this point and later use is subject to anomalies among heavy users and outliers. We also are interested in immediate reactions among users and how they initially respond and interact.

The dataset contained 11,017 tweets from 6,803 Twitter accounts, where 2,073 users wrote one post and the remaining 4,730 users wrote two or more posts. Of this set, 3,116 were retweets reposting information, news, and views about the George Stiller story (e.g. “RT @username [msg]”), 1,477 were replies to another Twitter user’s tweet (e.g. “@username [msg]”), and 2,105 contained references to other users somewhere in the tweet. It is important to note that the datasets returned by the Twitter API are not full datasets of all tweets.

We manually coded users for categorical “issue-position” (Kelly, et al., 2005) on the abortion debate. Related research has looked at ways of applying natural language processing techniques to identify linguistic markers of agreement (Gilbert, et al., 2009); however, it is not clear how such

GROUP POLARIZATION ON TWITTER

approaches transfer to 140 character constrained chunks of text. Thus, we examined tweets about the Tiller story from each user and in some cases looked at the user's Twitter profile more generally to code their position on the abortion debate. Unlike other genres of discussions (e.g. Gilbert et al.'s study of political blogs, in which roughly half of the cases were "neither" (Gilbert, et al., 2009)), most people *have* an opinion on abortion. Indeed, opinion polls consistently show that people express opinions on the abortion debate, one way or another. For example, May 2009 polls by CNN, Fox, and Gallup asking about abortion-related issues showed that only 1%, 2%, and 2% checked "unsure", respectively, among a range of given options.

We begin by drawing on Kelly et al.'s work coding the Usenet talk.abortion channel (Kelly, et al., 2005). They coded authors according to their issue-position as "pro-choice", "pro-life", or "other". In their analysis, no Usenet authors were coded as "other"; they all fit into either pro-life or pro-choice. Thus, we defined our categories so that most users were characterized as simply pro-choice or pro-life. The prototypical comment from a pro-choice believer was:

"how can someone claim to be pro-life and then go out and murder someone?"

while the prototypical pro-life comment was:

"Tiller wasn't pro-life. I am pro-life and I condemn murder".

Users who could not be classified made statements like:

"sad to hear what happened to Tiller".

After observing a handful of more extreme tweets, we added an additional layer of categorization. Users characterized as "strong pro-life" were those who rejoiced in Dr. Tiller's death:

GROUP POLARIZATION ON TWITTER

"I'm glad he's dead so he can't kill more babies", "I'm glad he deserved it".

We characterized users as "strong pro-choice" based on two characteristics: 1) associated the shooter with entire groups or movements; and 2) associated said group with terrorism:

"The shooting was done by Christian Taliban".

Issue-position alone is not evidence of political commitment (Kelly, et al., 2005). There are liberal Democrats who take a "pro-life" stance on abortion, and conservative Republicans who are "pro-choice." Ibrahim et al. define an "issue-public" concept of authorship that escapes the difficulty of coding ideology into specific well-defined groups (Ibrahim, et al., 2008). Authors can be passionate about a given issue even if their view is not aligned with a specific political identity.

Results

We selected all 1,447 reply-pairs from the first 24 hours of posts in our dataset—these are pairs in which one user tweeted and another responded to the tweet. We coded both the original poster and the replier to identify what kinds of people reply to other kinds of people. In other words, if A's are pro-life and B's are pro-choice, how often do A's reply to A's versus B's, and vice versa?

Each original poster and replier was coded as strong pro-life, pro-life, moderate/can't tell, pro-choice, or strong pro-choice. The majority of repliers were pro-life and pro-choice (434 and 677 repliers, respectively). A minority of repliers were strong pro-life and strong pro-choice (53 and 84, respectively).

Figure 2 shows number of repliers by ideological preference; there are total of 783 on the pro-choice end of the debate and 496 on the pro-life end (61% pro-choice, 39% pro-life). In comparison, Kelly et al. found that 77% of authors on Usenet's talk.abortion board were pro-choice and 23% were

GROUP POLARIZATION ON TWITTER

pro-life (Kelly, et al., 2005). It is important to note that this number represents a sample of those who chose to reply to another Twitter user in the first 24 hours after Dr. Tiller's shooting. Twitter has become mainstream (e.g. (Golder, 2009)) and it is likely that there are a range of issue and ideological views represented.

Figure 3 shows number of like-minded and opposite-minded reply pairs. We omitted pairs where replier or poster was moderate/can't tell, as well as official news accounts. Pro-choice believers are almost three times more likely to reply to other pro-choice believers and pro-life believers are about equally likely to reply to other pro-life believers as they are to pro-choice believers. An ANOVA was performed which shows a weak significant difference between like-minded replies and opposite-minded replies ($p=.047$). In other words, people are more likely to reply to people who share the same view. This indicates that like-minded interactions takes place among Twitter users discussing the abortion debate.

