Chapter 1

Making Great Predictions

Claudio Feser, Daniella Laureiro-Martinez, and Stefano Brusoni

> It is not enough to possess a good mind; the most important thing is to apply it correctly.
>
> —René Descartes, *Discourse on the Method* (2018)

During their flight to London, Isabelle shared with Eve some, but given confidentiality, not all aspects of her situation.

"The situation the company is facing is very challenging," she said, "I expected to be taking the helm of a well-performing, 'lighthouse firm' and I found myself in a situation where ATG is challenged on two fronts. One, poor results. In fact, I am flying to London to pacify some of our investors after the last earnings release. And, two, the market outlook is very uncertain. Like all our traditional competitors, we must make difficult decisions: should we digitize? Should we specialize on smaller niches? Should we merge with a competitor? But also, what changes should I make to the organization?"

"You seem to be facing uncertainty. A very dynamic situation with many unknowns. You probably wonder what is the right thing to do," commented Eve.

"Yes, I do. In this situation, and as a new CEO, the investors and the board are expecting me to address the situation, to analyze the situation, and to make important strategic and operational decisions," answered Isabelle.

"OK, you need to make lots of decisions under uncertainty," confirmed Eve.

"You have studied making decisions under uncertainty, I know. What are those?" asked Isabelle.

"Well, decisions can be categorized into one of three types. First, decisions under certainty. With decisions under certainty, you know all possible options and the consequences of each option. The outcomes of each option are certain. There is no risk, or if there is, it is minimal. Signing a rental contract for your apartment is a decision under certainty. You have only two options: you can sign it, or not. The outcome of signing is clear. You will have the right to use the apartment, and you will be bound by the provisions of the lease, including paying the rent. That's for sure," said Eve.

"OK, got it. What are the other two categories?"

"The second category is decisions under risk. As with decisions under certainty, you know all possible options and their outcomes. The outcomes are only probable, but you know the probabilities. These are situations for which the statistician Leonard Savage, who is generally regarded as the founder of probabilistic or Bayesian decision theory, coined the expression 'small worlds.' According to Savage, 'small worlds' are the situations in which Bayesian theory – in essence, probabilistic thinking – provides the best answer (Savage, 1954). Examples are the games of poker or blackjack. In those games, players know all possible card combinations and their payouts. Further, for each combination, which changes as the game unfolds, they know the probability of winning," added Eve.

"And the third?" asked Isabelle eagerly.

"The third category are decisions under uncertainty. With decisions under uncertainty, all possible options, outcomes, and probabilities are unknown. For such situations, Savage coined the term 'large worlds' (Savage, 1954). Examples of large worlds are decisions about when to plan a picnic, where to go on vacation, where to eat tonight, or whom to marry (Volz and Gigerenzer, 2012)."

"Well, aren't most of the decisions made under uncertainty?" asked Isabelle.

"Yes, that's right. Decisions under uncertainty come up in every realm of life: from simple decisions such as where to eat tonight (Shall we go to the usual place and order what we like and usually eat, or shall we order something different, or even try another restaurant?) to potentially life-changing decisions (What is the best next step in my career? Should I stay and build my career at my current company, or change companies or even careers?), all these decisions are decisions under uncertainty. We make such decisions most of the time, while we relatively seldom must make decisions under certainty or under known risk. What's interesting is that classical approaches of decision theory aren't sufficient to make decisions in such situations. Approaches such as scenario planning, decisions trees, and statistics are not sufficient because new branches in a decision tree continuously pop up, payouts aren't stable, nor are probabilities. To make decisions amid uncertainty, we need strategies beyond Bayes' rules."

"That is?" asked Isabelle.

Eve continued: "When making decisions under uncertainty we – consciously or unconsciously – make predictions about the future. We make a guess about the return of an investment, about the need for surgery of an unusual tumor, or about the behaviors of a competitor or an adversary (Satopää et al., 2021). And then, we apply heuristics, or general rules, to make decisions (Volz and Gigerenzer, 2012)."

