

THE ASPEN INSTITUTE

SPOTLIGHT HEALTH

ASPEN LECTURE: SENSING THE WHOLE - BIG DATA, BIG
INDICATORS AND THE FUTURE OF PLANETARY HEALTH

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LIST OF PARTICIPANTS

Andrew Zolli
Founder, PopTech

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MS. CLARK: Welcome to Saturday, it's Spotlight Health. It's another beautiful morning in Aspen, Colorado. My name is Peggy Clark. I am vice president of the Aspen Institute and one of the directors of Spotlight Health. We hope you guys are having awesome time. How is it going at Spotlight Health so far? Awesome, great, great, great, great.

So, one of the, you know, secret sauce of Spotlight Health and everything we do at Aspen is really unusual suspects coming together and unusual thinkers. And you know how it is every once in a while you meet someone who completely blows your mind and helps you -- makes you think of things in a way you have never really thought of before.

So, that happened with me when I met Andrew Zolli who is our Aspen lecturer this morning, who is a remarkable, remarkable man and he's had many, many accomplishments for his quiet young life. But one of the ways I felt was that I just really wanted to hang around him more. He is at the forefront of thinking about what is happening with our planet, the intersection of planet -- what's happening with the planet, what's happening with human health, what's happening with many, many of the systems that are so such a key part of our lives on a daily basis.

There is a long bio of Andrew so I won't give all of it but I do want to say that he's the founder of an event called PopTech that many people say is actually cooler than Aspen Ideas Festival. So I don't know if that's true Andrew. We're going to wait to hear the great. But it's on the coast of Maine and it is a really interesting as Spotlight Health is, is a mix up of entrepreneurs and scientists and others who are working on key issues.

Andrew is a strategic adviser now for Planet Labs which you're going to hear more about today. And he is responsible for impact as it relates to one of the

largest satellite systems in the world, which is really fascinating. He also is the author of a book called *Resilience: Why Things Bounce Back* which became very, very, very widely read.

He's also the chair of an organization called The Garrison Institute, which is looking at transformative spiritual change in our lifetime. So, you know, Andrew moved heaven and earth to get here. He came in very late last night. He is a very special, very special speaker. As we do with these lectures, this will be a longer talk from Andrew and then we'll have plenty of time for question and answers. But welcome, we're delighted you're here this morning. You're really in for a treat. Welcome Andrew.

(Applause)

MR. ZOLLI: Can you all hear me? Vo la re, I feel like I should unbutton another -- all right. Good morning. It's great to be here with all of you. Thank you very much Peggy for that terrific introduction. Peggy and I are both recovering hyperbolics. So, when she makes introductions like that, I need to tell her to set the bar much lower in terms of introductions. I will tell you that I am on a radically different time zone that was not at 8,000 feet above sea level. So, if I fall over in the middle of the stage, you know, this morning, someone just come along and wake me up or splash cold water on my face.

It's my great honor and pleasure to be here with all of you this morning. And thank you Peggy for that wonderful introduction. I today would like to talk with you about how we understand the world around us? How we come to see change? And how new ways in which we might come to see change might shape new possibilities for the way we tackle most -- some of the most significant challenges we face in this century and how we come into new places of manageable equilibrium between the world of human affairs and the world around us.

And to have that conversation, I want to start with a little exercise together. Okay. We're going to talk about noticing change. And in -- on the next slide,

I am going to show you two pictures. They're going to flash like this one the screen. Just like that. I promise you there is one and only one difference between the two images. You can take either screen, they're going to run exactly the same image. And if you've played this game with me before you're not allowed to participate in this round.

But what I'd like you to do is when you see the change I'd like you to gently, non-competitively, not blocking the other people at your table, I'd like you to gently raise your hands so I can count you, okay. That's the whole game. You got that? You're ready? Okay. Pick a screen and go. There is one, two, three, four, five -- I'm just going to get to ten -- six, seven, eight, nine, ten. Okay. Now, how many people here honestly saw no difference between those two images? Please raise your hands. I'd like you to meet the honest cohort here at this Spotlight Health. I don't know what those other people were looking at. You never mess with an Italian with a clicker. That's a terrible decision. Now, for those of you who didn't see it and I will tell you the first time I was shown this, I didn't see it.