Conversational Heterogeneity

Heterogeneous conversation occurred when users with opposing viewpoints discussed and debated abortion. Despite the presence of homophily, there is a significant amount of cross-talk: 396 out of 1,137 replies are responses to an opposing viewpoint (see Figure 3). The pro-choice to pro-life replies ($n=195$) were primarily commentaries on the perceived disconnect between someone claiming to be pro-life then shooting and killing another person. Many tweets contained requests for clarifications or explanations around this dichotomy:

@DChi606 How can one preach about pro life but turn around and kill someone? Sad.

GROUP POLARIZATION ON TWITTER

Pro-life to pro-choice replies (n=201) were primarily clarifications of the position of pro-lifers, most of whom asserted that the shooter did not represent their views:

```
savvyconsumer7: @michellew_ I don't know AnyOne who condones  
the murder of Dr. Tiller. I'm pro-LIFE.
```

In some cases, replies were defensive and confrontational:

```
tmgesq: @nytimes How can anti-abortion activists call abortion  
murder, then justify shooting to death an abortion doctor?
```

```
Beregond: @lennytoups Conflating ordinary pro-life people with  
radical antiabortionists is like equating anyone who plants a  
tree with ELF ALF or FOE [Earth Liberation Front, Animal  
Liberation Front, Friends of the Earth]
```

and in other cases, were deliberative and conciliatory:

```
kacybailey: @ChrisCuomo I am very pro-life and am ashamed of  
this. All life is precious and we should act as such! There  
is no excuse for this crime.
```

The underlying message contained in most pro-life replies was that Tiller's shooter was not pro-life and did not represent the values or position of pro-life believers. For either position in the debate, the value system that murder is morally wrong was pervasive, although not universal. While many—indeed, most—from both sides of the debate condemned killing, a few users felt that killing could be justified in some cases:

```
nicholaaas: @skinnyblackgirl but what if you kill one dr who  
gonna kill 1000 babies? Ain't you pro life in summation?
```

GROUP POLARIZATION ON TWITTER

shawna811: Attempting to maximize lives saved by killing one who is killing others can be pro-life even if done in cold blood

shawna811: I'm only saying that killing someone you believe is a murderer is not inconsistent with claiming to be "pro-life."

Support for Tiller's shooter was rare but may have served to define outgroups boundaries for the rest of the Twitter sphere. We return to the implications of these patterns of group identification in the discussion section.

Media Interactions

To detect the relationship between news sources and individual users on Twitter we captured replies to tweets posted by news sources who were reporting the George Tiller story. We were interested in interactions between mainstream news sources and Twitter users. We found that most users did not interact with most news sources; all but two of the major news sources received less than five tweets from Twitter users. Two outliers received 29 replies each: @EaglePhotos and @donlemoncnn. Replies to @EaglePhotos, a local station, were of two types: users saying thanks to them for their reporting (which had been very active, particularly in the first few hours after the event):

rmjh: @EaglePhotos thanks for the onsite updates! National news very slow to pick it up!

Users sometimes asked news sources for more information:

WichitaCindy: @EaglePhotos Do you know if #Tiller's grown children were in the church at the time of his murder?

GROUP POLARIZATION ON TWITTER

After TV anchor @donlemonCNN tweeted: “kansas abortion doctor killed in a church no less. any tweeters know him or in the wichita area? what in the world is going on?”, people responded with comments on their own views about the story, using a more personal and conversational tone:

kavebevan: @donlemoncnn appalling - how can anyone kill anyone, never mind a doctor, and call themselves pro-life?

MorgaineSwann: @donlemoncnn Don't call them pro-life - anyone that would kill a doctor, or condemn a woman to die in childbirth doesn't care about life.

nujerzey856: @donlemoncnn so what's the difference between an abortion death and murder??? this man was doing his job

Don Lemon heavily advertises his Twitter account on CNN television and encourages peoples to follow him and share their comments; followers may thus feel inclined to reply to his account as they would any personal account rather than a formal CNN account.

We also coded reply pairs for replies from news sources to individual Twitter users. We measured what proportion of replies involved interactions with mainstream media. There were fewer than 10 replies from news sources to individual Twitter users in the dataset. Among the 41 tweets from @EaglePhotos, two were replies. The first was a response to a particular question about whether they knew who the killer was yet: “@danimichelle Don't know yet. I heard police released a description, so I'm thinking no.” and the second was giving support to a fellow local news station: “@12Klose same to your crew.”

