THE ART AND SCIENCE OF COMMUNICATING NUMBERS

MAKING NUMBERS COUNT

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Introduction

We both fell in love with numbers as kids, thanks to the same remarkable book, the *Guinness Book of World Records*. It was as big as a flowerpot and four times as heavy, printed in the same small type that we're reading when someone warns us to "check the fine print," but was full of extraordinary facts, stories, and most importantly *numbers*. World's largest pumpkin: 2,624 pounds. World's fastest animal: peregrine falcon, 242 miles per hour. Most forward somersaults, underwater, in one breath: 36 by Lance Davis of Los Angeles, California.

These enticing figures, of mind-boggling diversity, were the gateway to a lifelong love of numbers. The working world is full of them. From athletes to climate scientists to marketing professionals, people use numbers to measure their work, press their case, and motivate others to change.

But with all the numbers floating around, it's easy to start believing that everyone else is more on top of the numbers than we are, that somehow we missed the right class or lack the right gene, and that we are constantly at a disadvantage in understanding and using these excessively common objects.

But here's a secret: nobody really understands numbers.

Nobody.

That's just a fact of being human. Our brains evolved to deal with *very small* numbers. We can recognize 1, 2, and 3 at a glance, up to 4 or 5 if we're lucky. You can get a sense of this from any kid's counting book; your brain shouts "3!" when you see a picture of 3 goldfish, no counting necessary. That's a process called *subitizing*, which our brains developed long before numerical systems were invented.*

Indeed, most languages in the world and throughout history have names for the numbers 1, 2, 3, 4, and 5. But after that, the supply of numbers with names runs dry, and the language is forced to resort to a generic word such as "lots" for all the other numbers—from 6 and 7 on up to a billion gazillion.† Picture the day-to-day frustration of trying to communicate in a culture that doesn't have words for numbers past 5:

Scene 1:

"Did we get enough eggs today to feed our people?"

"Well, we got lots of eggs. But on the other hand, we've got lots of people. So I guess we'll find out at dinnertime."

Scene 2:

"You said you'd trade me lots of pistachios for my feather necklace."

"This is lots."

"Yeah, but I meant, like, lots-lots."

And more than the frustration, imagine the out-and-out tragedies that could accrue when your culture hasn't given you words for describing critical plans using numbers.

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* There's an extensive set of endnotes that provide links to the academic research, sources for facts, and sample calculations.

† This is another place where you might want to look for an endnote.

Scene 3:

"I've told you lots of times, it's lots of miles across the desert and it takes lots of days, so we'd better bring lots of water!"

"I did bring lots."

"Well, it wasn't enough lots! Now, what are our chances of reaching the oasis before we die of thirst?'

"One chance in, er, lots."

So it was a great advance when humans developed additional tools for doing math—first, systems for counting (scratches on a stone, knots on string, bar codes); then numbers (455 or 455,000); then mathematics. But while our cultural math infrastructure has changed, our brains are still the same from a biological perspective. Even if we train a lot—and we do all the way up through college—mathematics is a blisteringly new piece of high-tech software strapped on top of a clunky piece of hardware. It can work, but it will never be our first instinct. Billions, trillions, millions, kajillions . . . they all sound the same but describe wildly different realities. Our brains were designed to grok 1, 2, 3, 4, and 5. After that, it's just "lots."

Consider this thought experiment designed to help people understand the difference between "a million" and "a billion." You and a friend each enter a lottery with several large prizes. But there's a catch: If you win, you must spend $50,000 of your prize money each day until it runs out. You win a million dollars. Your friend wins a billion. How long does it take each of you to spend your lottery windfall?

As a millionaire, your encounter with runaway consumerism is surprisingly short. You go bust after a mere 20 days. If you win on Thanksgiving, you're out of money more than a week before Christmas. (Sorry, Cousin Ana, the lottery money ran out before we bought your present, but we did get you the Orange Crush umbrella!)

For your billionaire friend, resources would hold out a tad longer. He or she would have a full-time job spending $50,000 a day for . . .

55 years.

Approximately two generations. Almost 14 presidential terms. One wait to hear your name called at the DMV.

1 billion—1,000,000,000—is a number. We might think we understand it because it's right there, in black and white, but it has so many zeros that our brains fog up. It's just "lots." When we see how much larger it is than a million, it comes as a surprise.

Think of what we accomplished by forcing you to imagine watching your friend spend $50,000 every day for 55 years. Not only does it make the number click, it morphs our envy into something so real and palpable that we'll help you kick your friend in the shins. It's an animated picture that brings the number to life.

This book is based on a simple observation: we lose information when we don't translate numbers into instinctive human experience. We do hard, often painstaking work to generate the right numbers to help make a good decision—but all that work is wasted if those numbers never take root in the minds of the decision makers. As lovers of numbers, we find this tragic. The work that is being done to understand the most meaningful things in the world—ending poverty, fighting disease, conveying the scale of the universe, telling a heartbroken teen how many other times they will fall in love—is being lost because of the lack of translation.