I'd like you to pay attention in this image to this part of the screen. And I'd like you to watch as the thing that holds airplanes in the sky disappeared in front of your eyeballs over and over and over again. And about 98 percent of the people in this room didn't see it. And those that did by the way when you are counting raising your hands, I wasn't counting you. I was counting the number of exposures. It took the first person in this room 20 exposures to a non-trivial change that I told you with certainty was in the image, just one of us to see it. And I want to ask you a question. Why? Why did all of us miss this? Just shout it out. Yeah. Exactly. We're trained to look at people. Fantastic.

Anything else true about where this change occurred? How it occurred? Yeah. Looking at details instead of the big picture. Any other -- absolutely correct. One more from you. It's not supposed to change. Exactly. Long time ago our brains overcame the problems of lions and tigers and bears and primarily had to deal

with the problems of other people. Our brains adapted to deal with change where we expected to occur. And so, we're highly calibrated for looking for change where we expected. We're terrible at seeing change. Well, we don't expect it to -- how many people here started, just by curiosity, by looking at the soldiers?

How many people here then either first or second looked at the tail of the aircraft. Exactly. Right, none of you are coordinating with each other. That makes you exactly like all other human beings. Okay. We are so sensitive to the relationship that we have with other people, that we build entire television programs. We put small numbers on an island and watch them vote each other off. Right? Now, it's important to know that human perception as a result is deeply biased. We're very good at seeing change that moves at one meter per second. Change that move like this.

We're really bad at seeing change that moves like this. And we're also terrible at seeing change that moves like this or change that doesn't appear where we expected to. And that's what I think very beautifully by a wonderful thinker about the future Stewart Brand who said very famously "In our society, it's the fast-moving trends that get all of the attention. But it's actually the slow moving trends that have most of the power."

I mean, just think about this, we're at a health conference. What is the typical American's health risk from ISIS-inspired terrorism? See if you can fix the number in your mind. Now, think about what the typical American's health risk is from heart disease. And see if you can fix that number in your mind. How much time -- well, let me ask you, how many people here think ISIS is more dangerous than heart disease? How many people here think heart disease is more dangerous than ISIS? Okay. But we don't have any international war on cheese burgers. Thank God, because I would have to become Canadian.

But the inability of us to see change, to see it happening at scales, at speeds and with kind of valences that naturally attenuate themselves or calibrate it to our perception has real consequences. Especially now that we

live in an age which geologists and historians of geology now refer to as the Anthropocene, the age of us in which we have become one of if not the signature forces of change on the planet. What we're doing and I'm going to show you a lot of -- this whole talk is going to about looking at things back and forth.

Just so you know, that's going to be a theme throughout our journey together. We do this to the planet and we turn this into this. This is what we do. This is our function in terms of ecosystems. You can just see the change. But this change happens at a scale that's so big that it seems invisible to us. In fact, people who think about the Anthropocene have actually coined a new term for it; they refer to these things as hyper objects, objects that are so big in time they persist over many lifetimes and so big in scale that they just swamp our natural cognition.

And it's not just the fact of these big systems, it's that they're interconnected in ways that are complex and non-linear and non-obvious and only partially visible and partially understood and that's a problem because we cannot fix what we cannot see. And sometimes it's not just a matter of having the information, it's about having the cognition of the information in order to be able to act. In fact that's driven maybe the signature design agenda for the 21st Century, which is this one.

It's a kind of resilience agenda but we can think about it well beyond that. How do we help people and communities and systems persist and recover and thrive in an era of these large scale disruptions? Now, at this point I will just say there's probably good reason that there's no like sharp implements on the -- at the tables because we'd all be slitting our wrists and like this will be a Jonestown Massacre right of depression. Because while it's true that the scale and speed and scope of the challenges we confront are bigger than ever before, it's also true that the unfolding scale and speed and scope of our capacities is accelerating faster than we previously been able to understand, in fact that most of us really understand on a daily basis.

And to demonstrate that I want to just show you -- we're going to play little game, okay. Maybe you've heard of it. I'm going to show you two images on the screen. They're going to flicker back and forth. Just like this. I promise you there is one and only one change. When you see it, I'd like you to raise your hand. Are you ready? Okay. Here is the election the moment in which we elected we burned white smoke and elected Pope Benedict in 2005. Okay.

Here is exactly the same thing in 2013 when we elected Pope Francis. See if you can see the change. It's subtle. I promise you it's there. Just keep looking you will eventually get there. So, what happen between 2005 and 2013? 2007 happened, the iPhone happened. In less than a decade, less than a decade ago, we dramatically catalyst putting censors into huge swaths of people's hands, just enormous numbers of people. That's what they are. They're communications devices. We think of them as communications and access devices. But they're also sensing things about where are, about what we're doing.