Users frequently retweeted news sources. Retweeting a news source means an individual reposts what a news account, such as @cnn, has posted. The syntax is to type “RT @cnn:

GROUP POLARIZATION ON TWITTER

[msg]”. Referencing a news source is to tweet something that refers to (mentions) a news source, such as “I’m not sure when it happened but @cnn is posting live updates”. We measured number of references to news sources within the first 24 hours, where we define references as including both retweets and mentions within a tweet. The ratio of number of references to number of followers was higher for local news accounts than for national news accounts. For @kansasdotcom and @EaglePhotos, the ratio of references/total followers was 117/1,309 and 181/1,242, respectively (8.9% and 14.6%). In contrast, the number of references/followers for @NYTimes and @BreakingNews was 287/1,070,086 and 90/545,714 (.02% and .016%). This affirms that local stories will have stronger influence and large spread in local communities than local stories will in a national community of readers.

Changes in Polarization, Extremism, and Emotion

To examine if kinds of participation changed significantly over the first 24 hours after the shooting broke out we looked at cross-talk over time, changes in extremism over time, and emotion over time.

Change in Cross-Talk over Time

We plotted reply pairs over the first 24 hours to assess if they become more or less polarized. In Figure 4, light bars represent like-minded views (pro-life to pro-life and pro-choice to pro-choice) and dark bars represent cross-talk. The % of like-minded replies ranged between 20-40% of total replies in the above graph; however, it neither decreases nor increases consistently within the first 24 hours.

Change in Opinion over Time

We plotted individual positions over the first 24 hours to see if the aggregate opinion becomes more biased towards one side of the debate or the other, or if opinions became more extreme overall (see

Figure 5). We looked for “bursty” behavior in a constrained 24-hour sample. While the total number of tweets fluctuated, we observe little change in relative opinion extremity.

Change in Emotion over Time

We used LIWC, a text analysis tool (Pennebaker, Booth, & Francis, 2007), to calculate the degree to which people use different categories of words across texts. We bucketed tweets by quartiles of tweets rather than by equivalent six hour chunks. Thus, bin 1 is the 1st 25% of tweets, bin 2 is the 2nd 25%, bin 3 is the 3rd 25%, and bin 4 is the last quartile. These mapped to bin 1 representing the first 3 hours, 22 minutes (3:22:41), bin 2 the second 3:39:29, bin 3 the third 3:45:32, and bin 4 the last 13:53:06. Bin 4 is longer than the first 3 bins combined.

LIWC returns linguistic output variables along emotional, cognitive, and structural components. We extracted the top three output variables that exhibited the most linear change (measured by slope) over the four time buckets. We were not looking for overall emotion (the overwhelming presence of “anger” and “negative emotion” are not surprising), but instead for changes in emotion—do people get more or less angry, or more or less emotional, over the 24 hours? Table 1 shows three of the top changing variables: anger, negative emotions, and religion. Anger refers to words like “hate”, “kill”, or “annoyed”, negative emotions refers to words like “hurt”, “ugly”, “nasty”, and religion refers to words like “altar”, “church”, “mosque”.

Both anger and negative emotions increase over the 24 hours, while religion decreases. This suggests that the specific topic of religion becomes overridden by emotional conversations of a more personal nature. However, the decline in religion may be because early tweets contained references to “church” where the shooting took place.

GROUP POLARIZATION ON TWITTER

Other output variables that increased consistently are hearing, feeling, money, and home/family references. Output variables that decreased consistently are bio and health, which are indicated by terms like “eating” and “blood”, and “pain”, “clinic”, “flu”, and “pill”. This is likely because early reports of the shooting also referenced the clinic that Dr. Tiller ran, which were soon replaced by stories about people’s own feelings and reactions to the shooting.

We returned to every reply pair user account one month after the shooting, between June 28th and June 30th 2009, to see how many users were still talking about abortion. We looked at their most recent 20 tweets and noted references to abortion specifically, as well as general political and ideological references. Of 1,137 accounts, fewer than ten referenced abortion directly, and 86 referenced broader political and ideological issues in their latest 20 tweets. The frequency of tweeting varied and latest 20 tweets for some users had all occurred on that same day, and for others traced back many weeks. This may suggest that many people who tweeted about the abortion debate simply follow news and engage in conversation about whatever topic is notable and timely.

Discussion

Defining the Group

Individuals have a tendency to disassociate themselves from other members of a group if the group is seen to be low-status, or an outgroup (Sidanius & Pratto, 2001). Outgroup members do not favor their own group the ways that ingroup members do, and may attempt to disassociate themselves from the group (Sidanius & Pratto, 2001). After Dr. Tiller’s death, many pro-life supporters looked to differentiate the shooter from the pro-life group:

GROUP POLARIZATION ON TWITTER

politicalcrunch: @Jillmz Of course this guy wasn't pro life, don't tell me you assign his actions to those who are TRULY pro-life?

