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FACTFULNESS

New York Times Bestseller

Ten Reasons We're Wrong About the World—and Why Things Are Better Than You Think

Hans Rosling with **Ola Rosling** and **Anna Rosling Rönnlund**

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Designed by Steven Seighman

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CHAPTER THREE

THE STRAIGHT LINE INSTINCT

How more survivors means fewer people,
how traffic accidents are like cavities, and
why my grandson is like the population of the world

The Most Frightening Graph I Ever Saw

Statistics can be terrifying. On September 23, 2014, I was sitting at my desk in the Gapminder office in Stockholm when I saw a line on a graph that gripped me with fear. I had been concerned about the Ebola outbreak in West Africa since August. Like others, I had seen the tragic images in the media of people dying in the streets of Monrovia, the capital of Liberia. But in my work, I often heard about sudden outbreaks of deadly diseases, and I had assumed it was like most others and would soon be contained. The graph in the World Health Organization research article shocked me into fear and then action.

The researchers had collected all the Ebola data since the start of the epidemic and used it to calculate the expected number of new cases per day up to the end of October. They showed, for the first time, that the number of cases was not just increasing along a straight line: 1, 2, 3, 4, 5. Instead, the number was doubling like this: 1, 2, 4, 8, 16. Each infected person was infecting, on average, two more people before dying. As a result, the number of new cases per day was doubling every three weeks. The graph showed how enormous the outbreak would soon become if each infected person kept infecting two more. Doubling is scary!

I had first learned about the effect of doubling at school. In the Indian legend, the Lord Krishna asks for one grain of rice on the first square of the chessboard, then two grains on the second square, four grains on the third square, then eight, and so on, doubling the number of grains each time. By the time he gets to the last of the 64 squares, he is owed 18,446,744,073,709,551,615 grains of rice: enough to cover the whole of India with a layer of rice 30 inches deep. Anything that keeps doubling grows much faster than we first assume. So I knew the situation in West Africa was about to become desperate. Liberia was at risk of a catastrophe worse than its recently ended civil war, and one that would almost inevitably spread to the entire world. Unlike malaria, Ebola could spread quickly in all climates and could travel on airplanes, across borders and oceans inside the bodies of unknowingly infected passengers. There was no effective treatment for it.

People were already dying in the streets now. Within only nine weeks (the time needed for three doublings) the situation would be eight times as desperate. Every three-week delay in dealing with the problem would mean twice as many people infected and twice as many resources needed. Ebola had to be stopped within weeks.

At Gapminder we immediately changed our priorities and started studying the data and producing information videos to explain the urgency of the situation. By October 20, I had canceled all my

assignments for the next three months and was on a plane to Liberia, where I hoped my 20 years of studying epidemics in rural sub-Saharan Africa could be of some use. I remained in Liberia for three months, missing Christmas and New Year's with my family for the first time ever.

Like the rest of the world, I was too slow to understand the magnitude and urgency of the Ebola crisis. I had assumed that the increase in cases was a straight line when in fact the data clearly showed that it was a doubling line. Once I understood this, I acted. But I wish I had understood, and acted, sooner.

The Mega Misconception That "The World Population Is *Just* Increasing and Increasing"

Nowadays, the word *sustainability* is found in the title of almost every conference I get invited to. One of the most important numbers of the sustainability equation is the human population. There must be some kind of limit to how many people can live on this planet. Right? So when I started testing my audiences at these sustainability conferences, I just assumed that they would know the basic facts about global population growth. Seldom have I been so wrong.

We have now arrived at the third instinct—the straight line instinct—and the third and last mega misconception: the false idea that the world population is *just* increasing. Please pay attention to the word *just*, which I've made italic and underlined for a purpose. This word is the misconception.

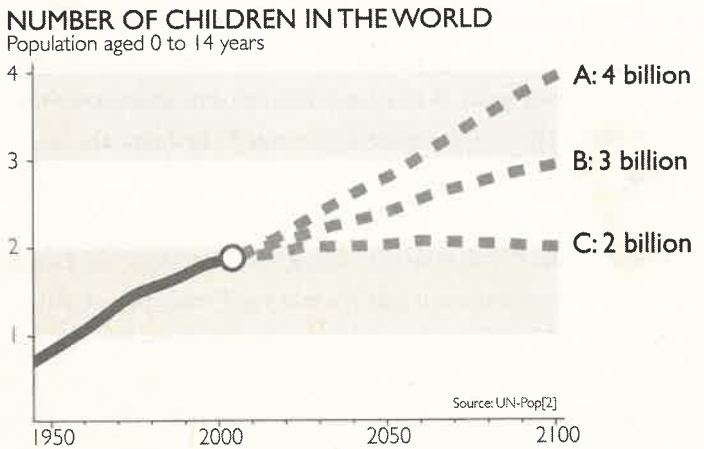
In fact, the world population *is* increasing. Very fast. Roughly a billion people will be added over the next 13 years. That's true. That's not a misconception. But it's not *just* increasing. The "just" implies that, if nothing is done, the population will just keep on growing. It implies that some drastic action is needed in order to stop the growth. That is the misconception, and I think it is based on the same instinct that

stopped me and the world from acting sooner to stop Ebola. The instinct to assume that lines are straight.

I rarely get speechless, but it happened the first time I asked an audience the following question. It was at a teachers' conference in Norway (but I don't mean to be too hard on the Norwegians: it might just as well have been in Finland too). Many of these teachers were teaching global population trends as part of their social science classes. When I turned my head around and saw the results from the live poll on the screen behind me, I couldn't find words. I remember thinking that there must be something wrong with the polling devices.