And that enables an entirely different kind of sense making about what's happening around us. So, first -- and some of you might have seen on your phone or in your car something that looks like this. So, anyone ever seen something that looks like that? Right, okay. That is a map. Is some people here from Los Angeles? Right. You're from LA? Is that's pretty accurate about the 405? It's all read all the time, right? Now, here's the really interesting thing about this. There are no traffic censors on the highways of Los Angeles. Zero, there are none. So, what is this a map of?

It's a map of where all the phones are. This what Google knows. What Google has that no one else has is they know that all these phones are moving along at one mile an hour in a line while people are cursing into them at loud volumes and taking out handguns. Okay. This is big data. It tells us the macro state of the system. But this is the interesting thing about this, nobody wants big data. You don't want big data. Big data is a big pain in the ass. It's too much. What all of us really want are

indicators.

Tell me as a consequence of the system what I should do. Help me pilot where I am going to go. And we'll certainly see tremendous new applications of these technologies and I'd give you just one example. In the city of Boston where I don't know anyone here from Boston? I'm from Boston originally. So, some of you will know like you're probably are running away from the psychopaths on the highways of Boston. The Boston drivers are notoriously terrible, the streets are bad, full of potholes.

So, a team of people at the City of Boston built this really interesting app, which they gave to all of the municipal garbage workers and the ambulance drivers and the firefighters and the police called street bump. And what it does is as people are driving around, these are people who work for the city. As they're driving, if they hit a bump, their phone vibrates and the phone sense a little signal that says I just -- the car just jumped there. If enough people are driving by and like after five, six, seven, eight, nine, ten in a row, automatically a cruise dispatch to fix the pothole.

And today the City of Boston has saved 150 million dollars in liability would have had to payout because it used the sensor network to tell us something important, but specifically to connect it to action. And I want you to keep that kind of idea in your mind because the era we're coming into is this. It's a shift away from a conversation about the data. It's going to be increasingly be a focused effort to build indicators to tell us about the health of ourselves, the health of the systems and it's communities in which we operate and the health of the world because there are complex, non-linear dynamics between all of those things.

Let me give you just one example of the way in which we can use the things we do everyday. So, in Norway there's a glacier and people come by on those giant Norwegian cruise line ships, some of you might have even been on one every once in a while and then they paddle people out and thousands of people lift cameras in unison

and they take pictures and they come through year round. Well, a team at the University of Washington figure out how to take all of those pictures and turn them into something really interesting.

They use some very sophisticated software to actually watch the glacier through all of the little snaps that you take. So, they took a form of change that's happening too slow for us to perceive and using some complex mathematics, simplified it and harmonized it in a way that the macro change pops out. Here is another one actually. You can actually watch the rise of building in Las Vegas. You can literally just watch the city appear in front of your eyes. Now, we're taking some of these technologies now and we're beginning to put them in places where we can capture everything, everywhere, everyday.

And this is going to be one of the most important elements for driving the future of what we think of as deep planetary health; really understanding the complex dynamics between human systems and global ecological systems. In order to tell you about this, I want to share with you a story about NASA. So, when NASA builds a satellite, I'll just show you a picture of guys working on one. This is a typical picture, they're about the size of a school bus. They take decades to make, to go from concept to execution and they're really beautiful, exquisite instruments.

So, if you are a young engineer for instance you might get to work on two or three of these programs in the course of your career if you work at NASA. As a consequence, a really interesting thing, a friend of mine was watching the launch of the Martian curiosity rover, the one you know the things we sent to mars. And at the tip of the launch vehicle was the rover they were going to parachute it down onto the planet and on the rover is a camera. The camera is a 4 mega pixel camera. My friend took a picture of the launch with a 12 mega pixel camera phone, right, a much better phone in his hand when we were launching the thing in the space. So why can't we just take this and put it up there?

The reason is it took 10 years for them to lock

the camera in place, lock all the technology in place. So, we're launching obsolescence in the space. So, a group of young engineers at NASA did something kind of interesting. They went down to Best Buy -- I am going to simply what is a much more complicated story. They picked up an off-the-shelf smartphone. They took it apart because that's what you can do if you're a NASA engineer. They put it together in a tiny little package. They gave it to an astronaut who's headed to the national space station and ask her to throw it at the airlock to see how your phone would work in space.

And it turns out your phone works great in space. Amazing if it's shielded correctly. And that catalyzed a revolution in a way we think about using the space part, the low earth orbit space around the earth, not for looking at the stars but for looking back at ourselves. This was the launch of a company called Planet Labs where I oversee the, what we call the impact program which is climate, public health, humanitarian response. That's sort of collection of big complicated nested thorny issues. This is one of the satellites, it's literally that big. It's about the size of loaf of bread.

