



# A WINDOW ONTO GUN VIOLENCE

Gang-related shootings plague many US cities, and researchers are trying to tackle the problem using artificial intelligence.

In the middle of the day on 11 April 2014, a hooded gunman ambushed Gakirah Barnes on the streets of Chicago's South Side. A volley of bullets struck her in the chest, jaw and neck. The 17-year-old died in a hospital bed two hours later.

To many, her death was just another grim statistic from a city that has been struggling with gun violence. Last year, around 3,500 people were shot in Chicago, Illinois, of which 246 were aged 16 or younger; 38 of those children never celebrated another birthday.

But Barnes's death was unusual for several reasons. She was a young woman in an epidemic of violence that largely affects black men. She also had an Internet following. Barnes had a reputation as a 'hitta' — or killer — with rumours of at least two dead bodies

BY ROD MCCULLOM

to her credit. Although never charged with murder, she embraced the persona, posing in photos and videos with guns in her hands and making threats against rival gangs on Twitter. In a morbid modern irony, it's likely that she revealed her location in real time to her killer through a tweet. Police have yet to charge anyone in connection with her murder.

Desmond Upton Patton was sitting in his office at the University of Michigan in Ann Arbor when he first saw the headlines about Barnes. The social worker had been studying 'Internet banging', or 'cyberbanging', the use of social media by gang-involved youths to challenge, taunt or threaten rivals<sup>1</sup>. The online disputes can often spill out into the

streets as physical violence.

Patton took a deep dive into Barnes's archived Twitter timeline and discovered a treasure trove of social-media data — random thoughts as well as boasts, threats and violent imagery. But what surprised him most, he says, was the grief. "My pain ain't never been told," Barnes wrote after a friend was killed just weeks before her own death.

What emerged from her timeline was a picture of a teenage girl who lived in a community steeped in violence, who was deeply hurt by it and who wanted revenge. Now at the Columbia School of Social Work in New York City, Patton thinks that social-media histories such as that of Barnes can offer ways to identify young people at risk of being involved in gun violence. He assembled an interdisciplinary group of

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**Gang-related graffiti in Chicago, where around 3,500 people were shot last year — 246 were minors.**

researchers who use artificial-intelligence (AI) techniques to study the language and images in social-media posts to identify patterns of grieving and anger.

By developing tools to automatically recognize these telltale emotional signs, Patton hopes to provide a way for community organizations to intervene before digital fights turn deadly. Programmes in Chicago are starting to take notice. “Our violence-prevention outreach has to change because gangs have changed,” says Eddie Bocanegra, senior director of READI Chicago, an initiative aimed at reducing gun violence.

### GUN VIOLENCE AND SOCIAL MEDIA

The United States leads the world in gun violence against children. About 1,300 minors die in shootings each year and another 5,800 are injured, according to researchers at the US Centers for Disease Control and Prevention<sup>2</sup>. Gun-related injuries are the third leading cause of death for children aged 17 and younger. And the death rate for African American children is ten times higher than for white and Asian American children.

Patton and others have found that social media has exacerbated gun violence among young people and changed how gangs recruit members, conduct business and initiate violence. It has become an acute problem in Chicago, Patton says, where street gangs have splintered into small, unruly crews with younger members who often settle minor disputes — such as insults on social media — with deadly force.

Violence and grief are common themes in Barnes’s online and offline history. Between December 2011 and her death in 2014, she tweeted nearly 27,000 times. She adopted Facebook and Twitter names that paid homage to slain friends, and she vowed vengeance on their killers.

Barnes started hanging around with a local street crew in her early teens. In early 2011, a friend, Shondale ‘Tooka’ Gregory, was killed by gunfire while waiting for a bus. He was 15 years old. The crew started to refer to its territory as ‘Tookaville’ in memoriam, and Barnes began using ‘Tookaville’kirah’ as her Facebook name.

Later that year, when a member of a rival gang, 20-year-old Odee Perry, was killed just blocks away, Internet chatter suggested that Barnes was the shooter. She neither confirmed nor denied the speculation, which probably enhanced her online mystique.

In a survey of young black people in Chicago, nearly half reported that they had witnessed a gang-related killing<sup>3</sup>. Such experiences are especially detrimental to the adolescent brain, which is still developing, says Karen Sheehan, a paediatric emergency-room physician and professor at Lurie Children’s Hospital and Northwestern University’s Feinberg School of

Medicine in Chicago. It affects the frontal lobe, she says, and diminishes the capacity to make good decisions. And the stress of grieving can exacerbate these deficiencies.