FACT QUESTION 5

There are 2 billion children in the world today, aged 0 to 15 years old. How many children will there be in the year 2100, according to the UN?



Before asking the question, I had told the teachers, "One of these three lines shows the official UN forecast. The other two lines, I just made up."

Again, chimpanzees pick the correct line 33 percent of the time. The teachers in Norway? Only 9 percent. I was shocked. How could such an important group of people score worse than random? What were they teaching the children?

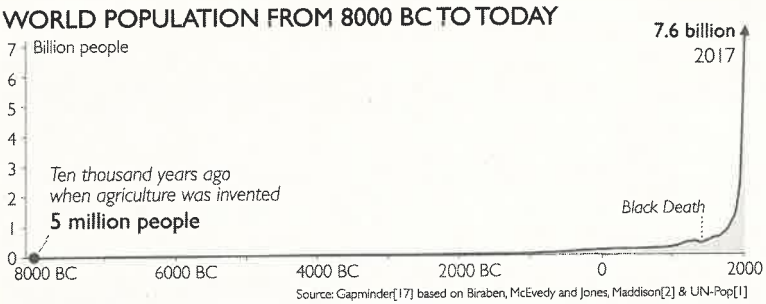
I kind of hoped the polling devices were broken. But they were not. We got the same terrible results in our public polls. In the United States, the United Kingdom, Sweden, Germany, France, and Australia, 85 percent of people picked the fake lines. (The full country breakdown is in the appendix.)

The experts at the World Economic Forum? They answered much better than the public. Almost as well as chimpanzees. Twenty-six percent got it right.

Thinking it over more calmly after the teachers' conference was over, I started to see the size of the knowledge problem. The number of future children is the most essential number for making global population forecasts. So it is central to the whole sustainability debate. If we get this number wrong, we are going to get a lot else wrong. Yet almost none of the highly educated and influential people we have measured have the slightest knowledge of what the population experts are all agreeing about. The numbers are freely available online, from the UN website, but free access to data doesn't turn into knowledge without effort. The UN line is alternative C: the flat line at the bottom. UN experts expect that in the year 2100 there will be 2 billion children, the same number as today. They don't expect the line to continue straight. They expect no further increase. I'll soon get back to this.

The Straight Line Instinct

This graph shows the world population since the year 8000 BC. That's when agriculture was invented.



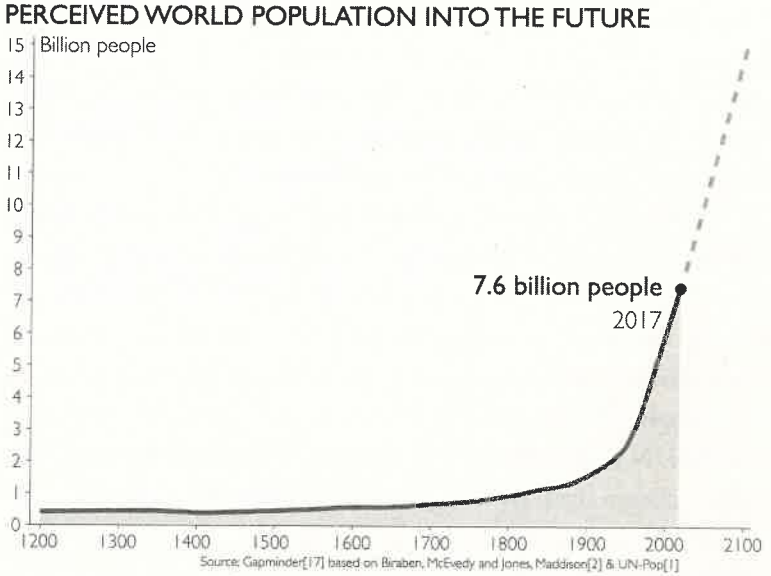
Back then, the total human population was roughly 5 million people, spread along coastlines and rivers all over the world. The total of humanity was smaller than the population of one of our big cities today: London, Bangkok, or Rio de Janeiro.

This number increased only slowly for almost 10,000 years, eventually reaching 1 billion in the year 1800. Then something happened. The next billion were added in only 130 years. And another 5 billion were added in under 100 years. Of course people get worried when they see such a steep increase, and they know the planet has limited resources. It sure *looks* like it's *just* increasing, and at a very high speed.

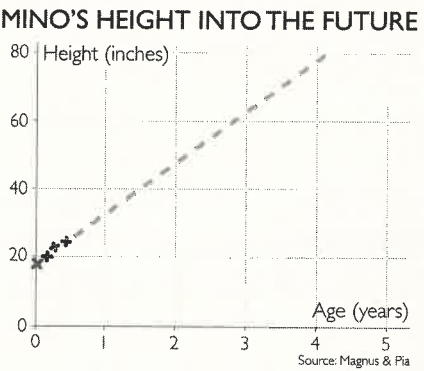
When looking at a stone flying toward you, you can often predict whether it is going to hit you. You need no numbers, no graphs, no spreadsheets. Your eyes and brain extend the trajectory and you move out of the stone's way. It's easy to imagine how this automatic visual forecasting skill helped our ancestors survive. And it still helps us survive: when driving a car, we constantly predict where other cars will be within the next few seconds.

But our straight line intuition is not always a reliable guide in modern life.

When looking at a line graph, for example, it's nearly impossible *not* to imagine a straight line that stretches beyond the end of the trend, into the future. On the population graph on the next page, I added the dashed line to clarify what I think people are instinctively imagining. Of course they get worried.