Most satellites are name for birds of prey, they have names like falcon and hawk and eagle, kill, maim, destroy, eat, eat the bunny, there's a lot of that going on in the naming of spacecraft. These satellites are called doves. They are humanitarian satellites. They've totally different function. As a consequence what they can do and what Planet's mission is to image the entire surface of the earth everyday to see everywhere in the world, everyday to have a completely new picture of what's been happening and to keep the old ones.

So, we have the whole earth yesterday and the day before and the day before and the day before. The way we do that we take hundreds of those little satellites in this case something on the order of a 150 of them in a giant ring that orbits the earth from pole to pole. Roughly over the north pole to roughly over the South Pole. So, if I can say, what's your name? Merriam. Okay, Merriam is the sun, I am the -- here's the earth, the earth goes around Merriam on an annual basis, it spins

on a daily basis. These are in which call the sun synchronies orbits, so they go up between the earth and the sun and then over the dark side.

So, it's always noon when the camera's taking a picture. That's actually a picture of two of them being ejected from the international space station, that's the biggest thing in space launching the littlest thing in space. As a consequence of this though, you can do some really extraordinary things. You can see every glacier in the world everyday. You can watch the move, you can build the movies I was showing you minute ago from the ground but you don't have to rely on the accidental use of ground imagery, you can actually do it from space.

You can see the health of every field on earth. You can see how much food and what kinds of food we're growing because vegetation throws off light in a differential way depending on what kind of plant it is. So, we've met very good imagery and very good insights into how much corn is being grown in the world, how much wheat is being grown in the world, how much of it is being consumed if we want to move ourselves to a planet healthy to a climate compliant human diet. We have to be able to measure our progress and this is going to be one of the tools that gets there.

It also lets you see every water point in the world. So, for instance this -- these are two images of the Bhama Asakhed in India that are about a month apart and if you look you can actually see the water receding as farmers are using it to plant their crops which shows up to be very interesting to people living in California for all kinds of reasons. And then we start to get into places where using this persistent monitoring which I want to say right off the bat the pixels here are about three meters per pixel. Three meters per pixel is from here to the podium square.

So, we're not looking at you. We're not reading your newspaper from space. We're not, you know, we're not doing any of that kind of stuff. This is all designed specifically to avoid the breaking of personal privacy. But what's really interesting here I want to show you is

this is from Indonesia. This is from March of last year and here is another picture that's just from three months later. So, do you see what's changed there? Do you know what those are? Those are the roads that people are putting in to illegally deforest.

They're taking out the trees. But before they take out the trees at scale, before they do the thing that I showed you way back at the beginning that we do and this is in a protected area, they have to put in roads to take the assets out before they cut the trees down and we can see the roads from space. Now, that's really important for all kinds of reasons. It's important for conservation reasons, it's important for climate reasons, it's important for the preservation of the planet which should require no further justification.

But there's one very important public health reason to do that and that's this. When you cut down the forests, you change the local bio-system in such a way that you take wild life and you begin to concentrate it into smaller and smaller areas. When you cut down the natural habitat, you squeeze the local wild life into smaller and smaller place. You also heat up the area that you've cut down because the trees aren't absorbing the sunlight, it's now being absorbed into the earth which raises the local temperature. This is outside of climate change.

So, that makes it easier for some forms of mosquito to breed. And those mosquitoes happen to transmit malaria intensively through macaques monkeys which happen to be native to this part of the world. As a consequence, you bring more and more human beings into concentration into contact with concentrated communities of wildlife who are themselves being infected with malaria at a higher and higher rate by mosquitoes that are living in the deforested part of where -- the tree -- the area we just cut down of the forest.

And that has real consequences for these guys which is the people that live there. This happens all over the world. It's where our illnesses come from. How many of you here have heard of Zika? How many people know

where Zika came from? Okay. One -- less than 1%. It's named for what? The Zika forest in Uganda. It's name for a place. It emerged in the 1940s. And see this over and over again with avian bird flu with all kinds of things, it's the -- what we often call the bats and pigs problem, it's when human life stock come into contact with wild life.

So, our ability to manage this effectively is really important as a way of understanding where the risks come from because 60 percent of the diseases that effect you and me spend some portion of their life in wild animals. Now, the very tools that led us begin to see and unravel these complex relationships can also be used to interdict them. And I'll just show you -- these are actually two images also taken from Planet Labs imagery from the Tambopata reserve in Peru. This is a river and the green line is the original line of the river. All of that stuff that's been cut down, that's illegal gold mining that's going on.