BenCalliccoat: @AndyArnold the cheapshot comes in linking anti-abortion with murder of abortionist. Pro-life movement condemns violence; always has.

erickohndotcom: @sbolen Yes, the lunatic who did this is CLEARLY representative of the entire pro life movement. That's a disgustingly gross generalization.

Others tried to disassociate themselves entirely from the stereotypical pro-life position, highlighting that not all pro-life believers share the same ideological and political views:

lardvark: @dardhdilbert Hi. I'm a pro-life NASCAR fan, and very liberal. Not all 'liberals' fit into a specific category. :)

sedilady: @LYCANPEDIA I'[m] pro-life and i'm a christian i don't believe in the death penalty, torture, or preemptive warshow dare u Generalize

missxchelsea: @pandammonia I am pro-life and christian, which means I am against any kind of murder. Don't act like you know my beliefs.

Ingroup and outgroup identification has a long history in political and ideological contexts. Similar to the Dr. Tiller's shooting, the assassination of President John F. Kennedy in 1963 elicited stratification along political lines. In an opinion poll conducted directly after JFK's death, subjects were asked: was there someone or some organization that you hoped would turn out to be responsible?" Respondents indicated who they hoped did not do the shooting (revealing information about whom they would like to see protected rather than harmed) (Banta, 1964):

GROUP POLARIZATION ON TWITTER

- *I hoped that whoever had done it hadn't been a Communist or foreigner or a conservative. (R)*
- *President Kennedy was to speak against the right wing. I was afraid that it might be a “right wing” radical. (R)*
- *Just that it wasn't a U. S. citizen, as that is barbaric (D)*
- *I hoped it would not be a Negro [sic] and generally hoped it was not an American (D)*

Republicans (R) tended to be protective of the “American”, the right wing, and the conservative. Democrat (D) and independent respondents, on the other hand, showed concern for protection of “Negroes” [sic], “the American”, and the left. The absence of Republican mention of concern for “Negroes” suggests that interest in other people’s well-being is pre-empted when one's own ideological position is threatened. Similarly, in the case of Dr. Tiller’s shooting, people who were not in the threatened position were attentive to the potential threat to a minority group (Banta, 1964):

unfunn: @_kim_ber_ly_ I agree. I am Pro-Choice, but know many decent Pro-Life people. The extremists give them a bad name.

dcalleja: @Miranda_WHTLaw I'm not religious but I am pro-life. A lot of the problem is that people endlessly try to force their views on others.

Studies of social identity show that the need to maintain positive identity leads one to identify with the ingroup—those people who are similar to oneself (Brewer, 1979). Ingroup members are treated favorably, often at the expense of the outgroup. In other words, when group identification becomes salient, people begin to compare themselves to others using categorizations that enable differentiation.

Defining the Individual

One way people protect social identity is by dealing with threats to their identity collectively, by accentuating intragroup homogeneity and emphasizing group solidarity (Haslam, 2004). Low identifiers

GROUP POLARIZATION ON TWITTER

may cope with identity threats by differentiating themselves as individuals from their ingroup members.

By representing their ingroup as relatively heterogeneous, they can disassociate from the group:

```
realet: @bigpieps Way to lump me and the other 99.999% of pro-  
life people who don't kill people in with that cold blooded  
killer. That is perverse.
```

```
mystic23: @liberalchik just saying people i personally know  
(not internet kooks) who are pro-life are not bloodthirsty  
thugs.
```

```
deniPath4Change: @telegantmess I am pro-life. Proud of it. And  
I am NOT a terrorist. #tcot
```

Indeed, one of the most heavily retweeted tweets during the first 24 hours was a message from pro-life supporters:

```
RT @Roseblue: RETWEET THIS UNTIL IT TRENDS RT: Pro-life leaders  
condemn murder of abortionist
```

This tweet was reposted in its entirety 224 times and the first part, containing “Pro-life leaders condemn murder of abortionist”, was reposted 398 times.

Stereotypes, Labels, and Fringe

A number of tweets were extremist in nature, e.g.:

```
phreakwars: @EaglePhotos Charge him with domestic terrorism,  
throw him in Gitmo, and waterboard him.
```

A small number of users were responsible for the majority of the most extreme posts. However, these tweets and users define group boundaries—the occasional extreme post may bound the rest of the group as rational. Indeed, the notion of “fringe” was mentioned a number of times:

GROUP POLARIZATION ON TWITTER

Jillmz: @problemchylde but from my legal background, thoughts on #sotomayor nomination, then #tiller killing, this idea of fringe, defining fringe..

Jenna139: @politicalcrunch my point is that "Fringe" is subjective; just two weeks ago Right was touting polls showing support for pro-life...

sandbar17L @studentactivism It's almost 2010. Time passes. I work in the pro-life movement. No one I know endorses violence. OR [Operation Rescue] is the fringe now.