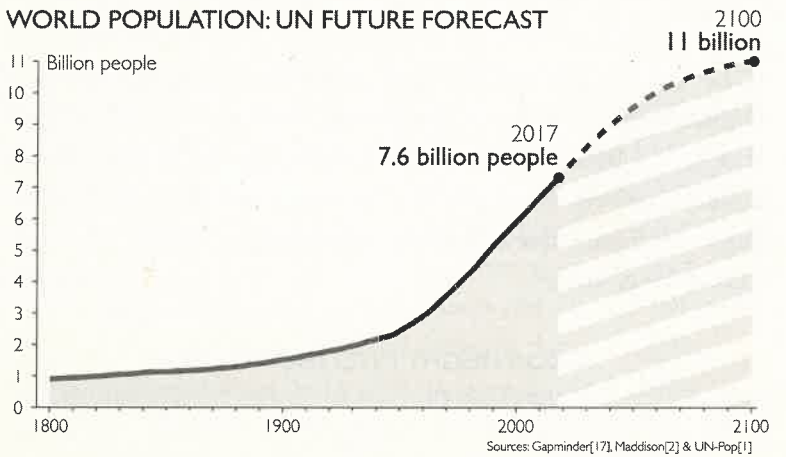
Let me now give you another example that I know you are more familiar with. My youngest grandchild, Mino, was 19.5 inches long when he was born. In his first six months he grew to 26.5 inches. An impressive growth of seven inches. Impressive, but also scary. Look at his growth chart. I have added the intuitive straight line into the future. It's terrifying, isn't it?



If Mino *just* continues growing, he will be 60 inches tall on his third birthday—a five-foot toddler. By his tenth birthday he will be 160 inches tall—over 13 feet. And then what? This can't *just* continue! Somebody must do something drastic! Mino's parents will have to remodel their house or find some medication!

The straight line intuition is obviously wrong in this case. Why is it obvious? Because we all have firsthand experience of a growing body. We know Mino's growth curve won't just continue. We've never met a person 160 inches tall. Assuming the trend will continue along a straight line is obviously ludicrous. But when we're less familiar with a topic, it's surprisingly difficult to imagine how stupid such an assumption may be.

The UN population experts have firsthand experience of calculating population sizes. It's their job. This is the line they expect:



The world population today is 7.6 billion people, and yes, it's growing fast. Still, the growth has already started to slow down, and the UN experts are pretty sure it will keep slowing down over the next few decades. They think the curve will flatten out at somewhere between 10 and 12 billion people by the end of the century.

The Shape of the Population Curve

To understand the shape of this population curve, we need to understand where the increase in population is coming from.

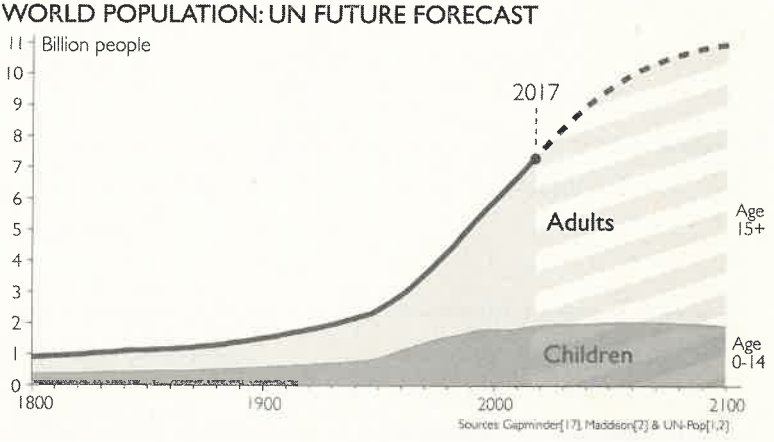
Why Is the Population Increasing?

FACT QUESTION 6

The UN predicts that by 2100 the world population will have increased by another 4 billion people. What is the main reason?

- ☐ A: There will be more children (age below 15)
- ☐ B: There will be more adults (age 15 to 74)
- ☐ C: There will be more very old people (age 75 and older)

This one, I'll give you the answer right away. The correct answer is B. The experts are convinced the population will keep growing, mainly because there will be more adults. Not more children and not more very old people. More adults. Here's the same population graph I just showed you, but now separating children and adults:

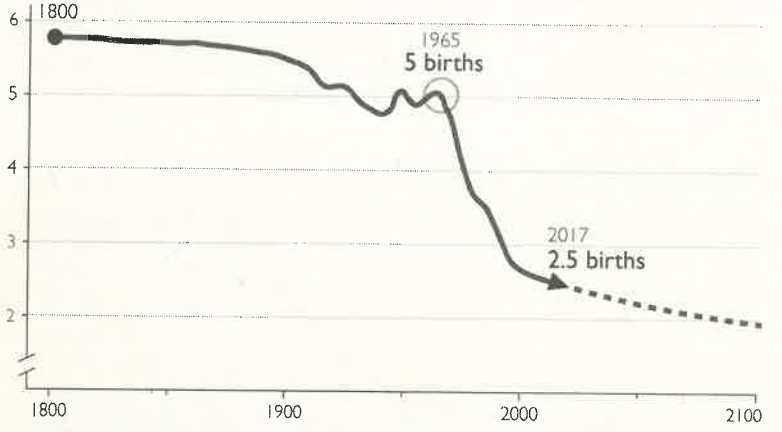


The number of children is not expected to increase, which we know already from this chapter's first fact question. Now look closely at the children line in this graph. Can you see when it gets flat? Can you see that it is already happening? The UN experts are not *predicting* that the number of children *will* stop increasing. They are *reporting* that it is already happening. The radical change that is needed to stop rapid population growth is that the number of children stops growing. And that is already happening. How could that be? That, everybody should know.

