

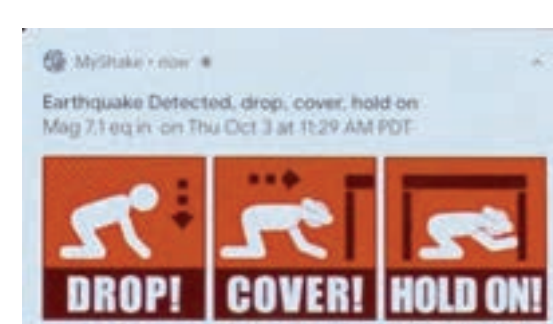
Michele L. Cooke², Audrey C. Cooper¹, Kota Takayama¹, Danielle F. Sumy³ and Sara K. McBride⁴

1. Gallaudet University | 2. University of Massachusetts, Amherst | 3. National Science Foundation | 4. U.S. Geological Survey

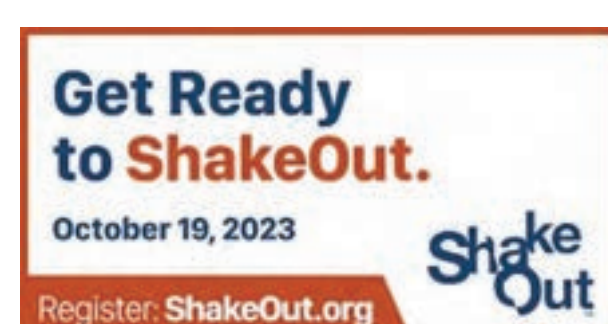
Goals of Earthquake Early Warning (EEW)

EEW alerts may give people valuable seconds to take protective action, such as drop, cover and hold on, before earthquake shaking starts.

Receive the alert: Alert delivery includes: public systems (audible sirens, TV, AM/FM/radio, weather radio) and text-based/SMS messaging, which can be programmed to alert the receiver via audio or vibratory signaling (or haptics)



Understand the message: Both text and images communicate alert more effectively than text alone (Dallo et al., 2022, Sutton et al., 2023). WEA limited to 2 lines of text.



Know what to do: Public outreach & drills, such as ShakeOut, have been effective education approaches (e.g., McBride et al. 2019)

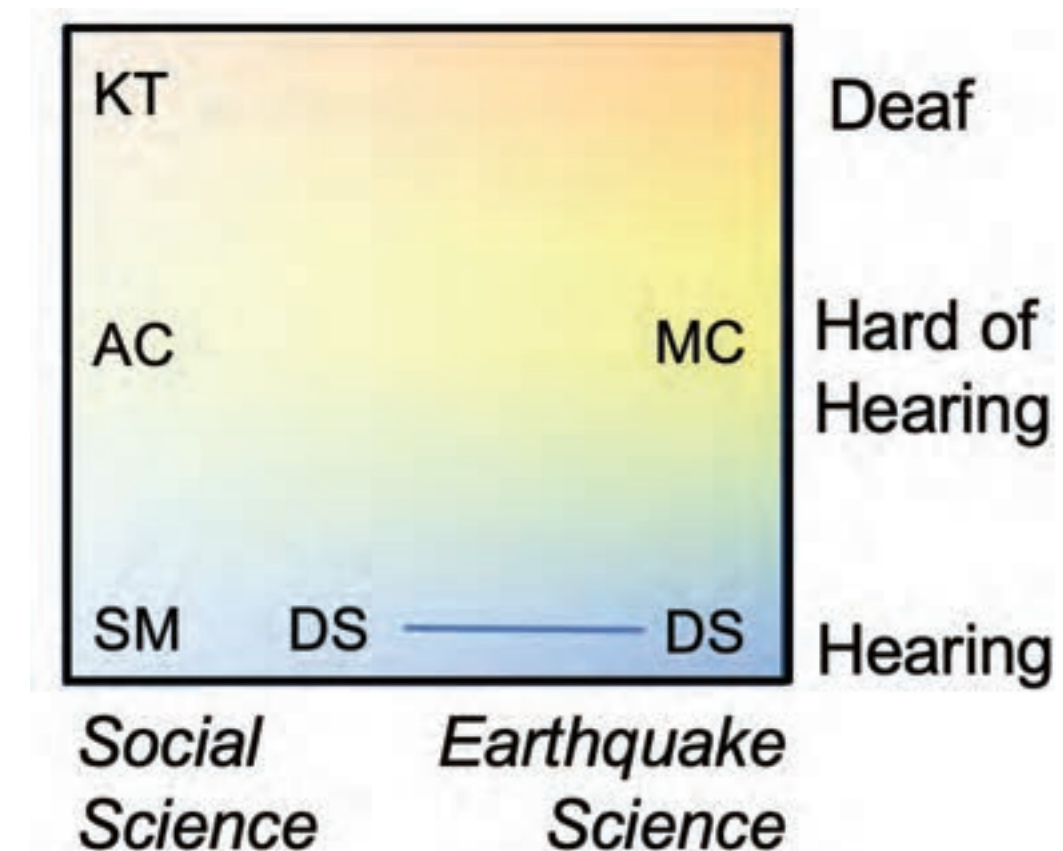
Is EEW accessible to Deaf and Hard of Hearing (DHH+)?