"Predictions and heuristics? That sounds interesting. Can you tell me more?" asked Isabelle.

When making decisions under uncertainty we – consciously or unconsciously – make predictions about the future. And then, we apply heuristics, or general rules, to make decisions.

The Crystal Ball in Your Head: Wired to Make Predictions

Our brain's ability to make predictions may have been a key aspect of the development of the human species. Throughout the intricate tapestry of human evolution, the capacity of our ancestors to anticipate and prepare for potential future events provided a substantial survival advantage. In the primordial landscapes, being able to predict the movement of prey or anticipate the lurking of predators was paramount for survival. Over successive generations, individuals endowed with heightened predictive faculties were more likely to evade danger, secure sustenance, and subsequently reproduce. As such, natural selection favored these predictive neural circuits, leading to the gradual entrenchment of this ability within our brain's architecture (Figure 1.1). The advanced predictive capabilities we observe today in modern humans can be understood as a sophisticated manifestation of these primordial neural adaptations.

The brain's predictive wiring has also a crucial role in optimizing cognitive resources. As we will discuss later in the book, the human brain, while remarkably powerful, is also "chemically" expensive to operate. By constantly forecasting upcoming stimuli, the brain can effectively reduce the amount of information it needs to process at any given moment. Instead of reacting to every new piece of data as a unique and isolated event, the brain leverages past experiences to

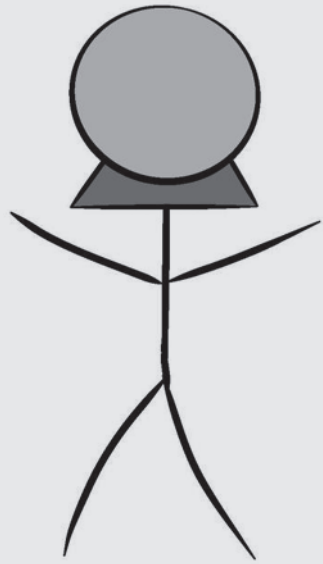

Figure 1.1 Our brains are wired to make predictions.

set up expectations, allowing for quicker and more efficient responses to familiar stimuli. This not only reduces cognitive load and fatigue but also facilitates rapid decision-making in dynamic environments. Thus, the brain's predisposition to make predictions is not merely a relic of our evolutionary past, but a vital component of our cognitive economy.

"Sure," said Eve, who continued, "let me start with predictions. For example, there is a very interesting line of research that was started in 2011 by two psychologists teaching at the University of Pennsylvania: Philip Tetlock and Barbara Mellers. In that year, they launched the Good Judgment Project (GJP), a series of tournaments on predictions. Their goals were to understand whether some people are better at making guesses than others, and whether people doing forecasts could learn something from them and enhance their prediction performance. The GJP initiative, which ran from 2011

to 2015, asked forecasters to answer the types of questions that US intelligence agencies would pose to their analysts: would Greece exit the Eurozone? Would Russia see a leadership change? To what extent would China experience a financial panic? (Schoemaker and Tetlock, 2016). The tournaments run for long stretches of time, so that forecasters could gain more information, learn, and revise their predictions as they got closer to the event they were forecasting."

"Interesting approach!" said Isabelle.

Eve continued: "Indeed. The competition ignited a whole series of research papers. In a recent one, researchers studied the effect of different strategies – they called them 'treatments' – to improve forecasters' prediction accuracy (Satopää et al., 2021). They randomly assigned some forecasters to undergo three types of treatments. The first group of forecasters had to complete a tutorial on probabilistic reasoning. The tutorial trained forecasters in the basics of statistics and to avoid judgmental biases, such as overconfidence or confirmation biases, using data. The second group was asked to debate forecasts in teams. In this group, forecasters, whether they had received 'treatment one' or not, worked in teams in which they debated each other's predictions."

