"Digital contact tracing might be our best shot"

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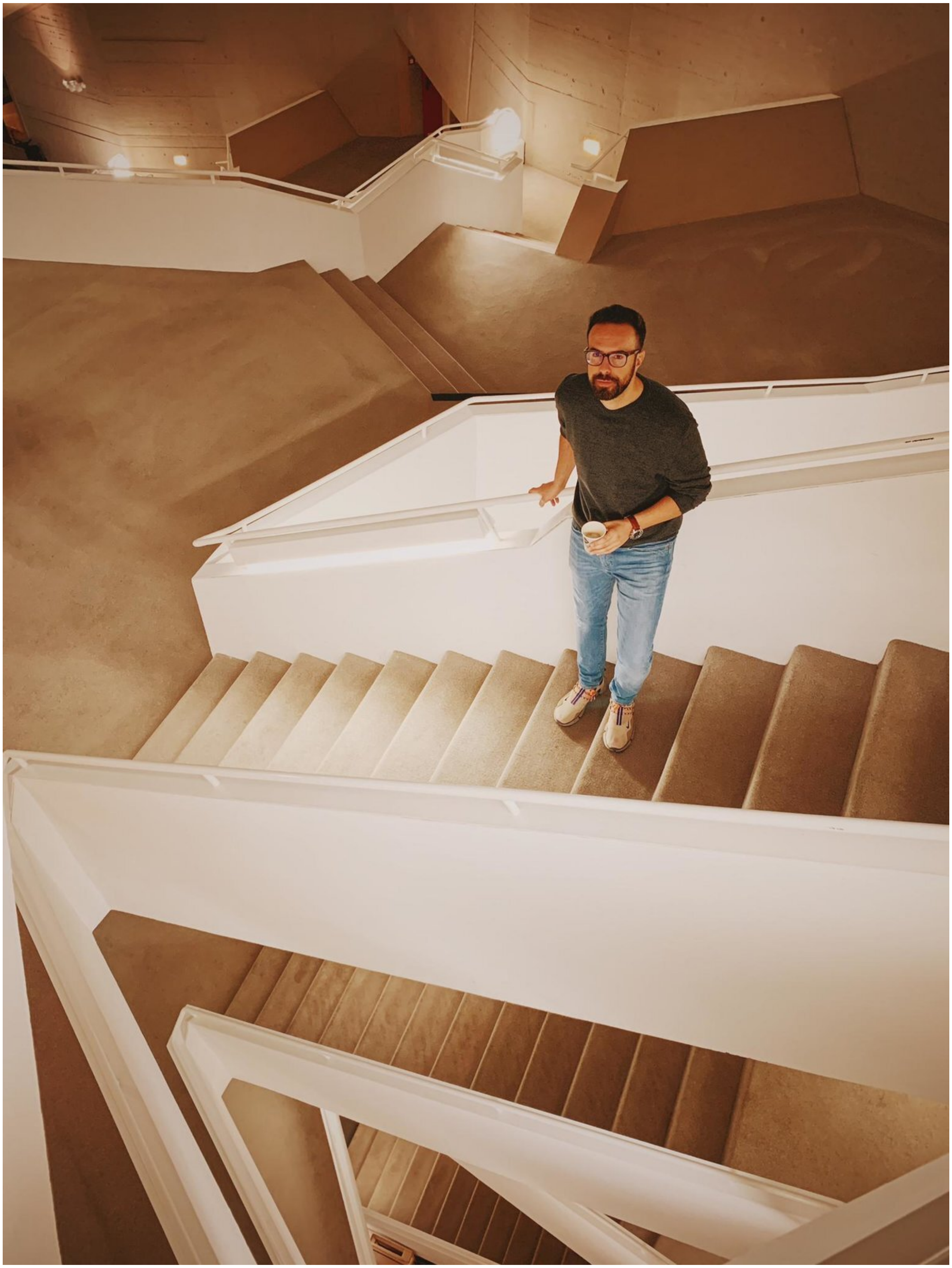

Manuel Cebrian is leader of the Digital Mobilization Group at the Center for Humans and Machines at the Max Planck Institute for Human Development in Berlin. Credit: Victoriano Izquierdo

Many countries are relying on corona contact tracing apps to identify the contacts of infected persons and isolate those affected in order to break the infection chains. Germany has now also published an app that uses Bluetooth technology to warn people if they have been in the vicinity of infected people. One of the first scientific studies on the subject has been published already in 2014. Computer scientist Manuel Cebrian showed together with Kate Farrahi and Remi Emonet that smartphone data can help with contact tracing during an epidemic. Today Manuel Cebrian heads the Digital Mobilization research group in the Center for Human and Machines at the Max Planck Institute for Human Development. In the Interview he explains if contact tracing needs technical support and why it can work even if not everyone installs a tracing app.