In 2012, Barnes experienced another tough loss. She witnessed first-hand as Tyquan Tyler, a 13-year-old boy and close friend, was killed by a stray bullet at a neighbourhood party. Barnes changed her Twitter username to ‘TyquanAssassin’ in memoriam, and her activity on the platform increased considerably.

Patton was most interested in the posts Barnes made in the days leading up to her own death. On 28 March 2014, 19-year-old Raason ‘Lil B’ Shaw, a member of her crew, was killed by Chicago police after he allegedly pointed a handgun at them during a foot chase. It was on the same street where Tyler had died, and Barnes was soon expressing her profound grief online. She renamed her twitter profile ‘No Surrender Lil B’ and tweeted darkly, presciently, “In da end we DIE,” on 10 April. The very next day, Barnes was dead.

## “OUR RESEARCH HOPES TO SHOW THERE ARE PATHWAYS TO VIOLENCE.”

### GRIEF AND LOSS

The deaths of Shaw and Barnes helped motivate Patton to develop SAFELab, a research initiative that explores how urban youth of colour navigate their lives and express violence across social media. Patton and his team looked closely at 2,256 tweets posted in the weeks surrounding the killings from 235 unique users, all interacting with Barnes and her network<sup>4</sup>. Patton’s goal was to sort tweets into categories. There were those expressing loss — including expressions of grief or sadness and descriptions of trauma, death or incarceration. And there were others signalling aggression — insults and threats of violence or the desire for revenge. Tweets that did not include features of aggression or loss were assigned to a catch-all category.

What the researchers found was a regular pattern of grief leading to aggression, often as rivals taunted those in pain or used language or imagery meant to minimize the loss of a friend or insult the dead. “They’re going through a grieving process, and part of that process is anger and disbelief,” says Patton. “Rival crews or gangs are interrupting the process. That heightens the conversation over time.”

For example, one member of Barnes’s crew tweeted shortly after Shaw’s death, “Opps in

trouble, we want blood.” Shaw was killed by police officers, but his fellow crew members were enraged and wanted to take out their anger on an opposition, or ‘opps’, crew. A rival tweeted back, “come on our block mfs we want dis shit.” (Original postings have been altered by SAFELab to protect the identity of the users.)

Patton’s team found that expressions of grief significantly correlated with subsequent aggressive tweets, which happened about two days later, on average. Those two days could be a crucial window for a virtual or clinical intervention by counsellors, social workers or mental-health professionals, the researchers think. But combing through masses of Twitter traffic to detect and identify such signs of danger would be impossible. So Patton asked Columbia’s Department of Computer Sciences to explore automating the search. The challenge caught the attention of Kathleen McKeown, a natural-language-processing specialist and founding director of the Data Science Institute at Columbia University in New York City.

Internet banging has its own distinctive lingua franca, which Patton describes as “a combination of African American vernacular English, social-media speak and brilliant uses of punctuation and numbers”.

It was “very different than any language that I had ever worked on,” says McKeown. To assist the computational interpretation, the team brought in violence specialists — individuals formerly involved with gangs — to annotate hundreds of tweets. Some of the translation was fairly obvious. A gun emoji and a devil face, for example, represent potential threats, and a phrase like “Got da Smithy on Me Right Na” would mean “I’m carrying a Smith & Wesson handgun.” Other phrases were more opaque. “Keta smoking and thinkin of Lil B,” was a tweet mourning the loss of Shaw, but also meant to disrespect a rival gang member who had been killed (see ‘Tweet translations’).

McKeown’s group created a tool that could translate words and phrases. “We developed a bilingual dictionary,” she says.

The first test runs of the tool accurately identified expressions of loss and grief 62% of the time, says Patton. By the time they published the research, this measure had improved. “We’ll never be at 100% because social media is always changing and the language is often new. But this is very high for data science,” Patton says.

They expanded the data set to include about 2 million tweets among 9,000 users, and the team is now training an additional AI application on the images that accompany posts. The researchers want to develop an AI application that can accurately identify grief and sadness even from facial expressions.

“The dominant narrative is that violence is a one-time incident like a finite moment in time. Our research hopes to show there are pathways to violence,” says William R. Frey, a doctoral student who is mentored by Patton and is the coordinator of SAFELab.

Research suggests that grief and grievances

## TWEET TRANSLATIONS

SAFELab works with community organizations and people formerly involved with gangs to evaluate and contextualize tweets and images posted by young people in Chicago, Illinois.

## ANNOTATION AND LABELLING

The team marked up thousands of tweets and images and then labelled them as pertaining to loss, aggression or other themes.

RIP (rest in peace) and BIP (ball in paradise) comes up commonly in tweets about loss.

The team added boxes around parts of images pertaining to drugs, firearms, gang affiliations (such as hand gestures and tattoos) and more.