That's when the two of us—Chip, a business school professor, and Karla, a science journalist—thought, There ought to be a book for this sort of thing.

But there isn't. We've looked. There are great guides for making graphs more stylish and persuasive, or for making infograph-

ics that make a complex process easier to understand. But there's no guidebook and writing guide for the fundamental process of making numbers count—getting people to understand them in instinctive and accurate terms.

And because we don't understand the process, we fear it. When numbers come up, half of us say, "I'm a designer/teacher/lawyer, not a numbers person," as if casting a spell to ward off a vampire. And the other half of us mumble apologies for the numbers and rush through our presentations before we slink back to our underworld lairs, where we can calculate in peace without facing scorn.

Our claim is that we aren't so different. If we simply translated our numbers differently, a lot more people would consider themselves numbers people. After all, there isn't really a choice. We encounter numbers *lots* of times in a given day. Our economy, our schedules, our transportation system, our household management, everything we do is based around numbers. We can choose to be involved with numerical decisions or stay in the dark, but we can't actually opt out. What we can do is ask that they make sense to us—we're only human.

It could even be fun. After all, the *Guinness Book of World Records* was not created to be an academic textbook. It was created to settle bar bets (yes, it is *that* Guinness, the company that makes beer so thick you can prop up a spoon in it).

But business first. Let's look at a case study of a number being translated in more and less effective ways. We'll start with a raw statistic that we found pretty shocking:

> *The U.S. government has a 5 A Day campaign that's designed to encourage kids to eat five servings of fruits and vegetables a day. McDonald's alone outspends this campaign by a ratio of 350 to 1.*

Anyone reading that sees a huge disparity in favor of the fast-food message. But initially, that's all we see—just one form of

"lots." We know the fast-food companies have big ad budgets, we know that they outspend healthy messages, but 20 times more, 143 times more, 350 times more? What's the big deal?

The higher numbers get, the less sensitive we get to them, a phenomenon psychologists have labeled "psychophysical numbing." Moving on the number scale from 10 to 20 feels significant. But moving an equal distance from 340 to 350, even though it's the same increase, we feel nothing . . . that's "numbing."

Our goal in this book is to give you some techniques that are going to improve your odds of overcoming that numbing. We believe you can use the principles of psychology to help people understand and act on a number. And that requires translation.

There are many possible ways to translate a sentence or paragraph from one language to another. Some will better convey the meaning, some may be more precise, some may even be more beautiful. Well, the same is true of number translations. Consider two alternative ways of translating the fact above:

Comparison Set 1:

Translation A.	*Translation B.*
McDonald's alone outspends the 5 A Day campaign by 350 to 1.	For every 5 hours and 50 minutes a child spends watching McDonald's commercials, they spend 1 minute on 5 A Day.

Translation B is better. We care about kids more than "outspending." The money budget is now converted to time. Breaking 350 down into hours and minutes makes it feel a little bigger, a little more concrete, a little more crazy.

But Translation B could be improved. 5 hours, 50 minutes is a big block of time, and it's not how children watch commercials. They don't see them one after the other—they see them sprinkled into their shows, again and again and again. Translation D below is designed to account for that insight.

Comparison Set 2:

Translation C.	*Translation D.*
McDonald's alone outspends the 5 A Day campaign by 350 to 1.	If a child sees a McDonald's commercial every single day, it would take them almost a year to see just one commercial about 5 A Day.

Calendar time is easier to feel than number counts. We know what a day is, and we know what a year is. Even young children know there is a *lonnnnnng* time between birthday parties. Whenever we can translate a number into calendar time, we're able to work with numbers we fundamentally understand. Nobody ever said, "I'm not really a calendar person."

(By the way, the colored boxes above follow a format you'll see a lot in the text. A box generally provides two translations. One presents a number the standard way, as people might normally present it. The other is translated using one of our techniques to help you make your numbers more understandable and usable. Our recommended technique is always in the shaded box which will typically be on the right.

Pro tip: *If you just want to get your creative juices flowing, thumb through the book and look at our examples. You may get some*

ideas from seeing the techniques in action. Go ahead, take a moment and look through some of the examples in the colored boxes before you proceed.

The McDonald's translations illustrate something that we'll see over and over in this book. Although our brains may not be prepared for numbers such as "112 times more" (or "a million"), there is probably a part of our well-trained cultural mind that has very good intuition about the number we're having a hard time understanding. So we may do better if we translate 112 to clock time (1 hour, 52 minutes) or calendar time (every day for almost four months). We've come to believe, after working with these principles for years, that almost every gnarly number has something—an analogy, a comparison, another dimension—that will allow us to translate it into something we can remember, use, and discuss with others.