All over the world great hope is now placed in corona tracing apps. What do you think about it?

Manuel Cebrian: We know that contact tracing, together with the medical care and isolation of sick patients is crucial for containing an epidemic. But a growing body of scientific evidence is making the case that human contact tracing might not be fast or accurate enough once the epidemic takes off. Especially for an elusive killer disease like COVID-19, where asymptomatic people might infect a substantial number of people. To help contact tracing get faster and more accurate, I think we need some extra technologically enabled solution.

How can computer science contribute to this?

My research interest here is to explore how high-resolution digital social-sensing, through for example collecting digital online data or analyses of social networks, can be used in disaster management and emergency response, from terrorism to biological weapons, to climate-change disasters to crowd panics, to energy blackouts or cyber-attacks. We showed, for example, that you could perform a quasi-real time estimate of damage from hurricanes and other natural disasters by exploiting publicly available information that people post on social media. We also studied predicting the spread of the flu in a community by using machine learning over Bluetooth data provided by mobile phones. This led us to believe that Bluetooth data could help with epidemic studies. When I heard from a colleague who is a biophysicist how important contact tracing is in infectious diseases, I wanted to evaluate if we could apply our experience in network science and digital social-sensing to make contact tracing faster.

What was your approach?

Around 2011, we had the opportunity to use a vast amount of real-world smartphone data for epidemic and contact-tracing models. The data, which had been previously collected by colleagues of ours included 72 volunteer students from a US university, whose smartphone usage was recorded over nine months. The data had subsequently been used in quite a few studies. For our study, we focused on anonymized Bluetooth interactions and phone call interactions between these students, with the Bluetooth data used as an indication of face-to-face interaction, which is conducive to an epidemic.

First, we ran a standard epidemic model through the network of contacts, represented by the student's Bluetooth network. We saw that the simulated epidemic spread through the population and we recovered a typical epidemic curve. Then we added contact tracing to this simulation, assuming that when somebody is traced, they cannot infect anyone. In COVID-19 terms that would be: You are quarantined. What we saw is that even with moderate levels of contact tracing it would push down the peak of the epidemic. So, the first test was not a surprise: If you have a perfect digital representation of face-to-face interactions, contact tracing works.

But not everybody can—or will—install tracing apps.

That's right. In reality a digital contact network is not the same as a physical contact network. Not everybody uses smartphones or wants to install the corona app. Or, you have a Bluetooth interaction with somebody near you, but they are behind a thin wall and you never meet. So, based on our contact network we created a second network with errors. The infection travels on one network and the tracing travels on the second network, an imperfect representation of the first one. Once you do that, you can vary the percentage off reality you assume to be capturing, i.e. the percentage of people using the tracing app at the time. You can also vary how much testing capability you have as well as how fast your tracing is or if you want to add random testing. In a real-life scenario, these parameters would represent possible interventions by Federal or Local Health Authorities. The good news is that our simulations showed that, for most of the parameter combinations, you needed to capture something as low as 40 percent of the physical contact reality to reduce the peak of the epidemic. However, one has to be very careful with extrapolating that number to any realistic setting, as we are just describing a computer simulation in a small community.

In the final part of this study, we assume that you only have phone calls, which would be the worst-case scenario. But even if we use only the phone calls of the 72 students for contact tracing this would work better than random testing and can still lower the peak of the epidemic.

Could contact tracing via phone calls also work during the corona pandemic?

As everybody experienced, our communication and physical networks changed dramatically during the last months: we talked to a lot of people on the phone and met a few or none in person in person. So, contact tracing via phone calls would work actually only at the beginning of the pandemic, while there is a connection between the people we talk to on the phone and the people we meet. However, I think the ethical, legal, and privacy implications could make this unfeasible.

Do you think the corona contact-tracing apps, which are currently being developed or already in use around the world could help contain the corona pandemic?

Because we don't want to go back to exponential growth of case numbers and we don't want to go back to full lockdowns, I believe digital contact tracing might be the only realistic option. I cannot say how it would be done in a legally and ethically correct manner, as again this is not my area of expertise. But I'm aware of the limits of human contact tracing and because those limits are becoming clear to me and other experts, it seems to me that we need to have something additional. And looking at the data of our study and other bigger studies being published lately, digital contact tracing might be our best shot.

What was the resonance of your study then and now?

It's funny because despite having put more than four years of work in it;

this was one of the papers I was involved in that got the least attention in my academic community when it was published. To be honest, I nearly forgot about it and seldom discussed it with colleagues. But then, beginning around early March, the media, different government agencies, and technological entrepreneurs contacted Kate Farrahi and me about it. It's great that the study gets more attention if it can help further discussion and development of digital contact tracing.

More information: Katayoun Farrahi et al. Epidemic Contact Tracing via Communication Traces, *PLoS ONE* (2014). DOI: 10.1371/journal.pone.0095133

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