Behavioral Project Planning

PART 1

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Introduction

The Energy Facility Contractors Group (EFCOG) is a self-directed group of contractors of U.S. Department of Energy Facilities. The purpose of EFCOG is to promote excellence in all aspects of operation and management of DOE facilities in a safe, environmentally sound, secure, efficient, and cost-effective manner through the ongoing exchange of information and corresponding improvement initiatives. The EFCOG Project Management Working Subgroup (PMWSG) established a Risk Management Task Team to promote, coordinate, and facilitate the active exchange of successful Risk Management programs, practices, procedures, lessons learned, and other pertinent information of common interest that have been effectively utilized by DOE contractors and can be adapted to enhance operational excellence and cost effectiveness for continual performance improvement by other DOE contractors. As part of the EFCOG Risk Management Task Team activities, initiatives are identified, prioritized, and planned. The planned activities are established in advance of the fiscal year start as part of an EFCOG Project Delivery Working Group (PDWG) Annual Work Plan.

One such initiative is research and development of *Behavioral Project Planning* training to reduce human thinking (cognitive) errors in planning and forecasting activities. This training includes identifying and defining the different types of cognitive issues such as heuristics and biases that influence predictions in project management. Knowledge of human thinking errors enables a more reasonable calibration of risk and uncertainty, reduces government waste, increases resource efficiency, and accelerates delivery of the Department of Energy's most critical projects.

This training is the first part of a series of training documents that merges project management with behavioral and cognitive science, with an emphasis on improving planning and forecasting by understanding human cognitive errors. This document focuses on building awareness of the behavioral foundations that cause thinking errors. Future training in the series will go further into detailed

processes and more depth in behavioral components and additional diagnostics for the organization. This training has been developed and adapted for EFCOG from NeuralPlan® with permission.

Chapter 1

1.1 About Behavioral Project Planning

1.1.1 The Purpose

It all began with a curiosity about why projects tend to perform poorly even when using disciplined traditional project management methods. Questions like, “Why do projects tend to fail cost and schedule objectives at scale? Why do optimistic plans fail time and again, and why do these issues still occur when project management methods are used by certified project professionals?”

Examples of planning and project failures repeatedly occur in research. An Oxford University article found that in 3,022 projects, only 27% were on budget or better. 2.8% were on budget and on time, and only 0.2% of projects were on budget, on time, and on benefits (Flyvbjerg, 2019). The data showed project budget overruns from 60% (Mexico City Metro), all the way up to 1,900% (Suez Canal). The Project Management Institute also found that half of the projects executed do not meet their schedule and cost objectives. For every $1 billion spent on projects, $122 million is wasted due to poor performance (Project Management Institute, 2016).

Issues with project failures led to research that went beyond standard traditional methods and dove deep into the workings of human behavior. The journey was a long one, digging to find the answers in the literature, as there were no books to read on the subject. As research was completed, the more it became clear a vital part of project management was missing: the integration of project management with behavioral science.

Why behavioral science? Because project management success is determined by the thinking and resulting behavior of the people participating in the project (and even those outside it). While it is recognized that optimism bias leads to underestimations of project duration and cost, the research on the other biases is sparse. In reality, a wide range of behavioral sciences is relevant to project management: from social psychology to cognition, from neuroscience to prediction science.

In this training, we merge the research in project management with the behavioral sciences. Knowing human behavior and the processes to mitigate it will enable you as a project professional to be a better planner, leader, risk detector, teammate, etc. By taking potential biases, social pressures, and other factors into account, your team will value your knowledge and decisions. The concepts introduced in this training are grounded in planning, forecasting, risk analysis, and behavioral science to provide an integrated approach to project planning.

1.1.2 The Design

This training was designed by creating planning processes and other criteria around the way the brain thinks and operates. This course is the introduction to the knowledge of the biases and underlying thinking that causes them. Follow-on courses will dive deeper into redesigning planning processes, deeper analysis of behavioral causes, and diagnostics of organizational planning and forecasting error. The course is built from evidence-based research that has tested how humans make decisions when planning and forecasting. The training is a whole-brain perspective integrating the behavior of human prediction, along with planning and forecasting in projects; *everything starts with and goes through the brain*.