We use 'DHH+' to indicate that individuals can have multiple identities and disabilities that include deafness.

UN global disaster risk reduction targets accessibility of multihazard early warning systems by 2030 (2015 Sendai Framework for DRR)

Positionality

Transdisciplinary team spans DHH+ identity and uses multiple language modes



Languages used in this collaboration

- Kota Takayama (KT) ASL and English
- Audrey Cooper (AC) ASL and English
- Michele Cooke (MC) ASL and English
- Danielle Sumy (DS) English
- Sara McBride (SM) English

DHH+ Earthquake Disaster Experiences

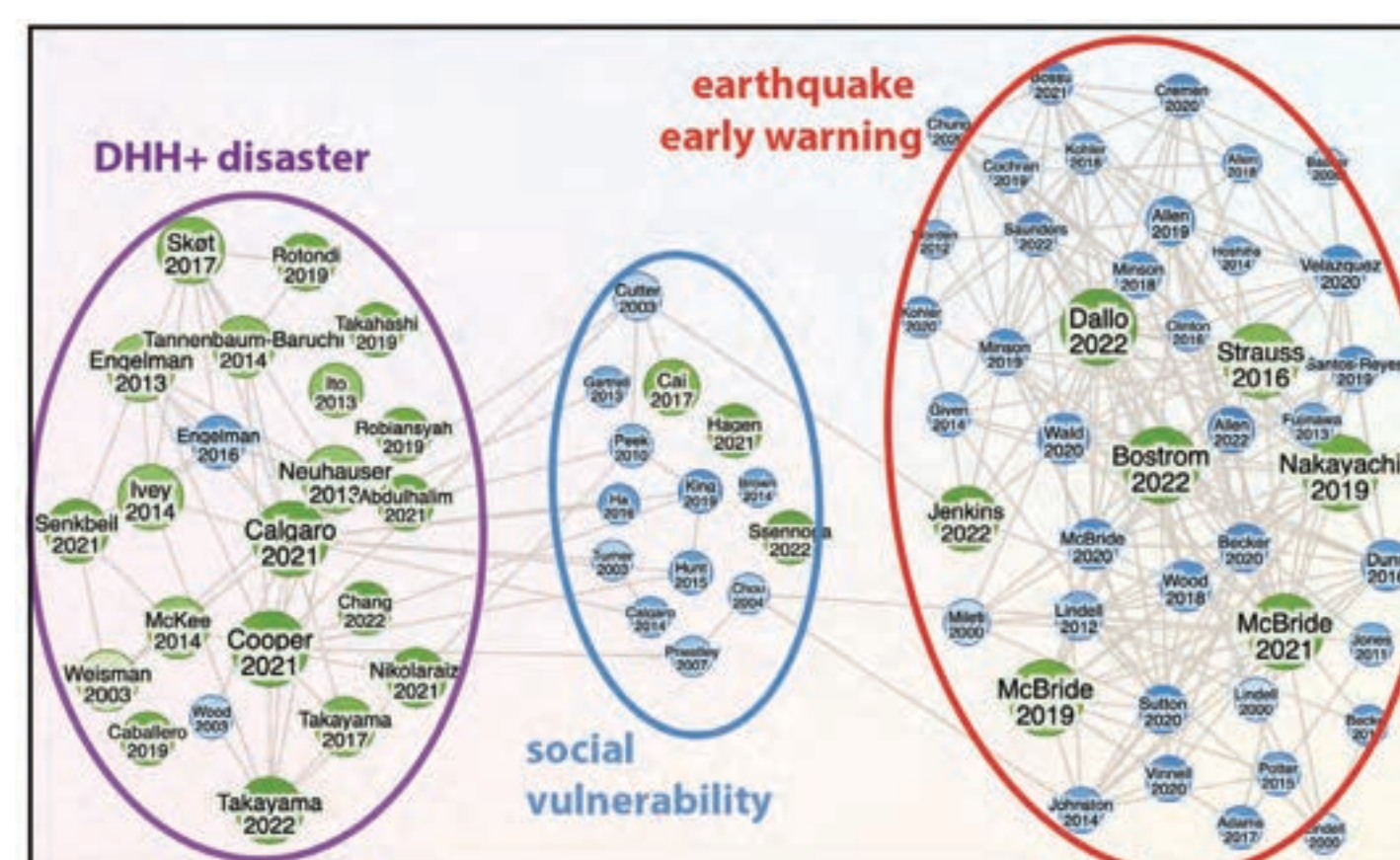
DHH+ persons are more vulnerable to earthquakes than hearing persons