Attention, now! Because this next chart is the most dramatic in this book. It shows the incredible, truly world-changing drop in the number of babies per woman that has happened during my lifetime.

When I was born in 1948, women on average gave birth to five children each. After 1965 the number started dropping like it never had done before. Over the last 50 years it dropped all the way to the amazingly low world average of just below 2.5.

AVERAGE NUMBER OF BABIES PER WOMAN FROM 1800 TO TODAY



Source: Gapminder[7] based on UN-Pop[3]

This dramatic change happened in parallel with all those other improvements I described in the last chapter. As billions of people left

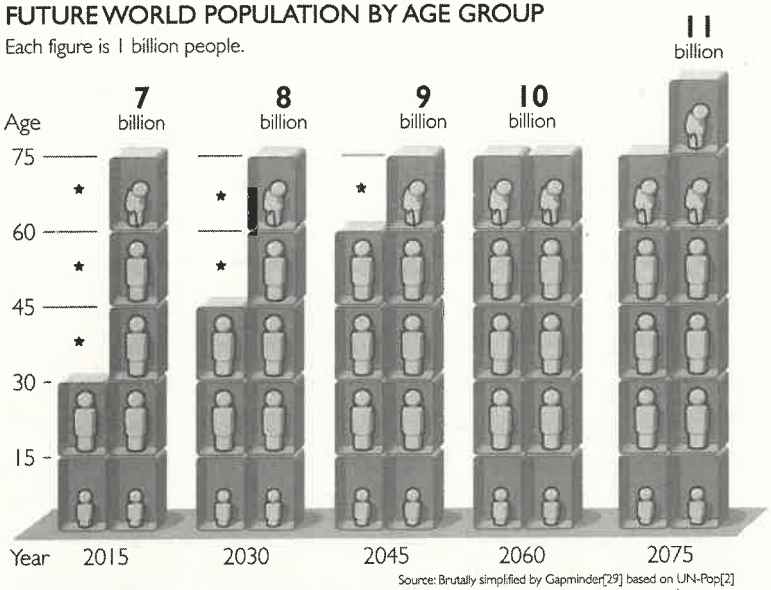
extreme poverty, most of them decided to have fewer children. They no longer needed large families for child labor on the small family farm. And they no longer needed extra children as insurance against child mortality. Women and men got educated and started to want better-educated and better-fed children: and having fewer of them was the obvious solution. In practice, that goal was easier to realize thanks to the wonderful blessing of modern contraceptives, which let parents have fewer children without having less sex.

The dramatic drop in babies per woman is expected to continue, as long as more people keep escaping extreme poverty, and more women get educated, and as access to contraceptives and sexual education keeps increasing. Nothing drastic is needed. Just more of what we are already doing. The exact speed of the future drop is not possible to predict exactly. It depends on how fast these changes continue to happen. But in any case, the annual number of births in the world has already stopped increasing, which means that the period of fast population growth will soon be over. We are now arriving at "peak child."

But then, if the number of births has already stopped increasing, where are the 4 billion new adults going to come from? Spaceships?

Why Will the Population Stop Increasing?

The chart on the next page shows the population of the world divided into age groups, in 2015 and then every 15 years after that.



On the left, the chart shows the ages of the 7 billion people alive in 2015: 2 billion were aged 0 to 15, 2 billion aged 15 to 30, and then there were 1 billion each in the 30 to 45, 45 to 60, and 60 to 75 age groups.

In 2030, there will be 2 billion new 0- to 15-year-olds. Everyone else will have grown older. The 0- to 15-year-olds of today will have become 15- to 30-year-olds. The 15- to 30-year-olds of today will have become 2 billion 30- to 45-year-olds. There are only 1 billion 30- to 45-year-olds today. So, without any increase in the number of children being born, and without people living for longer, there will be 1 billion more adults.

The 1 billion new adults come not from new children, but from children and young adults who have already been born.

For three generations, this pattern will repeat itself. In 2045, the 2 billion 30- to 45-year-olds will become 45- to 60-year-olds and we will have another 1 billion adults. In 2060, the 2 billion 45- to 60-year-olds

will become 60- to 75-year-olds and we will have another 1 billion adults. But look what happens next. From 2060, each generation of 2 billion people will be replaced by another generation of 2 billion people. The fast growth stops.

The large increase in population is going to happen not because there are more children. And not, in the main, because old folks are living longer. In fact the UN experts do predict that by 2100, world life expectancy will have increased by roughly 11 years, adding 1 billion old people to the total and taking it to around 11 billion. The large increase in population will happen mainly because the children who already exist today are going to grow up and "fill up" the diagram with 3 billion more adults. This "fill-up effect" takes three generations, and then it is done.

That's actually all you need to know to understand the method that the UN experts use to not *just* draw a straight line into the future.

(This explanation is a brutal simplification. Many die before they reach 75, and many parents have their children after they reach 30. But even including these facts makes no difference to the big picture.)