"And the third group?" asked Isabelle.

Eve continued: "The third group was called Track performance. Researchers tracked forecasters' results over time. Periodically, the researchers identified the top 2% of forecasters, which they called superforecasters, and gave them the chance to work with each other."

"So, the third strategy or treatment was to form groups of so-called superforecasters?"

"Yes, that's right," and Eve continued, "The researchers then analyzed and compared the accuracy of predictions made by people who received treatment and those who did not, calculating their individual and group performance. This may sound a bit technical, but they used Brier scores to measure the accuracy of the forecasters' predictions. Brier scores range between 0 and 1. A Brier score of 0 means that the forecaster always correctly predicts the future,

and a score of 1 means that the forecaster never correctly predicts the future[1] (Schoemaker and Tetlock, 2016)."

"So, if it is a range, then the closer the score is to zero, the better the forecast or prediction?" asked Isabelle.

"Yes, that's exactly right. An average individual would typically get a score, a prediction accuracy, of 0.2–0.25," said Eve, who started to flip through the pages of her folder as she appeared to be looking for something.

"I found it! Here it is," said Eve holding up a page depicting a table for Isabelle to see (Figure 1.2).

Eve explained, "This analysis shows groups that received the different treatments, or combinations of treatments, and their respective Brier scores (Satopää et al., 2021)."

And she continued: "The analysis suggests that attending a tutorial in probabilistic thinking reduces the Brier score from 0.21 to 0.19, that is, it improves individual forecasters' prediction accuracy by 10%."

"10%? That's not insignificant, but also not a lot," said Isabelle.

Eve continued: "Well, the effect is much bigger when trained forecasters can debate their predictions with other people working in a team. Then the teams' prediction accuracy increases by another 26%, or by 33% compared to untrained individuals."

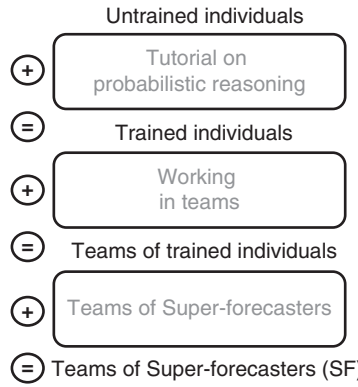

Figure 1.2: Impact of selected interventions on prediction performance. *Source:* Adapted from Satopää et al. (2021).

"That is quite a bit. So, teams overperform individuals. Does this imply that all decisions should be taken by teams?" asked Isabelle.

"Well, no, that's not the right conclusion. Teams aren't always the best solution," answered Eve. "While, in general, when making predictions in situations of uncertainty, teams outperform individuals, teams are not a panacea. Sometimes teams add little value, when, for instance, a decision-maker is surrounded by team members who clearly lack the necessary capabilities or willingness to contribute. Poor team dynamics can make teamwork and collaboration painful."

"Hmm. . . sounds familiar," mumbled Isabelle.

Eve continued: "Also, working in teams takes time. Issues sometimes need debating and that can be time-consuming. Team members need time to work together. They need to agree on common objectives, on the problems they are trying to solve, and on the approach forward, on how to solve the problems. It's not worth it for simple decisions, say, renewing a short-term lease in the office, or enhancing a product. Studies on team performance suggest that teams are not ideal when the tasks are simple. In such cases, teams just add complexity and time."

"So, when should I debate my predictions with others or use teams?" asked Isabelle.

"Let me show you another graph," answered Eve as she leafed through her papers looking for the graph. "Here it is. This comes from a study done by a group of researchers at University of Pennsylvania, MIT, and Purdue University. They compared the performance of 1,200 individuals working in teams and alone in solving tasks of varying complexity (Figure 1.3)."

Eve continued: "The graph shows that teams are not efficient for simple tasks, but clearly outperform individuals on complex tasks (Almaatouq et al., 2021)."