Without sufficient knowledge of behavioral science, project management competencies (forecasting, earned value, etc.), and technical issues, success in your projects will be harder to achieve. Using

traditional planning processes alone will not ensure success, but understanding and integrating the human elements driving the processes will increase the probability of success.

Examples of crossovers between neuroscience and behavioral research are abundant, and this course utilizes as much of this research as possible. Mooney et al. (2014) investigated social status and the brain regions associated with group phenomenon. Zhou et al. (2017) looked at the construct of social dominance. Caspar et al. (2016) examined a sense of agency and its links to the brain. Hundreds of research papers could be named here, and behavioral and neuroscience are increasingly popular fields of research.

From a neuro perspective, there are many major domains that Behavioral Project Planning references as contributing evidence of how human factors impact the accuracy of prediction in projects. As an example, here are just a few links to neuro studies of the human factors we will cover in more depth later:

- Time-pressure (click link here to see time-pressure on the brain: https://www.pnas.org/content/pnas/105/45/17538.full.pdf)
- Optimism Bias (click link here to see optimism bias on the brain: http://affectivebrain.com/wp-content/uploads/2014/09/Neural- mechanisms-mediating-optimism-bias.pdf)
- Risk (click link here to see an example of risk on the brain: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2629583/)
- Prediction (click link here to see a review article about prediction on the brain: https://www.frontiersin.org/articles/10.3389/fnhum.2010.00025/full)
- Confirmation Bias (click link here to see an example of confirmation bias on the brain http://affectivebrain.com/wp- content/uploads/2019/12/s41593-019-0549-2.pdf)

1.2 Why Behavioral Project Planning

Projects are responsible for the creation of many human endeavors. Most every temporary endeavor that was created, is being created, or will be created is a project. A successful human endeavor (a project) relies on two elements:

- A reliable *prediction* of the completed endeavor (a plan).
- An effective delivery of that *predicted* outcome.

Reliable prediction reduces risk, increases plan reliability, and higher forecast accuracy, thus enabling everything coming together to deliver the endeavor (on time and on schedule). This enables a successful outcome. The biggest foundational obstacle to reliable predictions is human thinking, which may slow down the progress of human endeavors. With this training, we provide a science-based foundation of human thinking problems, which helps the delivery of the project occur faster.

If we start by solving the problem of human thinking errors in predictions, we can accelerate worldwide human progress, creating cures faster and saving lives, deliver environmental solutions quicker, raise the standard of living, and more specifically, increase efficiency and effectiveness of every Department of Energy project. The possibilities are endless.

Planning vs Forecasting

Before we proceed, we should clearly define a few terms. When we say the word *prediction*, we are referring to the general act of making a statement or *decision about the future*. When we say the word *plan* or *planning*, we are referring to the initial project target, formal plan, or baseline; the initial project prediction that occurs before execution begins. When we say the word *forecast* or *forecasting*, we are referring to interim predictions that occur during project execution (with the exception of talking about the prediction and forecasting sciences). Forecasts may generally be made weekly, monthly, or quarterly, and are predictions occurring after the formal plan is in place. Forecasts determine durations

and costs for the remaining part of the project. Plans occur *before* project execution starts; forecasts occur *after* the project has started.

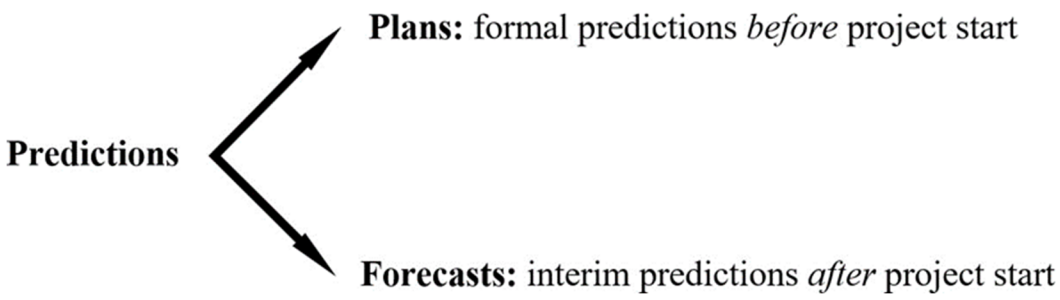

Figure 1. Predictions in Planning and Forecasting.