In Balance with Nature

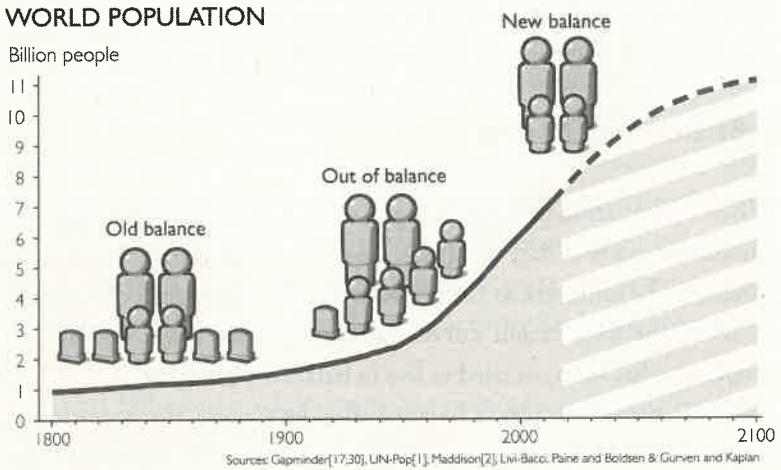
When a population is not growing over a long period of time, and the population curve is flat, this must mean that each generation of new parents is the same size as the previous one. For thousands of years up to 1800 the population curve was almost flat. Have you heard people say that humans used to live in balance with nature?

Well, yes, there was a balance. But let's avoid the rose-tinted glasses. Until 1800, women gave birth to six children on average. So the population should have increased with each generation. Instead, it stayed more or less stable. Remember the child skeletons in the graveyards of the past? On average four out of six children died before

becoming parents themselves, leaving just two surviving children to parent the next generation. There was a balance. It wasn't because humans *lived* in balance with nature. Humans *died* in balance with nature. It was utterly brutal and tragic.

Today, humanity is once again reaching a balance. The number of parents is no longer increasing. But this balance is dramatically different from the old balance. The new balance is nice: the typical parents have two children, and neither of them dies. For the first time in human history, we *live* in balance.

The population grew from 1.5 billion in 1900 to 6 billion in 2000 because humanity went through a transition from one balance to another during the twentieth century, a unique period of human history when two parents on average produced more than two children who survived to become parents themselves in the next generation.



That period of imbalance is the reason why today the two youngest generations are larger than the others. That period of imbalance is the

reason behind the fill-up. But the new balance is already achieved: the annual number of births is no longer increasing. If extreme poverty keeps falling, and sex education and contraception keep spreading, then the world population will keep growing fast, but only until the inevitable fill-up is completed.

Wait, "They" Still Have Many Children

Even after I show these charts onstage, people come up to me after the presentation and tell me that the charts can't be correct because, you know, *"People in Africa and Latin America still have many children. And religious people refuse contraceptives and still have huge families."*

Skilled journalists pick and choose dramatic exceptional people in their reports. In the mass media we sometimes see examples of very religious people, whether living in traditional ways or leading seemingly modern lives, who proudly show us their very large families as evidence of faith. Such documentary films, TV shows, and media reports give the impression that religion leads to much larger families. But whatever their religion—whether they are Catholics, Jews, or Muslims—these families share one quality. They are the exceptions!

In reality, the connection between religion and babies per woman is not so impressive. Throughout this book I discuss how the media chooses its exceptional stories, and in chapter 7 I will debunk the myth of religion and large families. For now, let's look at the single factor that does have a strong connection with large families: extreme poverty.

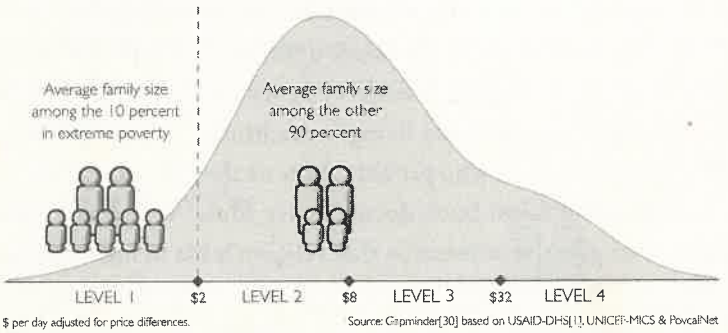
Why More Survivors Lead to Fewer People

When combining all the parents living on Levels 2, 3, and 4, from every region of the world, and of every religion or no religion,

together they have on average two children. No kidding! This includes the populations of Iran, Mexico, India, Tunisia, Bangladesh, Brazil, Turkey, Indonesia, and Sri Lanka, just to name a few examples.

The poorest 10 percent combined still have five children on average. And on average, every second family living in extreme poverty loses one of their children before he or she reaches the age of five. That is shamefully high, but still far better than the ghastly levels that kept population growth down in the bad old times.

AVERAGE FAMILY SIZE BY INCOME, 2017



$ per day adjusted for price differences.

Source: Gapminder[30] based on USAID-DHS[11], UNICEF-MICS & PovcalNet

When people hear that the population is growing, they intuitively think it will continue to grow unless something is done. They intuitively visualize the trend continuing into the future. But remember, for my grandchild Mino to stop growing taller, nothing drastic needs to be done.

Melinda Gates runs a philanthropic foundation together with her husband, Bill. They have spent billions of dollars to save the lives of millions of children in extreme poverty by investing in primary health care and education. Yet intelligent and well-meaning people keep contacting their foundation saying that they should stop. The argument

goes like this: *"If you keep saving poor children, you'll kill the planet by causing overpopulation."*

I have also heard this argument after some of my presentations, from people who may have the best intentions and want to save the planet for future generations. It sounds intuitively correct. If more children survive, the population *just* increases. Right? No! Completely wrong.

Parents in extreme poverty need many children for the reasons I set out earlier: for child labor but also to have extra children in case some children die. It is the countries with the highest child mortality rates, like Somalia, Chad, Mali, and Niger, where women have the most babies: between five and eight. Once parents see children survive, once the children are no longer needed for child labor, and once the women are educated and have information about and access to contraceptives, across cultures and religions both the men and the women instead start dreaming of having fewer, well-educated children.