"That means that difficult decisions – the strategy of ATG, for instance – should be taken by a team. But also, that I should make sure that all team members are contributing constructively to the making of such a decision, that is, that we have good team dynamics," said Isabelle.

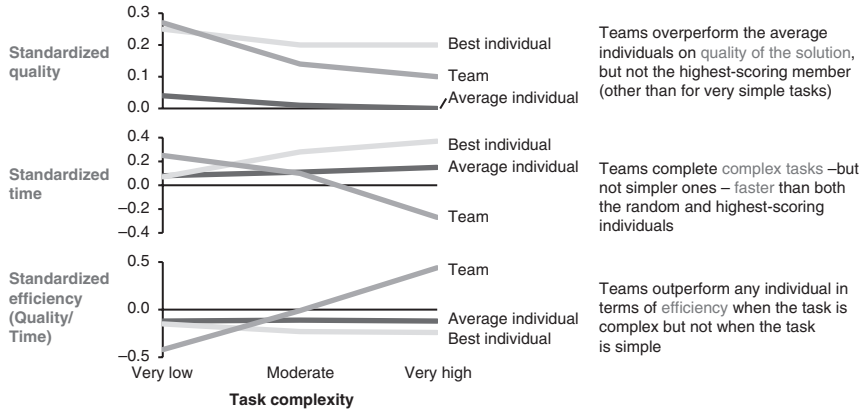

Figure 1.3: When do teams outperform?
Source: Almaatouq et al. (2021).

Teams outperform individuals on complex tasks.

"That's exactly right," confirmed Eve.

"But tell me about the third intervention. Teams of superforecasters have even lower Brier scores. 0.08, that's very close to perfect predictions. That's massive!" affirmed Isabelle.

"Yes, if you put the 2% best forecasters in teams to debate their predictions, the teams' prediction accuracy increases by another 43% compared to individual forecasters who have received a tutorial in probabilistic thinking and who are working as a team," said Eve.

"Wow, that's impressive. What makes someone a great forecaster or a superforecaster? Are great forecasters just born with that gift or are they using specific prediction strategies or techniques that can be learned?" asked Isabelle.

"Well, it is a bit of both, but I'd dare say a lot of it can be learned," answered Eve. "In two studies published in 2015, Barbara Mellers and her colleagues tried to answer this very question (Mellers et al., 2015a; Mellers et al., 2015b). To understand what drives forecast accuracy, they looked at 15 or so different variables that can be broadly grouped into three categories. One, traits, that is,

characteristics that individuals are born with and that are rather hard to change. Two, situational factors, such as, for instance, being placed in a group to debate forecasts. And, three, behavioral patterns that forecasters displayed during the tournaments (Mellers et al., 2015b)."

"What did they find?" asked Isabelle.

"Let's start with traits, which they called cognitive abilities and styles. The variable that most predicted forecast accuracy in this category was intelligence. The best forecasters, the superforecasters, were quite smart. They scored high on several measures of intelligence. They scored one standard deviation or more, higher than the general population on both fluid and crystallized intelligence. Fluid intelligence is the ability to quickly solve novel problems without any previously acquired knowledge. It is related to several important abilities, such as grasping new ideas, problem-solving, and learning (Unsworth et al., 2014). Crystallized intelligence is the ability to solve problems using knowledge acquired in the past. It is the ability to connect the dots and to develop new abstractions, new theories, based on experience (Cattell, 1987)," answered Eve.

"At least one standard deviation? That means that superforecasters were in the top 15–20% in terms of intelligence," said Isabelle.

Eve confirmed, "Yes, that's right. They were. Intelligence was the single most important driver in the category of cognitive abilities and styles, but there were a few more drivers that mattered: superforecasters tended to be competitive, they liked thinking, and they tended to be open-minded. They also did not seem to have a very 'deterministic' view of things (Tetlock and Gardner, 2016). They do not assume that what happens is meant to be. For them, faith doesn't play a big role. They preferred taking a scientific worldview (Mellers et al., 2015b)."