Furthermore, throughout this document, you will see the word *predictor* used frequently. This refers to the person that is making the prediction. Sometimes this may be the same person making the calculations, and sometimes the prediction may be led by a *facilitator*. In the case where there is a facilitator (such as an estimator or project controls analyst), the predictor might be the subject matter expert who is giving the facilitator their estimate of resource quantity or duration. In any case, the predictor is the source of the estimate and prediction, and the person that will most influence the plan or forecast either negatively or positively, based on their thinking errors.

1.3 Crucial Clarifications

- Predicting a project outcome (planning and forecasting) determines the project, milestones, and activities' completion dates and cost prior to execution and delivery. A prediction is defined as saying or estimating that a specified thing will happen in the future or will be a consequence of

something. Prediction is the central component of the training. Planning and forecasting is looking forward without knowing for sure what will happen. This is a prediction, and the core purpose of this course is to *improve project predictions*.

- While the level of rigor in Behavioral Project Planning emphasizes the development of the initial plan, the concepts also support forecasting and risk analysis. We recognize that forecasting during execution sometimes cannot support the full level of rigor that baseline plan development does. That said, we leave it to the skilled practitioner to determine which of the Project Prediction Processes should be used for forecasting, based on their individual needs and what issues are present in the project. In aggregate, the knowledge and skills learned from this course will help the practitioner reduce risk and predict better in both planning and forecasting.

- While this course is very prescriptive, the reader must realize that we have included as much research as possible for the practitioner to use. By all means, this does not mean that the practitioner or predictor has to employ every single detail of the processes, but instead should apply the knowledge they learn about human cognition to make the best determination of application based on the given situation and the time available. We have strived to provide as much research for planning as we could, and it is up to the informed practitioner to determine the best course of action in their prediction situation. The processes and their application are context-dependent.

- When we say master planner, predictor, facilitator, etc., we are not excluding any role, making assumptions about roles, or assuming you should adopt our roles in your organization. Someone who is a master planner is a practitioner who has mastered prediction in planning, regardless of whether their role in the organization is a project manager, superintendent, program manager, or what have you. In some cases, the project manager, master planner, and predictor are all the same person. In some cases, they are different people. The person with whom the estimate

originates is usually the predictor. The person helping the predictor is usually the facilitator, and the person who is an expert at prediction is a master planner, regardless of their title or position in the organization or project.

- We must clarify that while optimism bias is being unrealistic about the future, optimism in and of itself is not bad. We must be optimistic in order to maintain positivity and to fulfill the dream or deliver the need that the project intends. Optimism is healthy and is why projects even exist at all. However, being overly optimistic to the point of being unrealistic is counterproductive, as it causes us to ignore realities that should be mitigated to ensure effective delivery. Optimistic planning also results in wasteful spending on government projects. Throughout this training series, you will learn the difference between *optimism*, *optimistic output*, and *optimism bias*. The three are very different from each other.

- Some processes and recommendations may seem simplistic, apparent, or may already be standard practice in some cases. We recognize this. However, the reason why these recommendations may be restated in some places is that we are reinforcing them from an evidence-based approach. In other words, some traditional processes may now have behavioral evidence that they are a best practice. Backwards planning is one example. Some organizations may already be using this approach, but we are restating this for those who may not know about this approach and showing behavioral science evidence that the method has merit in increasing plan reliability.

- Nothing in this course should be taken in isolation from everything else. The brain is too complex, and little is as straightforward, absolute, and “one size fits all” as we want it to be. Better prediction in project management is about the totality of what we know about the brain. Better predictions cannot be solved through processes, skills, or measurement alone. It takes reducing cognitive error, increasing better decision-making at every point, using every tool, and

knowing what we know about human cognition. The literalist will find it challenging to navigate Behavioral Project Planning training if everything is viewed in isolation. It must be viewed from a critical-thinking, three-dimensional, and integrated perspective. Understanding the brain and how humans think is a complex endeavor.