"Saving poor children *just* increases the population" sounds correct, but the opposite is true. Delaying the escape from extreme poverty *just* increases the population. Every generation kept in extreme poverty will produce an even larger next generation. The only proven method for curbing population growth is to eradicate extreme poverty and give people better lives, including education and contraceptives. Across the world, parents then have chosen for themselves to have fewer children. This transformation has happened across the world but it has never happened without lowering child mortality.

This discussion so far has left out the most important point, which is the moral imperative to help people escape from the misery and indignity of extreme poverty. The argument that we must save the planet for future people, not yet born, is difficult for me to hear when people are suffering today. But when it comes to child mortality, we don't have to choose between the present and the future, or between our hearts

and our heads: they all point in the same direction. We should do everything we can to reduce child mortality, not only as an act of humanity for living suffering children but to benefit the whole world now and in the future.

Two Public Health Miracles

In the first full year of Bangladesh's independence, 1972, Bangladeshi women had on average seven children and life expectancy was 52. Today, Bangladeshi women have two children and a newborn can expect to live for 73 years. In four decades, Bangladesh has gone from miserable to decent. From Level 1 to Level 2. It is a miracle, delivered through remarkable progress in basic health and child survival. The child survival rate is now 97 percent—up from less than 80 percent at independence. Now that parents have reason to expect that all their children will survive, a major reason for having big families is gone.

In Egypt in 1960, 30 percent of all children died before their fifth birthday. The Nile delta was a misery for children, with all sorts of dangerous diseases and malnutrition. Then a miracle happened. The Egyptians built the Aswan Dam, they wired electricity into people's homes, improved education, built up primary health care, eradicated malaria, and made drinking water safer. Today, Egypt's child mortality rate, at 2.3 percent, is lower than it was in France or the United Kingdom in 1960.

How to Control the Straight Line Instinct, or Not All Lines Are Straight

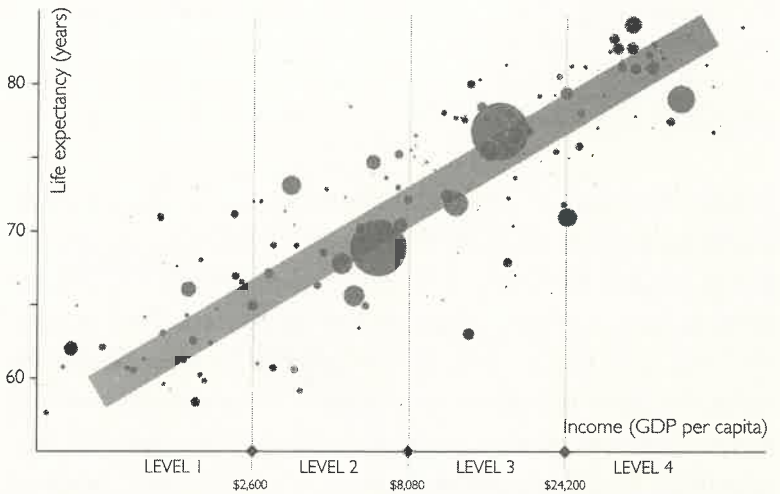
The best way of controlling the instinct to always see straight lines—whether in relation to population growth or in other situations—is

simply to remember that curves naturally come in lots of different shapes. Many aspects of the world are best represented by curves shaped like an S, or a slide, or a hump, and not by a straight line. Here are some examples, each showing how a particular aspect of life changes as we move across the four income levels.

Straight Lines

Straight lines are much less common than we tend to think, but some lines are straight. Below is a simplified version of the wealth and health chart you have seen before. Instead of all the bubbles, we can draw a line where most of the bubbles are. Some bubbles are above the line and others are below but you can see that in general they cluster around a straight line.

A STRAIGHT LINE
Longer lives and higher income go hand in hand.

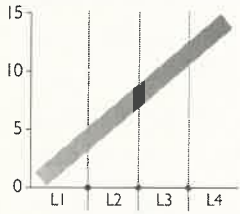


This chart shows that money and health go hand in hand. We don't know from just looking at the line which comes first or what the

relationship is between the two. It might be that a healthy population produces more income. It might be that a rich population can afford better health. I think both are true. What we do know from such a line is that in general where income is higher, health is better.

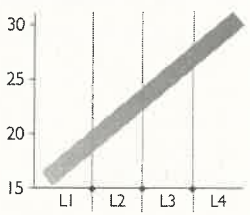
We can also find straight lines when we compare income levels with education, marriage age, and spending on recreation. More income goes hand in hand with longer average schooling, with women marrying later, and with a greater share of income going toward recreation.

SCHOOLING
Average length of education in years



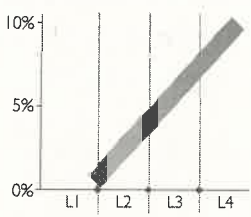
Sources: Gapminder[3,44] & IHME[2]

BRIDE AGE
Women's average age at first marriage



Sources: Gapminder[3,33]

RECREATION
Share of income used for recreation and culture



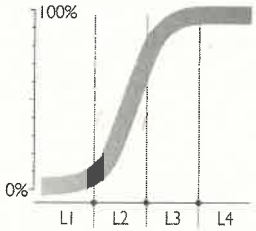
Sources: Gapminder[3,45] based on ILO[10]

S-Bends

When we compare income with basic necessities like primary-level education or vaccination, we see S-shaped curves. They are low and flat at Level 1, then they rise quickly through Level 2, because above Level 1, countries can afford primary education and vaccination (the most cost-effective health intervention there is) for just about the entire population. Just as we will buy ourselves a fridge and a cell phone as soon as we can afford them, countries will invest in primary education and vaccination as soon as they can afford them. Then the curves flatten off at Levels 3 and 4. Everyone already has these things. The curves reach their maximum and stay there.

