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Google Flu Trends: The Limits of Big Data

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Google Flu Trends, once a poster child for the power of big-data analysis, seems to be under attack.

This month, in a Science magazine article, four quantitatively adept social scientists reported that Google's flu-tracking service not only wildly overestimated the number of flu cases in the United States in the 2012-13 flu season — a well-known miss — but has also consistently overshot in the last few years. Google Flu Trends' estimate for the 2011-12 flu season was more than 50 percent higher than the cases reported by the Centers for Disease Control and Prevention. And, they wrote, for a period of more than two years ending in September 2013, the Google estimates were high in 100 out of 108 weeks.

The article, "The Parable of Google Flu: Traps in Big Data Analysis," declared that Google was guilty of "big data hubris," which the authors defined as the implicit assumption that big data sets trump traditional data collection and analysis. And they were skeptical of Google Flu Trends' algorithmic smarts. "The comparative value of the algorithm as a stand-alone flu monitor is questionable," they wrote.

A follow-up analysis by the four authors tracked Google Flu Trends' performance in the just-concluded 2013-14 flu season, after Google updated its

algorithm last October. There was some improvement, but the service still overshot by about 30 percent, the authors wrote, in their paper, posted online.

The authors' analysis found that simply using the recent trend of C.D.C. reports from doctors on influenza-like illness, which lag by two weeks, would have been a more accurate predictor than Google Flu Trends.

The authors might appear to be unlikely critics of a tool like Google Flu Trends. "We're fans of big data and the use of data science," said Alessandro Vespignani, a professor at Northeastern University. David Lazer is a professor at Northeastern, and Ryan Kennedy, an assistant professor at the University of Houston, has a yearlong research fellowship in computational social science at Northeastern. They have affiliate links with Harvard University's Institute for Quantitative Social Science, whose director, Gary King, is the fourth author.

Their technical criticism of Google Flu Trends is that it is not using a broader array of data analysis tools. Indeed, their analysis shows that combining Google Flu Trends with C.D.C. data, and applying a few tweaking techniques, works best. "The mash-up is the way to go," Mr. Lazer said.

Matt Mohebbi, co-inventor of Google Flu Trends, agrees. Much of the current criticism, in his view, misses the point that the service was always intended as a "complementary signal" rather than a stand-alone forecasting tool.

"I think we were consistent in the way we communicated that from the outset," Mr. Mohebbi said. He left Google in 2013 and is a co-founder of Iodine, a start-up that will use data science for a consumer health service, to provide personalized advice on medications.

Yet respected authors and academics often pointed to Google Flu Trends as proof of the triumph of the big data approach. Tracking 45 flu-related search terms over billions of searches, monitoring trends and making correlations would win out. Google could tap the "collective intelligence" of society in real time, free of the human bias and hypotheses of traditional methods.

The authors of the recent articles were partly motivated by the desire to puncture that notion. "Google Flu Trends became this paradigm that you just look at

all this data, make correlations, and we don't need anything else," Mr. Vespignani said.

Google Flu Trends was introduced in the fall of 2008, having started long before as a Google 20 percent project begun by Mr. Mohebbi and Jeremy Ginsberg. In an article in Nature in 2009, the two were among the co-authors who explained Google Flu Trends. "This system," they wrote, "is not designed to be a replacement for traditional surveillance networks or supplant the need for laboratory-based diagnoses and surveillance."

What it could do, they wrote, is give an early-warning signal of flu outbreaks one to two weeks ahead of the C.D.C. surveillance reports. In the 2009 Nature paper, they showed that it had given that advance indication in the 2007-08 flu season — and that it would again during the 2009 H1N1 outbreak.

"It gives you that near real-time signal," Mr. Mohebbi said, "and it has proven that it does add value."

"We're only at the beginning of what's possible with this big-data-style analysis," he added. "And big data and small data are both very important."

In a statement, a representative for Google Flu Trends, which now monitors 29 countries, said the service was reviewed every year, with improvements in mind. "We welcome feedback on how we can refine Flu Trends to help estimate flu levels and complement existing surveillance systems."

The two recent papers by the computational social scientists are part analysis and part commentary. Mr. King said one of the issues raised is the data reversal that has occurred in science. "It used to be that academics has way more data than companies," he said. "But that has flipped now."

In the paper, the authors wrote of the need for researchers to be able nonetheless to study the "evolution of sociotechnical systems" — and the work of data-driven algorithms of private companies with far-reaching influence. That includes a field like public health and the proprietary software engine beneath Google Flu Trends.

"The algorithms underlying Google, Twitter and Facebook," they wrote, "help determine what we find out about our health, politics and friends."

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