So, people are coming in to do illegal extractive activities in what is a nature preserve putting at risk not just the flow of the river and the people's downstream activities but all the public health issues I just mention to you. But the useful thing about this is if you can get it into the hands of people who care about it like the people who managed the reserve, they can act. And so, this imagery came out about three weeks ago and about two weeks ago the Peruvian coast guard came in and took all out. They just shut all that down, they burned and destroyed all the equipment and they stopped all that activity because you can't fix what you can't see.

So, if we can create the right kind of linkages between the sensors and the analysis and the action we begin -- can begin to think about different way of thinking about planetary stewardship that goes beyond the way that Californian say you know, we should steward the planet. You know what I mean like really steward the planet. Actually do it. I'd just give you one more example. These are refugee camps, set up make-shift refugee camps on the border of Syria and Jordan. This is from February 9th. This is from February 26th. I don't

know if you can see.

It's a little hard to see in this room so I thought I'd do it black and white. Everyone of those big whit dots are tent with somewhere between three and five people living in it. This is February 9th, this is February 25th. That's two weeks of a global refugee crisis in a place that's actually difficult and dangerous to get to. But it allows us to understand how these forces are unfolding around us and that kind of situational awareness is going to change a lot of things. It's especially I think that it change the expectation that we act because we will not be able to say we didn't know.

Now, much closer to home a team of researchers at the Harvard School of Public Health just in April published an extraordinary study which I think everyone in this room, I think many of us here are Americans. So, I want to give you an example from America. What they did is they looked at the relative concentration of green spaces in American communities. So, they looked across five different quintiles of greenness from the least green to the most green. Notice the least green doesn't have no green in it.

But the most green has a lot and they looked for eight years using a very large cohort of more than 100,000 subjects at the health outcomes that are correlated with this greenery. So, what is the affect of living in these kinds of environments differentially upon each other not for some random stranger but for you and me and the people you know. And here is what they found. They found as compared to people who lived in the least green area, if you looked to people who live in the most green area, among women mortality rates decline by 12%. 12% more people lived as a consequence of living in this areas, 30 percent of that benefit was attributable to mental health benefits.

Another 34 percent was attributable to the client in respiratory related mortality and 13 percent decrease in cancer mortality, which suggests that over these kinds of assessments we can begin to think about how

we build our communities. How do we shift? So, that's great. That is -- this is basically a brochure for living in Aspen, Colorado. I think you could probably all get that. But there is a really important thing here which is now there's a different agenda for those of you who work in public health which is go talk to your urban planner friends.

Go, talk to the people who design communities, the people who are responsible for development. The people who are responsible for governance because if we can move the people who are here one or two cohorts over, we don't have to move them all the way to the end, not everybody gets to live here but they can live in some place that's a little bit closer to here in ways that we can begin to quantify the real cost savings. We would all talk about and I imagine at a health care conversation, everybody wants to talk about how do we bend the health care curve.

While apparently living next to trees is a really, really good way to do and trees are cheap relatively speaking, you know. Okay. So, I want to go back to a subject I talked about at the beginning of this before we pivot to more social oriented stuff. And that is about when you get virulent serious public health outbreaks, what are you seeing? When see Ebola, what is that a proxy for? Well, it's actually a proxy for whole bunch of things. I mean, at the top you have an academic outbreak but underneath that you have inadequate public health systems. If you wanted to understand where Ebola struck the worst, the easiest proxy, the strongest correlations going to be where -- was the public health system actually good enough to absorb it?

But underneath that is a question about connectivity and infrastructure. And under that are questions of governance. And under that are questions of poverty. And each of these move more slowly than the one above them. They're sort of connected in a very deep chain, from things that move very slowly. Like chronic poverty has the word chronic in it. It's literally long lasting by definition. The rapid moving thing on top is

the consequence of the sharing forces between the slower-moving actions, but much of our dialogue it seems happens only above the water line of the stuff toward the top end. How do we interdict and then how do we built a better system, a slightly better system to observe the shock the next time. That's mostly because we don't understand the interconnections between these systems. But using the technologies I just described to, we can began to get to see some very different kinds of things.