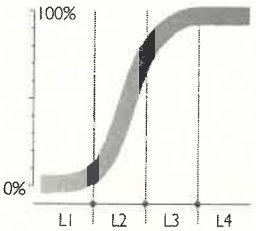
Remembering about this kind of curve will help you to improve your guessing about the world: on Level 2, almost everyone can already afford to have their basic physical needs met.

LITERACY
Share of adults who can read and write



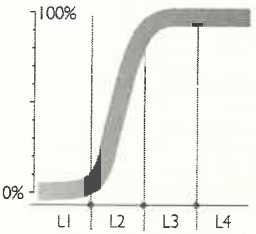
Sources: Gapminder[3,21] & UNESCO[2]

VACCINATION
Share of 1-year-olds vaccinated



Sources: Gapminder[3,23] & WHO[1]

FRIDGES
Share of homes with fridge or freezer

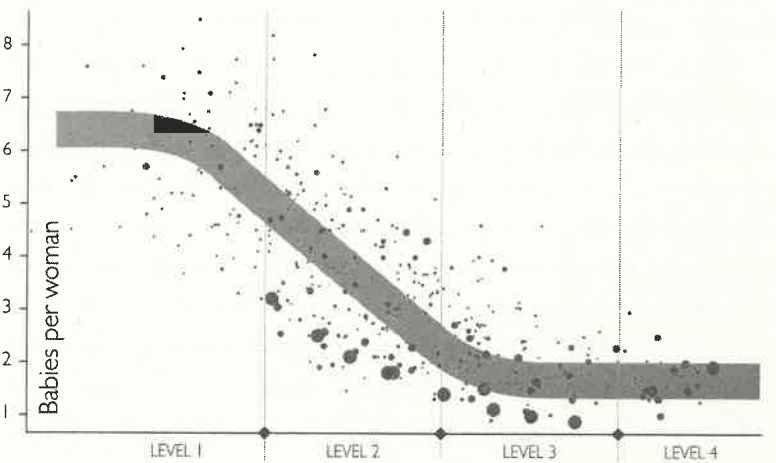


Sources: Gapminder[3] & USAID-DHS[1]

Slides

The babies-per-woman curve looks like a slide in a playground. It starts flat, then, after a certain level of income, it slopes downward, and then it flattens out and stays quite low, just below two babies per woman.

A SLIDE
In this graph dots may represent countries, or, wherever we had data, we split a country into five income groups, each representing 20 percent of the population. This shows 2017.



Source: Gapminder[3,47] based on GDL[11], USAID-DHS[1], UNICEF-MICS & OurWorldInData[10]

Shifting away from income graphs for a moment, we see a similar shape for the cost of vaccinations. In basic math classes, we teach children to multiply. If an injection costs $10, what's the price of a million injections? UNICEF knows how to count but it has also saved millions of children's lives by not accepting a straight line. It has negotiated huge contracts with pharmaceutical companies, in which the price is cut to the bare minimum in return for guaranteed long contracts. But when you have negotiated to the bottom price, you can't get lower. That's another slide-shaped curve.

Humps

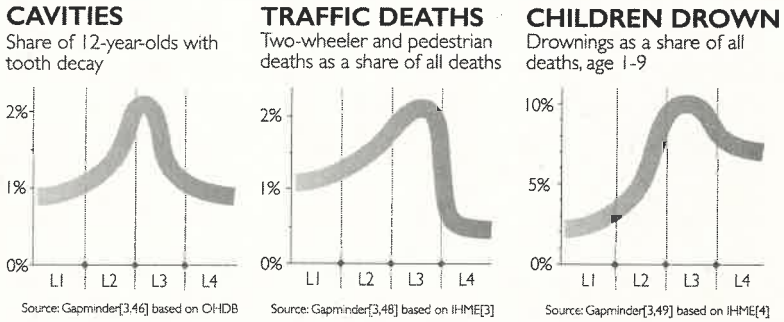
Your tomato plant will grow as long as it gets water. So, if more water is what it needs, why don't you turn the hose on it, so you can grow an enormous prize-winning tomato? Of course you know that doesn't work. It's a question of dosage. Too little and it dies. Too much and it dies too. Tomato survival is low in very dry and very wet environments, but high in environments that are in the middle.

Similarly, there are some phenomena that are lower in countries on Level 1 and countries on Level 4, but higher in middle-income countries—which means the majority of countries.

Dental health, for example, gets worse as people move from Level 1 to Level 2, then improves again on Level 4. This is because people start to eat sweets as soon as they can afford them, but their governments cannot afford to prioritize preventive public education about tooth decay until Level 3. So poor teeth are an indicator of relative poverty on Level 4, but on Level 1 they may indicate the opposite.

Motor vehicle accidents show a similar hump-shaped pattern. Countries on Level 1 have fewer motor vehicles per person, so they do not have many motor vehicle accidents. In countries on Levels 2 and

3, the poorest people keep walking the roads while others start to travel by motor vehicles—minibuses and motorcycles—but roads, traffic regulations, and traffic education are still poor, so accidents reach a peak, before they decline again in countries on Level 4. The same goes for child drownings as a percentage of all child deaths.