- The processes involved in planning and forecasting can vary greatly, and the rigor of developing a bottoms-up estimate of time, resources, and cost is different for the planning phase and execution phase.

- Even if one does not utilize the more predictive processes, the entire course is about human cognition in prediction, and this research is applicable to working with humans and thinking. For example, heuristics and biases are relevant throughout the human experience, regardless of whether it's in a project, at work, in a relationship, etc. Therefore, human behavior is not restricted to prediction, as the human factor is always present, regardless of project, program, or phase. This course is for anyone in project management, making predictions, and working with people in a project. Though this training is primarily about prediction and some parts of the course cover more predictive work, some are basic behavioral components that support human cognition as foundations of good prediction. We hope that you will learn about both human cognition and project planning and forecasting from the behavioral perspective.

Chapter 2

2.1 Decisions – Introduction

This course is about cognition in project predictions. Cognition is defined as the mental action or process of acquiring knowledge and understanding through *thought*, *experience*, and the *senses*. In cognition – thinking – a series of processes take place in the brain to output a decision from its *understanding* of data. This understanding is *not purely logical and rational*. Project management consists of a range of tasks, like coordination, cooperation, decision-making, and data processing. In this course, we focus on the last two: decisions and data.

Decisions cannot be made without some kind of data (information). Data is filtered by the brain, and this filtering is biased. For example, due to a confirmation bias (we see what we want to see), data is filtered toward the preferred outcomes of the brain (see confirmation bias in the brain in this study: http://affectivebrain.com/wp- content/uploads/2019/12/s41593-019-0549-2.pdf). Data is then integrated within the existing knowledge framework of the person. For an overview of biases that may affect our decisions, see Chapter 6.

The brain is the primary information processor and decision-maker and is therefore invaluable. Even with the rapid and recent developments in IT (think standard computers, but also advanced techniques such as artificial intelligence), we still need our brain. While there is talk about the replacement of human functions with software, robots, etc., the brain is still the one that processes the output and tempers with judgment.

Technology is a tool to provide data to the ultimate decision-maker, the human. With that in mind, data by itself has a limited capacity to change outcomes. Data is only beneficial if the person that has access

to it chooses to use it and use it well. And as we will see throughout the course, many cognitive factors may prevent a person from using data.

Project management is a *predictive*, *delivery*, and *feedback* decision system. For a task to be complete, there must be many large and small decisions along the way. And each decision starts in someone's brain. Decisions will be made:

- while initiating the project (authorization)
- while predicting the work (planning and forecasting) during delivery and execution of each task
- while providing feedback on the tasks that were delivered

No matter what phase of the project you are in, and no matter whether it's a predictive decision or not, learning how humans think benefits the decision. In this training, you will learn many things about how humans process information and how that processing affects decision-making. You will be able to use this knowledge for both predictive and non-predictive decisions. This course has a first focus on predictive decisions in planning and forecasting. The decision-making knowledge learned here will apply to all phases and activities in a project.

2.2 Philosophy

Every action takes a human decision, large or small. As part of this decision-making process, we must realize good decisions rely on a solid premise of reliable, accurate, unbiased, and usable data and information with which to make a decision. We must also realize that this data and information may be the output of another human and thus flawed. There is a level of responsibility that comes with becoming a thinker aware of human cognitive errors. The thinker should be aware of the inherent strengths and weaknesses of the brain's wiring to optimize outcomes toward the objective.

Data flows from human to human, from human to systems, and is propagated from systems back to humans for decisions. There are multiple places where data is interpreted, framed, and construed into either accurate information or channels of misinformation and misinterpretation along information highways. Once we know how the brain interprets and filters data, we are more prepared to make adjustments to the design of the inputs, outputs, processing, and systems. Usable and reliable data turns into insight, and insight turns into intelligence.

Throughout this training, you will also see familiar themes reminiscent of other methodologies that help us turn data into intelligence.

- **Design Thinking**: an approach used for practical and creative problem-solving.
- **Systems Thinking**: the process of understanding how systems influence one another within a whole.
- **Logical Thinking**: thinking based on proven knowledge and information that is accurate and certain.
- **Scientific Thinking**: involving inquiry, experimentation, evidence evaluation, and inference to achieve conceptual change or scientific understanding.
- **Integrative Thinking**: the ability to constructively create resolution from opposing ideas that contain superior elements from both ideas.