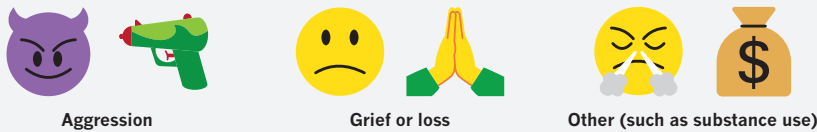
Names provide clear links to real events and people.

People involved in gangs sometimes name the drugs they use after dead rivals; to 'smoke' them is a sign of disrespect.

Emojis can provide additional context for things such as aggression (devil face) and drug use (blowing smoke).

## MACHINE LEARNING

Labelled tweets are used to train natural-language-processing and computer-vision models, which sort novel tweets into categories such as loss and aggression.



are data points along the road to violence, says Gene Deisinger, a psychologist, retired police officer and threat-management expert who has advised organizations and government agencies on how to identify and manage risks of violent behaviour. “We’ve learned that when a person fixates [on] the need for a violent resolution, that does increase the risk of violence.”

Deisinger sees some similarities between Patton’s research and threat-assessment activities. “You can actually develop some robust models of prediction of human behaviour such as what proportion of the group will escalate to violent behaviour. It still begs the question of what any individual will do,” says Deisinger. He cautions against using group outcomes and predictions, particularly where taking action might interfere with constitutional rights.

## EARLY INTERVENTIONS

Chicago has proved an ideal setting for Patton’s experiments; the city has become a laboratory for strategies aiming to prevent injuries and deaths from gunshots. Cure Violence, a programme founded by epidemiologist Gary Slutkin at the University of Illinois at Chicago, aims to treat gun violence as if it were an infectious disease. It monitors activity and intervenes to interrupt the spread of gun violence, treats high-risk individuals and educates the

community about prevention. READI Chicago offers employment opportunities, cognitive behavioural therapy and support services for young men at highest risk of violence.

One initiative that began in 2016 is the Institute for Nonviolence Chicago (INV), which was founded by Teny Gross, formerly of the Israel Defense Forces. He is aiming to partner with SAFELab to conduct field research on some of the intervention tools that Patton’s group is creating.

INV has a hyper-local approach that organizes the community around the non-violent principles advocated by Martin Luther King Jr. Its 25 outreach workers follow chatter on social media, but they have a limited reach, says David Cassel, INV’s director of strategy and organizational advancement. “They see conflicts happening in social media and then see the actual gun violence in the community. But it’s very difficult for them to monitor social media and do their jobs,” says Cassel. The organization hopes to get funding to test strategies for using SAFELab’s tools, possibly to send automatic alerts to case workers, who could then contact people at risk of carrying out retaliatory attacks.

Patton’s SAFELab project joins a growing body of research that uses AI and social data to predict public-health outcomes. An application called nEmesis, for example, developed by the

University of Rochester in New York, also uses AI and natural-language processing to search Twitter. This program looks for tweets about food poisoning to help identify the source of an outbreak for public-health investigators.

The University of California Institute for Prediction Technology, based in Los Angeles, has been working on another problem. Scientists have used a statistical model and machine learning to predict heroin overdoses on the basis of Google searches for prescription and non-prescription opioids<sup>5</sup>.

The study’s lead author, Sean Young, says that Patton’s research is “very promising”, but he suggests there are some limitations. “How do we get a sense of the validity of the information?” he asks. How does one separate real threats from boastful swagger?

Patton acknowledges there is a degree of showmanship on social media. “People who live in communities impacted by violence may present themselves as being in a gang, but they are simply acting or performing,” he says.

As SAFELab and INV look to secure funding for developing and testing tools for the real world, Patton and his colleagues hope that they can learn more from the short life of Gakirah Barnes and others like her. They have several new projects, he says, “including expanding Twitter analysis beyond aggression and grief to look at other factors associated with youth gun violence, such as substance use and mental health”. Members of the team are now using network analysis to look at the links between online chatter and real-world behaviour. They are also experimenting with virtual reality to teach young people how to navigate social media and limit their exposure to violence.

Patton worries that some people might try to use social-media data in a discriminatory way by improperly trying to predict problems and even police activity in marginalized communities. But he sees many more positive aspects to the work: “I think the power of social media is that it gives you depth, vulnerability and multiple perspectives.” He sees young people relating to each other and seeking out comfort and support. Strengthening positive connections in the community could be important for preventing the kind of violence that has ended so many young lives. He also hopes to broaden the discussion beyond violence. “With Gakirah, of course, we found a young woman who loved, who hurt, who was excited and who was in pain. That’s a normal person, not just a gang member.” ■

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