

Listening to bipolar disorder: Smartphone app detects mood swings via voice analysis

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Bipolar disorder is characterized by transitions between depression and mania.
Credit: Wikipedia

A smartphone app that monitors subtle qualities of a person's voice

during everyday phone conversations shows promise for detecting early signs of mood changes in people with bipolar disorder, a University of Michigan team reports.

While the app still needs much testing before widespread use, early results from a small group of patients show its potential to monitor moods while protecting privacy.

The researchers hope the app will eventually give people with bipolar disorder and their health care teams an early warning of the changing moods that give the condition its name. The technology could also help people with other conditions.

More patients, all taking part in the study funded by the National Institute of Mental Health and facilitated by the Prechter Bipolar Research Fund at the U-M Depression Center, have already started to use the app on study-provided smartphones. As more patients volunteer, the team will continue to test and improve the technology.

The U-M team, led by computer scientists Zahi Karam, Ph.D. and Emily Mower Provost, Ph.D., and psychiatrist Melvin McInnis, M.D., presented its first findings today at the International Conference on Acoustics, Speech and Signal Processing in Italy, and published details simultaneously in the conference proceedings.

They call the project PRIORI, because they hope it will yield a biological marker to prioritize bipolar disorder care to those who need it most urgently to stabilize their moods – especially in regions of the world with scarce [mental health](#) services. Bipolar disorder affects tens of millions of people worldwide, and can have devastating effects including suicide.

But first, based on these encouraging findings, the technology and

algorithms will be developed via research involving 60 American patients who receive treatment from U-M teams at the nation's first center devoted to depression and related disorders.

"These pilot study results give us preliminary proof of the concept that we can detect mood states in regular phone calls by analyzing broad features and properties of speech, without violating the privacy of those conversations," says Karam, a postdoctoral fellow and specialist in machine learning and speech analysis. "As we collect more data the model will become better, and our ultimate goal is to be able to anticipate swings, so that it may be possible to intervene early."

Adds McInnis, a bipolar specialist, "This is tremendously exciting not only as a technical achievement, but also as an illustration of what the marriage of mental health research, engineering and innovative research funding can make possible."

He adds, "The ability to predict mood changes with sufficient advance time to intervene would be an enormously valuable biomarker for bipolar disorder."

He notes that the initial seed funding for the voice technology research came from the Michigan Institute for Clinical and Health Research. The ready source of patient-volunteers came from a Prechter Fund-supported registry, and the new early results were made possible by NIMH funding.

The research team hails from the Department of Psychiatry at the U-M Medical School and the Division of Computer Science and Engineering in the Department of Electrical and Computer Engineering at the U-M College of Engineering. It includes Satinder Singh, Ph.D. an artificial intelligence and machine learning expert.

How it works

The app runs in the background on an ordinary smartphone, and automatically monitors the patients' voice patterns during any calls made as well as during weekly conversations with a member of the patient's care team. The computer program analyzes many characteristics of the sounds – and silences – of each conversation.

Only the patient's side of everyday phone calls is recorded – and the recordings themselves are encrypted and kept off-limits to the research team. They can see only the results of computer analysis of the recordings, which are stored in secure servers that comply with patient privacy laws.

Standardized weekly mood assessments with a trained clinician provide a benchmark for the patient's mood, and are used to correlate the acoustic features of speech with their mood state.

Because other mental health conditions also cause changes in a person's voice, the same technology framework developed for bipolar disorder could prove useful in everything from schizophrenia and post-traumatic stress disorder to Parkinson's disease, the researchers say.

Results so far

The first six patients all have a rapid-cycling form of Type 1 bipolar disorder and a history of being prone to frequent depressive and manic episodes. The researchers showed that their analysis of voice characteristics from everyday conversations could detect elevated and depressed moods.

The detection of mood states will improve over time as the software gets trained based on more conversations and data from more patients.

The researchers study patients as they experience all aspects of [bipolar disorder](#) mood changes, from mild depressions and hypomania (mild mania) to full-blown depressed and manic states. Over time, they hope to develop software that will learn to detect the changes that precede the transitions to each of these states. They also need to develop and explore strategies for notifying the app user and care providers about [mood changes](#), so that appropriate intervention can take place.

The app currently runs on Android operating system phones, and complies with laws about recording conversations because only one side of the conversation actually gets recorded. The University of Michigan has applied for patent protection for the intellectual property involved.

Provided by University of Michigan Health System

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