We pulled the McDonald's example from our "Avoid numbing by converting your number to a process that unfolds over time" chapter, which is just one of more than 30 translation techniques we focus on throughout the book. Each chapter introduces a simple concept, illustrates it with a few examples from business or science or sports, and explores one or two nuances. We designed the book to work as a training manual (when you're first trying your hand at translation), and also as an "I need inspiration now!" reference to thumb through when you're trying to translate an important number and you get stuck.

Where did these techniques come from? For the last 15 years, Chip has taught an MBA class on making ideas stick—mostly to MBAs, but also to physicians, artists, Naval commanders, and scientists. For years, he suggested avoiding numbers whenever possible. One semester, there was a student who challenged this advice. "I'm an investment banker. All of my ideas involve numbers. I can't escape them." So that year, Chip added a class devoted to making numbers stick.

The first session put the "error" in "trial and error." Arming his students with a set of dry statistics, Chip gave them one hour to come up with their best translations. The results were . . . uninspiring. Worse than uninspiring. They were awful. Rather than making numbers easier to grasp, the analytical MBAs often came up with a complex analogy from a loosely related domain that made the numbers harder to understand or made them seem less important.

Chip kept tinkering, hoping that with the right setup the students would arrive at some basic principles of numerical communication. After all, they were MBAs and engineers who worked every day with numbers. He didn't want to constrain their creativity by sharing too prematurely the few ideas he had at that time for making numbers count.

Finally, he gave up trying to facilitate discovery and instead described a few basic principles right before the exercises. Immediately, the results changed. The students not only grasped the concepts but ran with them, coming up with some brilliant applications.

The basic principles for communicating numbers are simple, but not obvious, even if they might feel that way once you grasp them. They're hard to discover, but not hard to remember. The trick is knowing that there *are* basic principles, ones that can be used again and again.

The class became one of the most enjoyable days of the quarter. Someone would come up with a clever translation and the class would go, "*Ooooooooohhhhhh*." Once, a group of students we'll describe later actually got applause . . . for a number translation!

In doing this book we had the advantage of casting a broad net. We searched the social sciences in psychology, anthropology, and sociology. We read books and papers about the development of math ability (and where our deficits are). We looked at what an-

thropologists discovered about how various cultures handle numbers. We searched history, science, and journalism for techniques that make numbers count.

Over the years, our principles have been road-tested by some of the planet's most skeptical and analytical minds—MBAs, engineering students, and New Yorkers. And they can be used by anyone who has mastered basic math; we've seen them work for middle schoolers.

The book is intended to be helpful to people at all levels of numerical fluency, or numeracy. You can rest assured that learning the principles won't require any computations that can't be done with a simple calculator—the old-fashioned kind with just a few giant buttons.

This, unfortunately, may be the first time anyone has bothered to show you that numbers can (and should) be translated. Think about it: in school, you were force-fed cardinal numbers and polynomial factoring and a thousand other topics, but there was never a lesson on How to Communicate Numbers. (Pop quiz: Which skill turned out to be more important in the work world?)

If you're one of the rare numerically savvy people, someone who loved the *Guinness Book of World Records* as a kid and who took the extra math classes (and kind of liked them), these principles will also be invaluable for you. Often experts become so accustomed to their own wizardry that they no longer see how much work it takes for the rest of us to do what they do. Researchers call this "the Curse of Knowledge," and it is the supervillain in any communication domain. When experts are asked to communicate something they understand intimately—musicians tapping out the rhythm of familiar songs, statisticians presenting shocking graphs, your dog barking to alert you to a *really* interesting smell—they wildly overestimate how much of their mental model of the world is shared by their audience.

The practices in this book, because they work with our natural

instincts, can help experts cursed with their knowledge translate their expertise into a blessing. Math can reveal truths about the world that the human mind was never built to intuitively grasp. If you can use math, you have a valuable skill. If you can use it and make it clear, bringing what is obscure and distant into the range where others can see it and feel it—well, then you have a superpower. Superman could see through walls; you can make the walls invisible so everyone else can see through them.

And for the non-experts, just understanding the simple trick of translation is like a judo or jiujitsu skill that gives you a fighting chance against even the most skilled numbers people. Know how to ask for the right translation—"Can you put that in concrete terms?" "What is that per employee per day?" "If this flip chart represents our total budget, can you draw me a rectangle that represents the size of this expense?"—and you put yourself back in the game. Opponents won't be able to snow you with a blizzard of numbers anymore. And analytical people of good faith will appreciate having a worthy sparring partner, pleasantly surprised that the seemingly artsy HR person has a mathematical edge.

It's hard to imagine someone who wouldn't benefit from this power: Picture a manager arguing for a bigger budget for testing a product with consumers. A scientist trying to convey the distance between two points in the universe. A marketer demonstrating a campaign's potential outreach. A coach discussing the benefits of practicing a few more minutes each day. Our world increasingly features numbers that lie beyond the scope of our intuition. They pop up in every area of business (from R&D to customer service), and are at the center of almost all human endeavor (consider science, sports, and government).

We live in a world in which our success often depends on our ability to make numbers count.