2.3 The Computer in Your Brain

The brain is like an organic computer. This computer is programmed to protect itself and its offspring. Like any other mammal, the human brain is programmed to make sure it and its genes are safe to survive and propagate. This programming is a crucial aspect of why we have to redesign project management around the brain. The computer on your desk or in your hand makes simple if/then logical calculations. Your brain does not. This is what is taken into account in Behavioral Project Planning.

Traditional operations research and project management are all about the data: optimization of schedules, resources, and contracts. While it is necessary to master the technical skills of project management, technical skills alone are not sufficient. Project management is not all about the data; it is about how the data is processed. Good project management is about making good decisions. Here is where cognitive science adds value to existing project management methods. It is not enough to know what the best technical practice is. It is a matter of recognizing the correct data so that your brain can draw the right conclusions. Behavioral Project Planning is unique because it teaches you how to use the data and your brain together constructively, leading to a higher chance of success.

Let's look at a standard computer. A computer, at its most basic level, consists of the following functions:

- **Inputs** – it takes in various types of data.
- **Memory** – all the inputs are stored in its memory.
- **Processes** – it takes the data stored from the inputs and through algorithms (see also the chapter on algorithms), with a series of logical commands, it processes the information, performs calculations, etc. Processing is the most critical function.
- **Outputs** – it takes the different types of information that are processed and outputs it in various ways.

The function of interpreting the data is not up to the computer or software. Even Artificial Intelligence (AI) is not capable of interpretation in the same way that humans are. Thus, while we can outsource data storage and processing, we cannot outsource interpretation. Data needs the brain to interpret, and the brain needs data to make decisions.

The brain is like a computer in that it has inputs, memory, processing, and outputs. But the brain's memory and processing are not purely logical like a computer.