So for instance a team at Stanford led by a researcher named Marshall Burke has taken night time satellite imagery and correlated it broadly with poverty. And then he has trained an algorithm to correlate the night time data with the day time data. So now they can built very sophisticated maps entirely from satellite imagery, there are maps of social exposure, social poverty essentially maps of risk. But because we can refresh them every day, we can watch poverty move in the next few years and we'd not there now.

We are building the systems that allow us to watch poverty move every day. We will turn poverty into a movie that we can watch everywhere in the world and that chronic poverty is the way down at the bottom of the stack. Similarly we are going to use some of those other mobile tools to help us understand with much greater sophistication the kind of economic risks and the economic geography to go along with poverty.

This is an organization called Premise; what they do is instead of relying on government statistics, they deploy thousands of people with smartphones to say go out everywhere all throughout the country, go into every market and take a picture of kilo of bananas or a fruit. Let's find out what everything actually costs people, so we know where the risk are. And then you start to see things like this, across the global itself, about 90 percent of the population uses their mobile phone in a prepaid way. How many people here pay their phone at the end of the month? Right. Yeah.

The reason everybody's hands go up is because you all have credit scores. So the mobile company can extend your credit so you can use your phone for month at the end you pay your bill. But because there is no infrastructure like that in many parts of the world, people have to purchase credit, spend it down and purchase it again and it turns out that the rate at which they spend that credit is very stable. Every week I put in a few dollars, a few shillings, every week very stably. If suddenly there is a shift and I go from putting in \$5 to \$1 on my mobile top up, it's a very good indication that there has been a local market failure, a public health outbreak or some other significant social issue. And we don't have to know anything about even the names of the people because the individual rates it doesn't matter, you only want to see in the aggregate, in the non personally identifying thing. And what we -- non-personally identifying aggregate statistic.

But what's powerful about that is what we expect to see is changes in the geospatial imagery, changes of what's happening on the ground that we can see with our eyes that presage and predict changes that we see in other domains and vice versa. Oh, we've got an early warning through the mobile surveillance that there is going to be some change in the physical environment or vice versa. So the king of all this is Mark Zuckerberg because Facebook is now the second largest social entity on the planet. It goes Christians, Facebook users, Muslims, Chinese, boom, boom, boom, boom. Okay.

Facebook can see because it has all of this kind of data, things that no one else in this room especially those of you're involved in health community health even individual health you would give your salary to get access to what they've access to. What can they see? Well, I'll give you one really simple example. These are two -- actually I'll give you two really -- I'll give one and use the time. So when it rains -- I live in New York, I live in Brooklyn. When it rains, the clouds come over typically from New Jersey, Jersey.

(Laughter)

MR. ZOLLI: And the minute it starts raining in New York about two, three minutes after the literally the first drops appear, there is stable replicable drop in the emotional salience of Facebook postings of people on whom it is began to rain. So they get better weather data than the satellite, than the, you know, dick thunder and value tron (phonetic) 9,000 or whatever that thing is you see on the Accutron 9,000. That's not surprising. There is a correlation between the physical weather and the emotional weather. What's more interesting is that in about 10 minutes after that, there is a secondary smaller effect in Los Angeles where it is not raining where the fact that people who live in New York are bumped out who are connective to people who live in Los Angeles, start to bump out the people in Los Angeles to a small degree, although these days given the fact that it's raining sometimes it's envy I think but that's a different story.

So we've just beginning to scratch the surface of what we can derive the kind of derived value that we can get from these kinds of platforms. And I would like to give you one specifically. So, okay, this is a good story, so for a long time psychologists have studied human affect, the emotional content of your lived experiences and one of the things that is invariant across human cultures are these kinds of expressions. A wonderful researcher, some of you might have read his work, Martin Seligman pioneered a field looking at the invariance of human expressiveness.

Now the culture under which when we decide we are going to smile and when we decide we are going to frown, that changes things dramatically. But human beings everywhere smile, human beings everywhere frown, everywhere there are sad and these expressions are universally recognizable to each other. They form a kind of language that goes along with our existing language, with our culture language. So a team of researchers at Berkley working with a team at Facebook took the evolutionary and cross cultural history of all that

research and they went out and partnered with a researcher from -- they partnered with an animator from Pixar, that Pixar.

And they designed these cross culturally invariant emotional expressive icons and then they went out and tested them all over the world to make sure that everybody could recognize what the emotions, the salient emotion that these emojis, you all have seen these emojis right? You use them or your kids use them, but what's really fastening about this is that when they could release them in the wild in such a way that they knew scientifically what was being expressed and at population scale they could then study on a country-by-country basis how prevalent the use of these emotions were in the way we communicate.