There were also cases where people looked for confirmation of existing views; confirmation bias connotes the seeking or interpreting of evidence in ways that are partial to existing beliefs or expectations (Nickerson, 1998). The corroboration–extremity effect suggests that even if one were to learn that another had the same reasons for having an opinion, their confidence can still be heightened (Baron, et al., 1996):

sandbar17: @HAHRealEstate The stereotype of pro-life bomber/assassin is ancient history. Pro-life movement works to provide options for women.

dontenvyyou: @LAmale Pro-life Every pro-lifer I knew also knew every way of milking the welfare system

sweetcherry: @bobpick because it's most[ly] the men who are out there causing this pro life craziness...

Opinion corroboration can induce increases in opinion extremity. It does not require the exchange, understanding, evaluation, and integration of persuasive material into one's value or belief system nor does it necessarily require knowledge of others specific actions or opinions (Baron, et al., 1996).

Emotion and Reactions

People reacted to the shooting in a variety of ways. Public reactions to shootings and other significant calamitous events have been studied extensively (Banta, 1964; Greenberg, 1964; Sheatsley & Feldman, 1964). Reactions, in general, appear to follow a well-defined pattern of grief: an initial phase of shock and disbelief; a developing awareness of the loss coupled with feelings of sadness, sorrow, shame, and anger; the onset of physical symptoms such as tears, tenseness, sleeplessness, fatigue; and, finally, a gradual recovery in the course of which these symptoms disappear (Sheatsley & Feldman, 1964).

For example, responses in the blogosphere to recent contentious events showed these patterns, beginning with outrage followed by more polarizing commentary about the cause and impact (PEJ, 2009). After the June 2009 shooting at the Holocaust museum almost 30% of links in the blogosphere were devoted to the topic, primarily turning to the question of who was to blame. The commentary was political and ideological, eliciting references to supremacy, right-wing extremism, left-wing radicalism, and terrorism (PEJ, 2009).

Dr. Tiller's shooting elicited a wide range of emotional responses, from anger to sadness to empathy. (The "sadness" variable remained consistent throughout the 24 hours in our dataset). The limitations of Twitter as a medium for deliberative discourse become apparent and elicited a variety of kinds of emotional responses. Some users became frustrated with the technology:

```
dareyn: @mcentellas I'm not referring to pro-life individuals,  
but the mvmnt leaders and institutions. Twttr prob not the best  
place for this convo.
```


GROUP POLARIZATION ON TWITTER

ncrtt: @dimsie I'm shocked by the number of people who are celebrating such a terrible thing! Far too complex for a 140 letter comment. #tiller

Others grew frustrated with the tenor of the conversation:

suth: @rpinal another common sense tweet: not everyone that's pro-life goes out and murders people. Twitter doesn't seem to understand that...

clare_ification: @GetLabourOut well they obviously arnt pro-life. and let's not kid ourselves- everyone on twitter is taking this murder out on proliferers.

This resulted in some disengaging from dialogue and debate:

dbtoub: @hbshmoie I'm not interested in a debate. Pleas engage another pro-choice person on twitter. Thank you. #prochoice

CelebAnonymous: @joycecutliff what could we possibly say to each other? You're a pro-life hypocrite who believes in the death penalty & murdering doctors.

pinkelephantpun: @southsidehitman You are why the pro-life movement is failing. I'm done with this conversation.

This echoes observations from Kelly et al. that some people refuse to speak to people with opposing views, and instead direct conversation only towards their co-ideologues (Gilbert, et al., 2009). However, the technical constraints on Twitter could exacerbate the effect. The kinds of interactions we observed suggest that Twitter is exposing people to multiple diverse points of view, but that the medium is insufficient for reasoned discourse and debate, instead privileging haste and emotion.

GROUP POLARIZATION ON TWITTER

Banta's opinion poll after JFK's assassination suggest that some people may have felt a sense of pleasure and stimulation from the news reports and conversations of the day, resulting in a simultaneous feeling of guilt (Banta, 1964). Similarly, many on Twitter may have enjoyed the details carried by the mass media and "gorged" themselves on the immediacy and novelty of the story (Banta, 1964):

```
mm mirele: @JennyPennifer It's the same rhetoric. You all but glorified in George #Tiller's death. Spare me the faux outrage.
```

We observed a handful of extreme views in short periods of time; however, a month later, individual tweeting has largely returned to normative behavior with users' preexisting networks. Indeed, the large spike and subsequent decays in tweets following immediately after any event breaks out on Twitter suggests that people enjoy spreading news that is novel and popular.