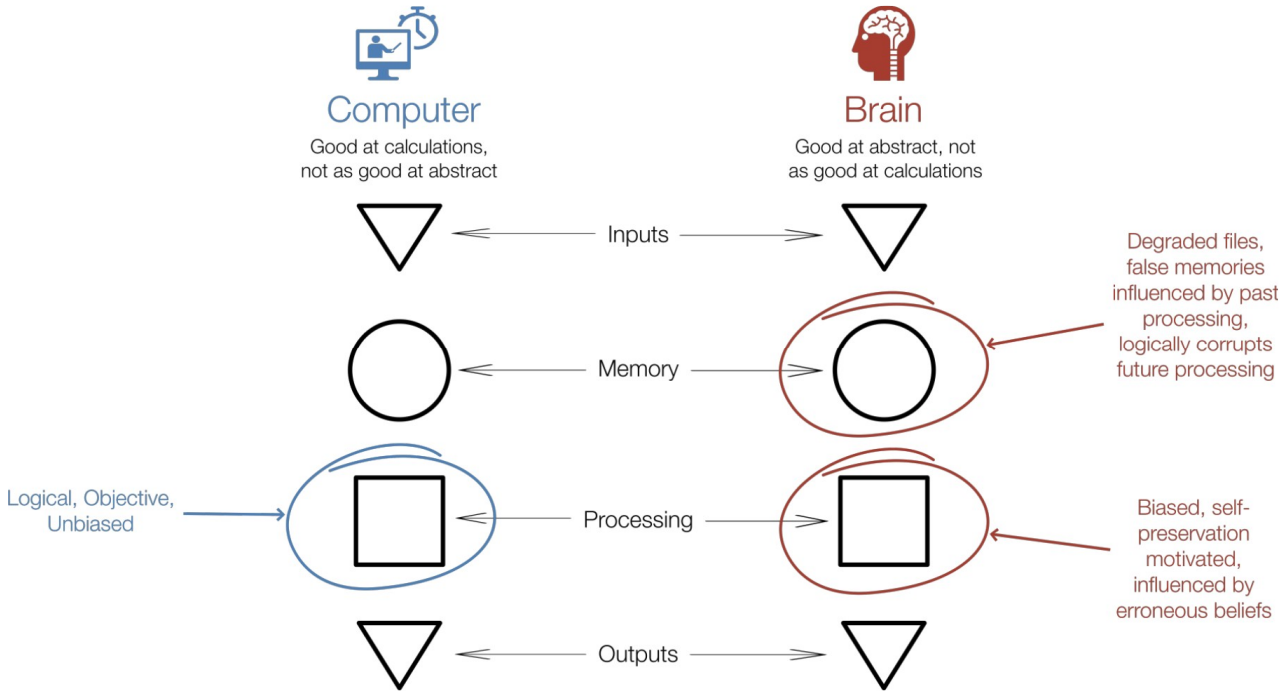

Figure 2. Computer vs brain.

2.4 Decision-Data

In Behavioral Project Planning, we will introduce you to the concept of decision-data. Data in and of itself means nothing. As we mentioned before, it is how the data is used to process decisions that are key. A clarification on the word *data*:

> *The word 'data' may mean different things to different people, depending on their frame of reference. We use the word data as any input of any information used by the brain to make a decision. Data is not limited to being numerical, analytical, or statistical.*

For biases and other thinking errors to be reduced and the brain to make more accurate, reliable decisions, it must first have the information, or data, to make the informed decision. Data is the first step in debiasing the decision, but not just any data. The data must be the right data for the right decision. This is where the term decision-data comes into play. Let's use a simple example:

> *When making a plan, a project manager schedules an activity for 5 days, based on an estimated need of 8 hours of engineer support per day for a total of 40 hours. The activity started, but it took twice as long to complete, resulting in the activity taking a total of 10 days to complete. The end result was obviously an optimistic plan.*

In this example, we see that the project manager had an optimistic plan, indicating they may have a high degree of optimism bias. However, is optimism bias really the issue? Let's look a little deeper. The project manager had the following information available to them:

- A well-detailed scope of work
- A risk analysis that showed no major risks
- A well-defined work breakdown structure (WBS)
- A critical path schedule with good logical activity relationships

In this case, the project manager had plenty of data. However, was it the right decision-data to make a reliable prediction in the plan? As it turns out, the project manager was missing the engineer's (resource) availability when making the plan. The engineer was not available for 8 hours a day, as assumed, but was only available for 4 hours per day. The project manager had lots of data, but not the right data for the right prediction.

Decision-data is data that is relevant to effective decision-making. As the first step in decision-making, the person making the prediction (the predictor) needs decision-data that will provide information to counter their automatic response. People's brains typically fill in the blanks with their own heuristics, biases, assumptions, etc., and providing decision-data is the first step in mitigating those issues. Suppose decision-data has been provided, and there are still decision-making errors. In that case, we move into the next steps in figuring out if other cognitive factors are contributing or if people are making intentional erroneous decisions.

Chapter 3

3.1 Introduction to Neuro & Behavioral Project Management

Neuro and Behavioral Project Management (BPM) recognizes that projects are created by humans for humans, with the understanding that science has shown humans make decisions that are not always based on logic or “maximum utility” (maximized usefulness). On the contrary, our decisions are often based on compromised and irrational factors. These human factors cause decreased accuracy in prediction and execution efficiency and effectiveness.

Every project starts in the imagination of a human, driven by the needs or wants to meet a personal or business objective. Inherent to these human objectives are degrees of optimism and the belief that something not yet in existence can be accomplished. Thus, the hope for the creation of something that does not yet exist implies the prediction that it can, in fact, be done. But we have to be careful, as prediction accuracy is a human weakness because of the many factors in our thinking (cognition) that influence our decisions and, subsequently, our decision errors (which are many times cognitive biases – see respective course section).

BPM integrates science into project management, with an emphasis on the human information processor (the brain). BPM has some of its roots in Behavioral Economics, a discipline that has successfully integrated Behavioral Science with the technical discipline of Economics. Like Behavioral Economics, BPM draws from many different sciences to inform an evidence-based approach to the creation of processes, project management human interfaces, metrics development, and skills building, designed around the beings that create and run projects: humans. By combining findings from different fields, we create a holistic view of BPM.