| | Mortalities from 1995 Kobe earthquake (and subsequent fires) | Mortalities from 2011 Tohoku earthquake (and tsunami) |
|---------|--|---|
| Hearing | 0.17% | All citizens 1.03% |
| Deaf | 0.76% | Deaf 2.00% |

data from Takayama, 2017

DHH+ individuals are more likely to receive information on disaster relief from personal networks in deaf communities than from public channels. DHH+ people who do not have deaf community networks, would be a population at risk (Takayama, 2017).

Literature review revealed no papers on EEW and DHH+ experiences.



Research Rabbit literature map using papers discovered in Web of Science (green circles)

Language Equity provides valuable lens

- DHH+ disproportionately impacted by hazards primarily due to language barriers (e.g. Calgareo, 2021, Takayama, 2017).
- Access to disaster information and preparedness activities reflects prevailing structural barriers (e.g., Takayama, 2017).



Lessons learned from disaster alerts



Haptic alerts not as effective as auditory alerts at rousing from sleep. Deaf slept through haptic missile alerts in Israel (Tannenbaum-Barusch, 2014).
Three long vibrations, may be more effective at alerting DHH+ than other signals (Harkins et al., 2010)



DHH+ persons had greater hesitancy and uncertainty about taking protective action and rely on a greater number of information sources than hearing people (Senkbeil et al. 2021).



DHH+ persons often sought shelter after observing behavior of others around them, but not necessarily based on understanding of a specific disaster threat (Tannenbaum-Baruchi et al., 2014 & 2024).



Preparedness materials not available in signed languages
Most DHH+ students attend hearing schools -- might not benefit from drills designed for hearing students.

Most DHH+ are born into hearing families -exclusion from incidental conversations about earthquake preparedness.



Call to Action

- EEW evaluation and research led by DHH+
- DHH+ community engagement & education on earthquake preparation
- Policy advancements that consider language equity
- Transdisciplinary efforts required to advance accessibility of EEW

To see references and learn more, access our recent open access paper Natural Hazards at the QR code



Cooper et al. 2024, From Alert to Action: Earthquake Early Warning & Deaf Communities, Natural hazards <https://doi.org/10.1007/s11069-024-06719-6>