Twitter affords different kinds of social participation. In the same way a reader has to skim the front page of a physical newspaper to get to the comic section, most Twitter users will be exposed to varied slices of news. Thus, many people may be witnessing diverse conversations, and also participating in topics they otherwise may not have. This can influence how people spread information, how they mutate it, who they talk to, and what they say. The triumvirate of the physical newspaper experience, with an added opportunity for discussion, and constrained by the 140 character limit introduces a new genre of conversation. People may well be exposed to a diversity of opinions on Twitter, and engaging in dialogues with people they otherwise wouldn't have, but we could do better at supporting them in having meaningful, deliberative conversations.

Conclusion

In this case study, we see both homophily and heterogeneity in conversations about abortion. People were more likely to interact with others who share the same views as they do, but they are

GROUP POLARIZATION ON TWITTER

actively engaged with those with whom they disagree. Diversity, discourse, and debate are critical components of society, but during calamitous events, the presence of homophily can help provide social support and emotional recovery (Hurlbert, Haines, & Beggs, 2000); both can play an important role in helping people to both mourn and discuss dramatic events.

Our results suggest that the wide range of interactions that we observed on Twitter may promote positive social outcomes. Sunstein argues that shifts toward a general “public sphere,” without much in the way of enclave deliberation, will decrease the likelihood of extremism and instability, but at the same time produce what may be a stifling uniformity. He suggests that deliberation should be directed in such a way that polarization is a result of learning rather than group dynamics (Sunstein, 2008). Even like-minded people who belong in the same groups will have varied opinions and perspectives such that within-group discussions can lead to debate and a diversity of views.

Surveys of public response immediately after JFK’s assassination show that individuals who contacted more people and spent more time in discussion reported stronger emotional (but not informational) motives for talking with others, and were more likely to say that they felt better after interpersonal contact (Ibrahim, et al., 2008). While individual tweets are not reliable markers of levels of anger, and we did not measure levels of anger or emotion among individuals, future work could examine ways that sites like Twitter can help people contact others in a way that has positive psychological or attitudinal benefits.

Our results suggest a number of directions for future work. We believe this work highlights fundamental issues in designing socio-technical systems. First, people should engage in the exchange of ideas and views among a diverse group. This can be facilitated through cross-linking between ideologically competing groups; this can also limit isolation and social enclaves. Competing views,

including within like-minded groups, should also be promoted. While not all views need to be endorsed within a group, it is important that no single majority view dominates such that members of the group are unable to promote and discuss other ideas. Voting and ranking algorithms can help control this balance. Finally, diversity of viewpoints may well be best promoted by encouraging members from diverse racial, social, and educational backgrounds to participate in discussions. As more and broader demographics use the Internet, from elderly users to rural users, there are opportunities to engage people in more diverse discussions than they did before.

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References

- Abcarian, R. (2009). Abortion fatigue' on both sides as Kansas clinic closes. *Los Angeles Times*.
Retrieved 2009-07-10,
- Adamic, L., & Glance, N. (2005). *The Political Blogosphere and the 2004 U.S. Election: Divided They Blog*. Paper presented at the WWW2005, Japan.
- Bainbridge, W., & Stark, R. (1981). Friendship, religion and the occult: a network study. *Review of Religious Research*, 22, 313-327.
- Banta, T. J. (1964). The Kennedy Assassination: Early Thoughts and Emotions. *The Public Opinion Quarterly*, 28(2), 216-224.
- Baron, R., Hoppe, S., Linneweh, B., & Rogers, D. (1996). Social corroboration and opinion extremity. *Journal of Experimental Social Psychology*, 32, 537-560.
- Barstow, D. (2009). An Abortion Battle, Fought to the Death. *The New York Times*, from <http://www.nytimes.com/2009/07/26/us/26tiller.html>
- Brewer, M. B. (1979). In-group bias in the minimal intergroup situation: A cognitive motivational analysis. *Psychological Bulletin*, 86, 307-324.
- Daniels, J. (2009). *Cyber Racism: White Supremacy Online and the New Attack on Civil Rights*: Rowman & Littlefield.
- Deutschman, P. J., & Danielson, W. A. (1960). Diffusion of knowledge of a major news story. *Journalism Quarterly*, 37, 345-355.
- G.A., C., & S.C., P. (1987). Political friendship in the legislature. *Journal of Politics*, 49, 953-975.

