

When it comes to eyewitness accounts of earthquake shaking, representation matters

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As scientists increasingly rely on eyewitness accounts of earthquake shaking reported through online systems, they should consider whether those accounts are societally and spatially representative for an event,

according to a new paper published in *Seismological Research Letters*.

Socioeconomic factors can play a significant if complex role in limiting who uses systems such as the U.S. Geological Survey's "Did You Feel It?" (DYFI) to report [earthquake](#) shaking. In California, for instance, researchers concluded that DYFI appears to gather data across a wide socioeconomic range, albeit with some intriguing differences related to neighborhood income levels during earthquakes such as the 1989 Loma Prieta, the 1994 Northridge and 2018 Ridgecrest earthquakes.

In India, by contrast, stark gaps in literacy and urban versus [rural communities](#) can lead to gaps in self-reported earthquake accounts though DYFI, write Susan Hough of the USGS and Stacey Martin of Australian National University.

Previous studies have looked at the reasons why people respond to DYFI, including a 2016 publication by Sum Mak and Danijel Schorlemmer. But socioeconomic differences in who reports earthquake shaking "is a factor we haven't thought enough about, even though it is shaping the [data sets](#) that are available, especially outside of the United States" said Hough.

Intensity data gleaned from DYFI are used to develop ShakeMap representations of ground motion in places with sparse instrumentation. ShakeMap in turn informs the Prompt Assessment of Global Earthquakes for Response (PAGER) system that provides crucial rapid information for earthquake response.

"The end result is that we are relying on unrepresentative [DYFI] data to flesh out ShakeMaps for large global earthquakes," Hough noted. "If the data are limited and unrepresentative, PAGER may not give emergency managers a good indication of where to direct their resources."

"I know many who take the DYFI observations from outside the United States at face value without any scrutiny and made the incorrect assumption that that's all there is to the story," Martin added. "As we've shown in this study, that would be a really inappropriate assumption."

Representation can also come into play when scientists rely on archival accounts to study historic earthquakes. Hough described the potential impact of unrepresentative earthquake reports in an earlier study when she and her colleague Morgan Page found a letter published in an Arkansas newspaper that helped to re-locate an 1882 earthquake within the Choctaw Nation in southeastern Oklahoma. The single chance [account](#) has helped seismologists better understand historical seismicity in Oklahoma, but there are still many "unknown unknowns" about earthquakes in the region during and after the 1882 event because Native American accounts are unavailable, Hough said.

When Hough and Martin compared DYFI responses with ZIP code [average household income](#) for the three California earthquakes, the researchers uncovered some complex and intriguing trends. For the Northridge earthquake, for instance, relatively affluent areas were more likely to contribute strong shaking reports, and strong shaking levels from poorer areas may be underrepresented in the DYFI data.

The researchers found that in India, DYFI reports skewed heavily toward urban individuals and depended strongly on a region's literacy rates. In some cases, the difference between DYFI self-reports and accounts gathered through traditional means such as local press accounts was significant. For the 2015 Gorkha earthquake, for instance, 74% of DYFI responses were from urban areas, while only 34% of traditional accounts were from urban centers.

"Being Indian, I know firsthand that there are disparities on numerous fronts in my country," said Martin. "Nonetheless the stark contrast in

urban and rural DYFI reports from India for the three earthquakes that were analyzed for this study was still surprising to me. I did not anticipate that the social disparities would show up in something as seemingly far removed as earthquake felt reports."

Further development of online systems will potentially make them more inclusive; for example, including online surveys in multiple languages, and designing easy-to-use apps. It also remains important, the researchers said, to survey earthquake effects using media reports, which the study showed tend to be more inclusive in India.

Hough noted that the geoscience community is grappling with how underrepresentation affects its workforce, but studies like this show how underrepresentation "is actually an issue for science itself."

"You can connect the dots, I think," she said. "If you don't have a diverse community of scientists, you don't have people who are asking the right questions."

More information: Susan E. Hough et al, Which Earthquake Accounts Matter?, *Seismological Research Letters* (2021). [DOI: 10.1785/0220200366](https://doi.org/10.1785/0220200366)

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