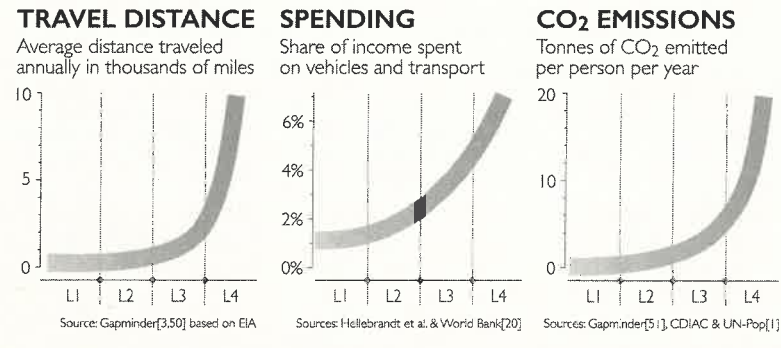


Like tomatoes, human beings need water to survive. But if you drink six liters at once, you will die. The same goes for sugar, fat, and medicines. Actually, everything you need to survive is lethal in high dosage. Too much stress is bad, but the right amount improves performance. Self-confidence has its optimal dosage. The intake of dramatic news from the rest of the world probably has its optimal dosage too.

Doubling Lines

Finally, doubling. The doubling pattern of the Ebola virus is actually a very common type of pattern in nature. For example, the number of *E. coli* bacteria in a body can explode in just a few days because it can double every 12 hours: 1, 2, 4, 8, 16, 32 . . . The world of transport also contains many doubling patterns. As people's incomes increase, the distance they travel each year keeps doubling. So does the share of their

income that they spend on transport. On Level 4, transport is behind one-third of all CO_2 emissions—which also double with income.



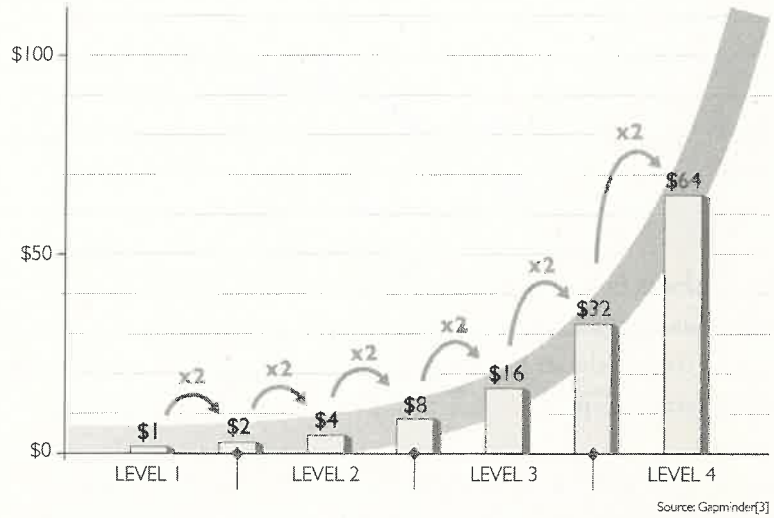
Most people's incomes grow much slower than bacteria, unfortunately. Still, even if your income increases by only 2 percent a year, after 35 years it will have doubled. And then, if you maintain 2 percent growth, in another 35 years it will have doubled again. Over 200 years—if you lived that long—it would double six times, which is exactly what we saw in Sweden's bubble trail in the last chapter, and which is typically the slow and steady way countries have moved from Level 1 to Level 4. The graph on the next page shows how six doublings move you across all four income levels.

I have divided the levels in this way because that's how money works. The impact of an additional dollar is not the same on different levels. On Level 1, with $1 a day, another dollar buys you that extra bucket. That is life-changing. On Level 4, with $64 a day, another dollar has almost no impact. But with another $64 a day, you could build a pool or buy a summer house. That's life-changing for you. The world is extremely unfair, but doubling one's income, from any starting point, is always life-changing. I use this doubling scale whenever I compare income because that's how money works.

By the way, the scales for measuring earthquakes, sound levels, and pH works in the same way.

DOUBLING INCOME

Daily income doubles twice from one level to the next



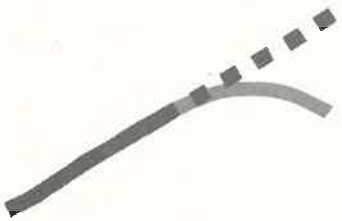
Source: Gapminder[3]

How Much of the Curve Do You See?

Curves come in many different shapes. The part of the curve with which we are familiar, living on Level 4, may not apply at all on Levels 1, 2, or 3. An apparently straight upward trend could be part of a straight line, an S-bend, a hump, or a doubling line. An apparently straight downward trend could be part of a straight line, a slide, or a hump. Any two connected points look like a straight line but when we have three points we can distinguish between a straight line (1, 2, 3) and the start of what may be a doubling line (1, 2, 4).

To understand a phenomenon, we need to make sure we understand the shape of its curve. By assuming we know how a curve continues beyond what we see, we will draw the wrong conclusions and come up with the wrong solutions. That is what I did before I realized that the Ebola epidemic was doubling. And that is what everyone is doing who thinks that the world population is *just* increasing.

Factfulness



Factfulness is . . . recognizing the assumption that a line will just continue straight, and remembering that such lines are rare in reality.

To control the straight line instinct, **remember that curves come in different shapes.**

- **Don't assume straight lines.** Many trends do not follow straight lines but are S-bends, slides, humps, or doubling lines. No child ever kept up the rate of growth it achieved in its first six months, and no parents would expect it to.