This course focuses on prediction. Prediction includes not only long-term planning for project baselines but also ongoing forecasting during execution. Essentially, prediction is anything that looks forward in a project, regardless of what phase the project is in, from initiating all the way through closing.

Another important part of prediction is risk. Because most all human decision-making revolves around the brain processing degrees of risk, you will see risk become a central theme in Behavioral Project Planning. You should not think of risk as strictly project risk, but also as a function of human decision-making. The brain processes all information through the lens of safety, which falls into the category of personal risk, not just project risk. This causes humans to subconsciously process their own personal risk during decision-making for the project.

3.2 The Behavioral Project Management Modalities

Let's first start by defining a modality: a particular mode in which something exists or is experienced or expressed. The Behavioral Project Management (BPM) modalities can be thought of as the different areas of the discipline in which the concept exists and resides. We need to make this very important clarification up front because of the stereotypes and assumptions that sometimes accompany the word behavioral. Learning the sciences associated with behavior, psychology, cognition, neuroscience, etc., are sometimes assumed to be strictly confined to learning skills about interacting with other people; however, skills are only one small part of the science. And interaction with other people (social psychology) is an even smaller slice of the skills domain. When considering all factors human, we must understand that everything that a human touches, sees, hears, and interacts with is an area where errors can occur, and potential improvements can be made. The science of improving decision-making is *not* confined to learning skills.

In project management, there are several major modalities where we can improve decision-making behavior:

- **Processes** – Design the project management processes to account for common human factors.
- **Metrics** – Measure human factors and redesign standard project metrics to identify behavioral trends in what has been done and improve decisions in what is to come.
- **Interfaces** – Design human interfaces, such as software, so that people default to decisions that result in better project predictions and delivery.
- **Skills** – And last, but not least, teaching project professionals skills to mitigate their own individual biases and work through interactions with other humans.

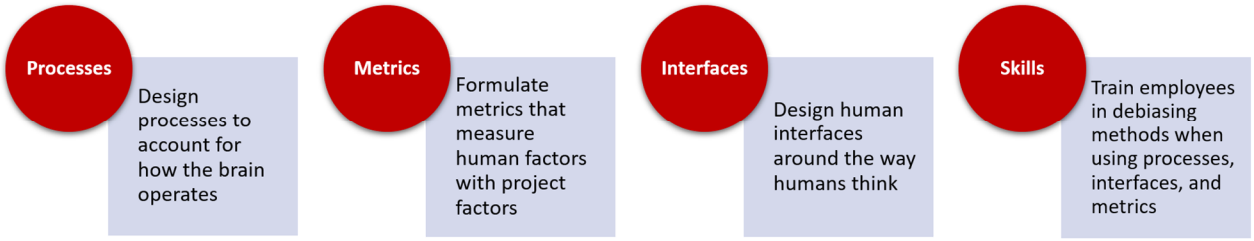

Figure 3. Behavioral Project Management Modalities.

Throughout the course, you will see the use of the various modalities. This is because effective project predictions in baseline plans and periodical forecasts (during project delivery) require debiasing and improving decision-making in all the modalities possible. For example, simply teaching a debiasing skill by itself isn't likely to have results that are as effective as also improving processes in the organization and providing the appropriate metrics. You need to measure with metrics what is going on in the

project, change the processes so that humans know the correct steps, and teach personnel the skills for the situation.

In future publications about Behavioral Project Management, we expect that you will see these modalities referenced more often, as these are the modalities in which project management design around human behavior can exist, regardless of project phase.

3.3 BPM Organizational and Interdisciplinary Domains

Behavioral Project Management impacts, and changes, a whole host of other disciplines, departments, organizations, and other domains associated with project prediction and delivery. Considering that human factors are in everything we do, it affects everything a human touches, and also has downstream and residual impacts. Here are a few other major domains that are either new or impacted by BPM:

Behavior-Informed Project Design – This is a new domain that will look at general project processes, organization, and other areas where redesigning around the brain is possible.

Project Prediction – The subject of this course, prediction, is a domain that will see significant growth in the coming years, and the Association for Project Management (United Kingdom) is already using this terminology in their body of knowledge. This domain is associated with anything to do with looking forward in a project.