GROUP POLARIZATION ON TWITTER

- Gantz, W., & Trenhom, S. (1979). Why people pass on news: Motivations for diffusion. *Journalism Quarterly*, 56, 365-370.
- Gilbert, E., Bergstrom, T., & Karahalios, K. (2009). *Blogs are Echo Chambers, Blogs are Echo Chambers*. Paper presented at the Proc. HICSS.
- Golder, S. (2009, July 14, 2009). Oprah, Iran and Twitter Growth Retrieved July 24, 2009, 2009, from <http://scottgolder.wordpress.com/2009/07/02/oprah-iran-twitter/>
- Greenberg, B. S. (1964). Diffusion of News of the Kennedy Assassination. *The Public Opinion Quarterly*, 28(2), 225-232.
- Hargittai, E. (2008). The Digital Reproduction of Inequality. In D. Grusky (Ed.), *Social Stratification* (pp. 936-944). Boulder, CO: Westview Press.
- Hargittai, E., Gallo, J., & Kane, M. (2008). Cross-ideological discussions among conservatives and liberal bloggers. *Public Choice*, 134, 67-86.
- Haslam, S. A. (2004). *Psychology in Organizations* Sage Publications Ltd.
- Hurlbert, J., Haines, V., & Beggs, J. (2000). Core networks and tie activation: what kinds of routine networks allocate resources in non-routine situations. *American Sociological Review*, 65, 598-618.
- Ibarra, H. (1992). Homophily and Differential Returns: Sex Differences in Network Structure and Access in an Advertising Firm. *Administrative Science Quarterly*, 37, 422-427.
- Ibrahim, A., Ye, J., & Hoffner, C. (2008). Diffusion of News of the Shuttle Columbia Disaster: The Role of Emotional Responses and Motives for Interpersonal Communication. *Communication Research Reports*, 25(2), 91-101.

GROUP POLARIZATION ON TWITTER

- Kelly, J., Fisher, D., & Smith, M. (2005). *Debate, Division, and Diversity: Political Discourse Networks in USENET Newsgroups*. Paper presented at the Stanford Online Deliberation Conference DIAC'05.
- Krebs, V. (2000). Working in the Connected World. *IHRIM Journal*, 4(2), 89-91.
- Kubey, R., & Peluso, T. (1990). Emotional response as a cause of interpersonal news diffusion: The case of the Space Shuttle Strategy. *Journal of Broadcasting & Electronic Media*, 34, 69-76.
- Lazarsfeld, P., & Merton, R. K. (1954). Friendship as a Social Process: A Substantive and Methodological Analysis. In M. Berger, T. Abel & C. H. Page (Eds.), *Freedom and Control in Modern Society* (pp. 18-66). New York: Van Nostrand.
- McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a Feather: Homophily in Social Networks. *Annual Review Sociology*, 27, 415-444.
- Miller, D. C. (1945). A research note on mass communication: How our community heard about the death of President Roosevelt. *American Sociological Review*, 10(5), 691-694.
- Nickerson, R. (1998). Confirmation Bias: A Ubiquitous Phenomenon in Many Guises,. *Review of General Psychology*, 2(2), 175-220.
- Palen, L., & Liu, S. B. (2007). *Citizen communications in crisis: anticipating a future of ICT-supported public participation*. Paper presented at the Proceedings of the SIGCHI conference on Human factors in computing systems.
- PB Gerstenfield, D. G., CP Chiang (2003). *Hate online: A content analysis of extremist internet sites*: Blackwell Publishers.

GROUP POLARIZATION ON TWITTER

PEJ (2009). Political Extremism (at Home and Abroad) Dominates the Blogosphere. (6/10/09).

Retrieved from

http://www.journalism.org/index_report/political_extremism_home_and_abroad_dominates_blogosphere

Pennebaker, J. W., Booth, R. J., & Francis, M. E. (2007). *Linguistic Inquiry and Word Count (LIWC2007): A text analysis program*. Austin, TX.

Schafer, J. (2002). Spinning the web of hate: Web-based hate propagation by extremist organizations. *Journal of Criminal Justice and Popular Culture*.

Sheatsley, P. B., & Feldman, J. J. (1964). The Assassination of President Kennedy: A Preliminary Report on Public Relations and Behavior. *Public Opinion Quarterly* 28, 189-215.

Sidanius, J., & Pratto, F. (2001). *Social Dominance: An Intergroup Theory of Social Hierarchy and Oppression* Cambridge, UK: Cambridge University Press.

Stumpe, J., & Davey, M. (2009, May 31, 2009). Abortion Doctor Shot to Death in Kansas Church. *The New York Times*, from <http://www.nytimes.com/2009/06/01/us/01tiller.html>

Sunstein, C. (2001). *Republic.com*: Princeton University Press.

Sunstein, C. (2008). The Law of Group Polarization. In J. S. Fishkin & P. Laslett (Eds.), *Debating Deliberative Democracy*: Blackwell Publishing Ltd.

GROUP POLARIZATION ON TWITTER

Table 1

Linguistic patterns binned by quartile.