So for instance, they could see cultures of love, where in the world is all the love being expressed. Where is all the irritation? Here is a really fastening thing Canadians and Americans roughly the same in terms of the way that we communicate, but there is one really critical difference between Americans and Canadians. Do you know what it is? It is the amount of anger Americans express. Americans are pissed off perennially. I think the minute Donald Trump got on the scene, I as like of course I totally get it, he would never work in Canada, he works here.

Now here is the interesting thing about this, then we began to cross correlate this data with other indicators of social and economic well being. You know what we discovered is that the happiest places in the world are not the places where the most happiness is expressed. Do you follow what I'm saying? The happy, using the happy icon did not correlate with the best indicators of social inclusion, social progress, economic inclusive welfare. In fact it was a different thing. It was the diversity of emotions that a culture allowed its citizens to express that was correlated with the greatest degree of well being. So very, very happy people who are

forcibly happy are North Korean, right? And that's the distinction that we are talking about here.

We've just began to begin to use these tools to understand psychologically the effect that we are all experiencing, the affect, and now we are beginning to correlate these kinds of internal emotional states and the other things that are going on in our geography. So here for instance is a big study that is currently going on, it's a program called the Urban Mind Program and what it does is you carry around an app on your phone, it's a research subject. It interrupts you and says how you're doing right now, how are you feeling, is there any noise, what kind of noise do you hear, what kinds of things are going. Just take a little audio recording of the place you are in right now. When you began to aggregate all of those things, what you find out is where in the world is all the stuff that pisses everybody off and upsets everybody, where are the places that cause us the most stress, what are the places that cause us the most both acute and chronic kinds of stress.

So we are beginning to take the geographical information and the internal affective and emotional states and beginning to cross correlate them. And as we begin do that, we begin to look -- we'll be able to look at environmental change and how environmental change, the things that start way out there cascade all the way through to the things that happen in here and in here. And that's critically important because we live in some very sorted out communities and across these boundaries there are inter-generational transmissions of acute and chronic stressors. And we do not understand fully, I think we all understand the fact of -- this fact, but I don't think we fully understand the way in which we are truly bound together.

The way in which those boundaries are elusory, in fact they are part of a much larger system. So I am excited about this particular kind of work and I'm particularly excited because as these tools become or democratized, we can begin to think about closing the

loops. Closing the gaps between ourselves and what we think of as separate systems. By designing the right kinds of feedbacks with these kinds of information, we can begin to move ourselves into a place of greater balance and I'll just -- I'm going to use a tiny example rather than a big one because it is my favorite.

How many people here give blood? Right. It's fairly sizable portion of the people, I don't like -- I happen like apple juice and cookies I give a lot of blood, okay. But I have no idea whether that's helping or hurting. After 9/11, people lined up around the corner, after Orlando, people lined up around the corner to give blood. It's what they know how to do, how can use my body to help?

So in Sweden they built something really amazing. They took the tools I've just been describing to you and they built the simplest thing in the world. When you go to give blood, you register your phone. When a person gets that blood, you get a text telling you someone has used your blood. And what happens? Participation skyrockets. Now there is no gaps because people understand the consequentiality of their decisions, they understand how, what they do know even with some latency. Actually it leads to a better outcome for everybody. That's the agenda in front of all of us and with that I will say just this last thing.

When we engage in that activity, when we begin to design that system, we return I think the system to a state of greater wholeness, a greater connectivity with itself, stronger senses of solidarity. This is an engine for solidarity with others if you understand how what you do shapes other people.

A wonderful architect and thinker named Christopher Alexander I think summarized what it aims to do this kind of work and I think it's the kind of work that happens in this room among the people who are working on transforming public health, individual health and planetary health and that is to build a sense of greater

wholeness. And Christopher said I think very aptly, he said making wholeness heals the maker. It doesn't just heal the system, it heals us. It has a consequence for the way we live. Not just the way that other lives as a consequence of our actions. And with that, I will say thank you. I hope you have a great conference.

(Applause)

MR. ZOLLI: Do you guys want to have some questions? There are -- I'm assuming you have none, I have answered all of them, but are there any? Okay. We've mics over there. So okay how about sir, and then there is another one over here. Please don't be shy.

Oh. God bless. Thank you.

SPEAKER: Hi, it was absolutely fabulous. I'm going to ask a question. Do you use this system for polling because we had some extraordinary results yesterday at Brexit?