"OK, these traits are rather given. What about the second category, the situational factors?" asked Isabelle.

"Situational factors are interventions performed ahead of the start of the tournaments and included training forecasters in probabilistic thinking and forming groups to allow the forecasters

to debate their predictions with others. In this category, working in teams was the most important driver of prediction accuracy," answered Eve.

"And the third category?" asked Isabelle.

"The third category included abilities and thinking styles exercised by great forecasters during the tournaments," responded Eve, and continued, "The category included behaviors such as how often forecasters gathered information, how frequently they updated their predictions, and how much time and effort they put into making predictions. While it turned out that all these behaviors mattered, the single most important predictor of forecast accuracy in this category was the frequency of updating forecasts. In fact, it wasn't only the most important factor in the behavioral category, it was the most important factor across all three categories. Superforecasters updated their estimates more frequently when new information became available, than the others (Mellers et al., 2015b). Great forecasters behaved like scientists. As more facts became available, they took the time to study them and to revise their estimates accordingly. Like scientists that revise their hypotheses when new evidence emerges."

"Interesting. Superforecasters work like scientists!"

"Yes, very much so. It is not so much who the forecasters were, but how they thought and, therefore, what they did. Their behaviors mattered more than other factors. Behaviors predicted forecast accuracy to a greater extent than dispositional traits or situational factors (Mellers et al., 2015a)," responded Eve, sharing another slide (Figure 1.4).

Eve continued: "This is good news, because behaviors can be trained and turned into skills."

"Hmmm. . . lots of insights," said Isabelle, and continued, "Let me summarize. First, most of the decisions we make every day are decisions under uncertainty. With decisions under uncertainty, all possible options, outcomes, and probabilities are unknown. Second, when making decisions, we – consciously or not – make predictions about outcomes and use heuristics to guide our decisions.

Figure 1.4: Predicting overall forecasting accuracy (Multiple R).
Source: Mellers et al. (2015a).

Third, debating predictions with others helps. Individuals who work with others make better predictions, and hence better decisions. Fourth, the ability to make predictions differs among people. Those who are best at it, the superforecasters, tend to be smart. But more importantly, they approach predictions like scientists. They continuously update their predictions when new evidence or data becomes available."

Do You Need to Be Super-Smart to Make Great Decisions?

General intelligence is generally considered to be fixed. Therefore, at this point of the discussion you may wonder whether – if you score average on intelligence tests – you are doomed to making poor predictions, and hence bad decisions.

You aren't.

There are several strategies that can help you increase your ability to make more accurate predictions. The most important ones are:

1. Build great teams. In two studies with 699 individuals working in groups of two to five, Anita Wooley from Carnegie Mellon University and colleagues showed that when diverse individuals collaborate effectively in groups, these groups develop a form of group intelligence called collective intelligence (CI), and that collective intelligence outperforms individual intelligence on a wide range of tasks. Interestingly, collective intelligence is neither strongly correlated with the average individual intelligence of group members, nor the maximum individual intelligence of group members. Collective intelligence relies on the average social sensitivity of group members (empathy), the equality in distribution of conversational turn-taking (equal share of voice), and the diversity (proportion of females) represented in the group (Wooley et al., 2010).
2. Surround yourself with smart people. Being together with intelligent people will not make you automatically smarter. But it will give you more to think about, as you are exposed to other points of view, differing perspectives, and opinions. That will help you make better predictions.
3. Take care of yourself. Several studies suggest that eating a healthy diet, exercising regularly, and getting enough sleep among others, will improve your cognitive abilities. More on this later in the book.
4. Possibly, adopt a growth mindset. The term growth mindset was coined by Carol Dweck, a psychologist teaching at Stanford University. In her work, including her important book, *Mindset: The New Psychology of Success*, she found that people doing better in life and at work are convinced that one can improve, that skills can be learned, and are

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not fixed or given (Dweck, 2006). For instance, in a 2019 study, 300 students who were taught to have a growth mindset achieved higher grades in advanced math classes than students who did not adopt a growth mindset. However, the size effect of adopting a growth mindset is a matter of debate currently. A recent study suggests that the positive effect of adopting a growth mindset on academic achievements might have been overestimated and that it might be rather small (Macnamara and Burgoyne, 2023).