	1 st	2 nd	3 rd	4 th
anger	2.66	3.19	3.25	3.54
negemo	3.84	4.4	4.64	4.71
religion	3	1.52	1.41	1.39

GROUP POLARIZATION ON TWITTER

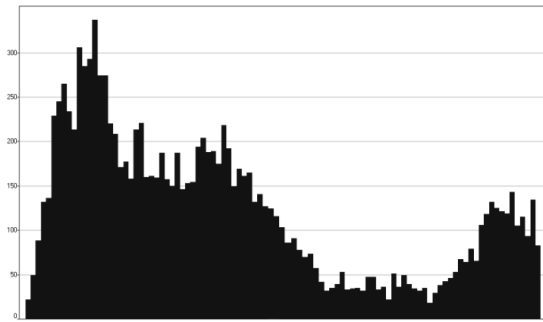


Figure 1. Number of tweets about Dr. Tiller shooting over the first 24 hours after the event.

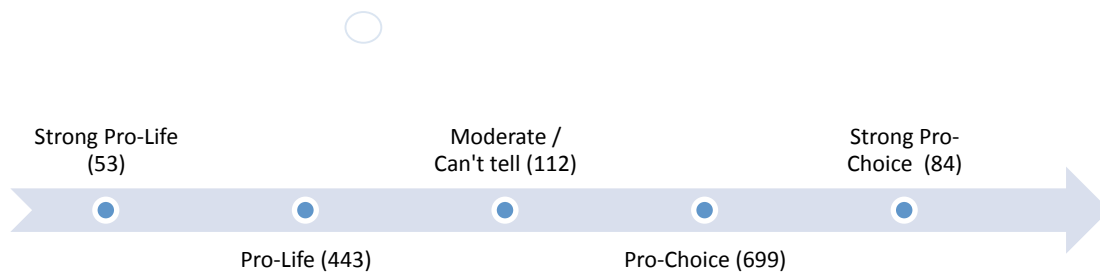


Figure 2. Replier position on abortion (n=1,391).

GROUP POLARIZATION ON TWITTER

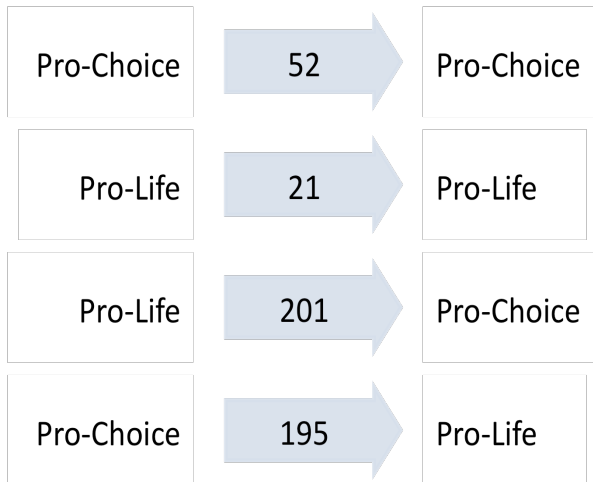


Figure 3. Number of like-minded reply pairs (top two rows) and number of opposite-minded reply pairs (bottom two rows).

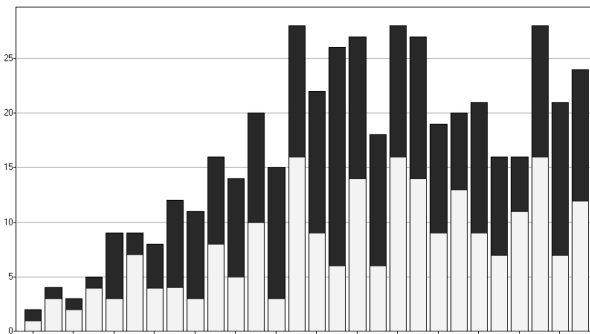


Figure 4. Ratio of like-minded (light) to opposite-minded (dark) replies over the first 24 hours (n=1,137).

GROUP POLARIZATION ON TWITTER

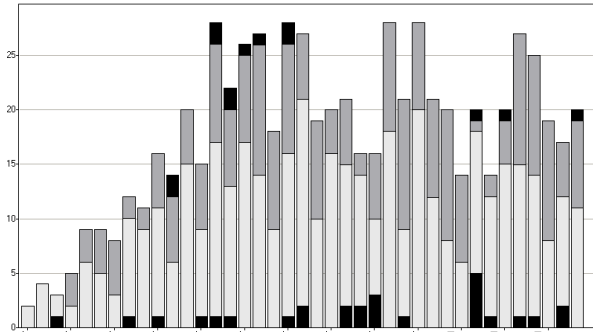


Figure 5. Number of extreme pro-choice (dark bottom bars), extreme pro-life (dark top), pro-choice (light bottom), and pro-life (light top) over the first 24 hours (n=1,137).