MR. ZOLLI: Yeah, it's really a good question. Yes. In fact I just flew here from England. I was in London yesterday during the voting and I was with the group of people who were thinking through what are the potential consequences of this would be and someone who voted to leave, I was just -- we're just having this conversation, e-mailed me and said, "I can't believe, I thought I was registering a symbolic vote, holy smokes." "Whops" was the subject line in the e-mail.

So of course we can use these technologies I think to get a much better calibrated sense of what is going on with ourselves and with others, but in general the big challenge for us is not going to be how to add data points, it's going to be how to synthesize them. Right now we are in a movement when our sensing capacity, nascent as it is, has swamped our sense-making capacity. And we have work to do there. Sense-making is a fundamental and core activity for health. You can't make a system healthy if it is incoherent to you. So that --

often means not adding information, but finding relevance and simplifying and kind of bringing things down, but you're right. It can be used for polling for sure, sir. Yes.

SPEAKER: Thanks Andrew. I'd like to shift from big data to indicators and sense-making, but I'm wondering about how to translate into action. So using these Syrian refugees, we've known about the Syrian crisis for a long time, but very few of us are acting on it and those in power aren't acting on it. And so I wonder we can give as many refugees, mobile phones to track how happy they are, what noises they don't like, what makes them happy or unhappy.

MR. ZOLLI: You're right.

SPEAKER: But the flood of data is not changing behavior and that's what I am really interested in that nexus. How do you -- what are your thoughts on what does it take to convert that to changing the situation that all the data is tell us?

MR. ZOLLI: Well, it's a great question and I certainly don't think that these are panaceas. They're intended to move us from ignorance to some sense of responsible, informed position that will enable better actions initially among the small cohort of people who are going to act and can enable just as importantly a different kind of storytelling to begin to bring people in.

Ultimately way over here which is when we all decide we are all going to do something together, that's a transition that doesn't happen has a consequence of data. It's a decision and it's a decision rooted primarily in two things; a solidarity which is I'm part of you, we are part of the same fabric, we are part of the same tribe. And subsidiary, which is I understand at my level what to do in order to affect the state of the system.

We don't have that for a lot of these things. So I mean you are absolutely right, I mean it's unconscionable what's happening in the Syrian refugee ecosystem because it effects -- it's an ecosystem, it literally effects the planet now, it's amazing -- it is horrifying and amazing. But if I polled most of the people in this room, I'm not sure that most of the people in this room would know what the action is to take and so you know that's a journey and this is fuel to move us in that direction. It's not the answer, but it's a component of the answer. So, I take that note of humility very seriously.

Anything else? Yes over there. Excuse me.

SPEAKER: And going back for a minute to the vote on Thursday, Brexit.

MR. ZOLLI: Yeah.

SPEAKER: And your comment that Facebook is the second most integrator in the world.

MR. ZOLLI: Yeah.

SPEAKER: So the vote sort of indicates trying to get smaller and Facebook is trying to connect, what incites do you have in that. And our election in America is also going to be comment on the same thing. The more integrated we are, the more small we want to become.

MR. ZOLLI: Well, we don't -- it's a very thoughtful comment. I'm not sure I -- it might be above my pay grade and certainly we don't have a whole lot time left, there is 2 minutes for me to answer that question and any others. But let me just say a couple of things which is the definition of a community is a group of people you care about more than you are contractually obligated to, typically. The challenge for all communities is to understand how they continually reaffirm a sense of shared purpose, shared belonging, shared experiences and shared outcomes.

All human beings have inequality aversion, a deep inequality version, it's a -- we're social primates and as social primates we depend on each other. And so if someone is getting something that's slightly better, if we perceive it be slightly better than what we are getting, we instantly go like this, we're not -- I'm not playing. People who are progressive look at the world of income inequality and they say that's unequal, that's Barney's argument. People who are on the conservative side of the aisle say all of these people getting benefits are free loaders. Look at those Mexicans coming and taking our jobs, that's Trump's argument. But at core, they are the same argument structurally which is about who are we, are we part of the same system and is the fundamentally fair.

The reason Facebook works is because it is fair. Now it's weird in all kinds of reasons, you know, there are all kinds of strange things about the way the Facebook works, it's advertising-driven and has all kinds of -- I'm not an apologist for Facebook by any means, but I think the issue that comes up and the questions we are deciding is what are the terms of fairness and I think what happened in the Brexit vote and I think what is coming are going to be lots of votes about whether or not large systems can be made to be meaningful and relevant for the people who particulate in it. And with that -- can I have this? I have zero minutes remaining. So thank you very much.

(Applause)

MR. ZOLLI: Have a great conference guys.

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