But let's also add a note of caution on intelligence. Unlike decision-making skills, intelligence is not strongly correlated with leadership effectiveness (Hoffman et al., 2011). Also, above-average intelligence might be a blessing for predictions but a curse for decision-making. Studies suggest that while smart individuals may make better predictions, they may also be more vulnerable to cognitive biases than average intelligence individuals. For instance, a recent study revealed that the higher your IQ score, the higher the probability that you fall for stereotypes, a form of cognitive biases (Lick et al., 2018). As we will review later in the book, cognitive biases can lead to poor decisions, especially in volatile, unfamiliar environments.

"A perfect summary! That's a better synthesis than what I had in mind," said Eve.

"Yes, but hang on, what about the heuristics, the decisions rules, you mentioned earlier?" asked Isabelle, as the plane landed in London.

Eve, who was excited about Isabelle's interest in her thesis, started to speak faster, as if she was concerned she would not have enough time to share all her work. "Making good predictions is important, but not sufficient to make great decisions. Making the wrong decisions at work and, for that matter, in life, isn't the same

as making predictions. Think of your own decisions. When advising a friend, say, on buying a house, you give excellent advice. But when making that decision for yourself, you struggle. All sorts of questions pop up in your mind. For instance, you may ask yourself, 'What will people think of me, if I buy a house in this area?,' 'What if the sellers didn't give me all information? Will there be some work to do?,' 'What if I am wrong in my assessment about the value of the house? Will I have overpaid?,' and so forth. Your emotions get in your way."

"Sounds familiar," affirmed Isabelle.

"Yes. Not much happens when you make a wrong prediction. Unlike making a prediction such as a hypothetical forecast in a prediction tournament, wrong decisions in organizations – and life, actually – come at a cost. There is a difference between analyzing and taking risks. After all, not all great financial analysts are good investors, not all great consultants make great CEOs, not all great management professors make good businessmen or good businesswomen."

"Is that when heuristics come in?" asked Isabelle as passengers in the front rows started to stand up and leave the plane.

"Yes, exactly. When making decisions under uncertainty, a lot goes on in our brain. The brain uses – sometimes consciously, sometimes unconsciously – decision rules, sort of 'what-if' rules of thumb. I call them heuristics," answered Eve.

"Eve, I have to dash now," said Isabelle, who was in a hurry to make it to her first meeting in London. "I found this conversation incredibly insightful. It has given me a lot of food for thought. Is there a chance we could meet or even do a video call in the coming weeks? I'd love to understand what heuristics are and how they work!"

"Yes, of course. I love discussing and debating my work! It also helps me in making it more succinct. I like how you summarized it!" said Eve smiling as she stretched out her hand to shake Isabelle's. Isabelle, who felt satisfied and empowered by the conversation they just had, shook Eve's hand, and said goodbye.

Key Takeaways

- You spend a significant part of your day – at work and beyond – making decisions.
- Most of the decisions you make every day are decisions under uncertainty, where possible options, outcomes, and probabilities are unknown.
- When you make decisions, you – consciously or not – make predictions about outcomes and use heuristics to guide your decisions.
- When you debate our decisions with others, your predictions get better.

The ability to make predictions differs among people. Those who are best at it tend to be smart. That said, the most important factor that sets them apart is their scientific approach to forecasting: they put in the time and effort to reflect and revise their predictions with an open mind whenever new information becomes available.