Behavioral Earned Value (BEV) – Because EV is already utilized significantly in DOE, and the measurement possibilities of EV are extraordinary, this provides an opportunity to correlate potential measurement of behavioral trends in the project or organization.

Behavioral PMOs and Behavioral Project Science Units – This domain has a lot of promise, as PMOs can begin to redesign their organizations around the brain and how humans think in projects. General Behavioral Science Units are already growing in popularity. Adding the project component can add enormous value to an organization that wants to use evidence-based methods to increase the probability of project success.

Safety, Risk, and Accident Prevention – This domain is interdisciplinary in nature and can interact with a large array of BPM behavioral and neuro components. Let's use a quick example for reference: Behavioral earned value (BEV) can look at trends in project performance that can indicate behavioral trends, and in some cases, reveal organizational cultural factors that are not only increasing project risk, but also safety risks. Because risk decision-making is a major theme in human behavior research, the residual opportunities in safety in an organization that utilizes BPM are exponential.

Chapter 4

4.1 Introduction to Behavioral Science

Behavioral science studies how human behavior interconnects with a person's thoughts, decisions, and actions. It focuses on "why" people do what they do and "how" that behavior impacts other areas of life like relationships, work, and society. Behavioral science incorporates multiple fields of study into one discipline (sociology, psychology, anthropology, economics, neuroscience, and political science).

We have mentioned the word "behavioral" several times so far. If we look at Google Scholar, Google's academic research engine, 'behavioral science' gives us 3,900,000 search results. But wait, there is more...if we write it as 'behavioural science,' we get an additional 3,200,000 search results. What exactly is behavioral science? Dictionaries define it as follows:

> *"A branch of science (such as psychology, sociology, or anthropology) that deals primarily with human action and often seeks to generalize about human behavior in society." (Merriam Webster, 2021)*

"Behavioral science, any of various disciplines dealing with the subject of human actions, usually including the fields of sociology, social and cultural anthropology, psychology, and behavioral aspects of biology, economics, geography, law, psychiatry, and political science" (Encyclopedia Britannica, 2021). The first thing you notice is that these definitions refer to the many different branches under behavioral science. It is an umbrella- concept under which several fields of research gather and includes many interdisciplinary relationships.

Behavioral Economics is an example of such an interdisciplinary field and is vital for this course. The introduction of psychology to economics happened in the fifties of the 20th century, by Herbert Simon. One of his papers, termed “Theories of Decision-Making in Economics and Behavioral Science,” has been cited nearly 5000 times since. The idea that psychology could be of influence to the field of Economics was a revelation. During that time, he also introduced the concept of bounded rationality in his book “Models of Man” (Simon, 1957), followed later with “Models of Bounded Rationality” (Simon, 1982). Bounded rationality implies that we have limits to our memory system and thinking capacity, influenced by factors such as time pressure. With this concept, Simon radically challenged the assumption of economic research that we are all rational actors, or the so-called *homo economicus*. Many of the ‘big names in the field later built further on Simon’s work. Amos Tversky and Daniel Kahneman are especially famous because they developed Prospect Theory and their empirical testing of Simon’s propositions.

The second aspect that is of notice in both definitions is the term ‘human action.’ Behavioral science covers two types of human action: human action in itself (e.g., cognitive psychology; decision-making, information processing) and human interaction (e.g., social psychology; relating to others, teamwork). We will discuss these sub-branches and their importance for project management in this chapter. While psychology may sound like a ‘soft science’ that is hard to integrate with project management, we can assure you of two things: first, psychology is based on rigorous experimental research and is far more data-oriented than one would think. Sound methodologies and nesting within theoretical frameworks are fundamental requirements for successful psychological research. It is data-driven and, arriving at our second point, has significant implications for all human action, including human action in the world of project management. Project management, after all, is performed by people, for people. So it is logical to take theories and data-driven conclusions into account about all aspects of being a human actor. We will be explaining this more in detail throughout the document.

If you want to read more about this topic, check the work from Ariely. His book “Predictably Irrational” (Ariely, 2008) is an informative and engaging read.

4.2 Neuroscience

The brain is the most complex organ in the human body and the central element of the human nervous system. A high-tech computer or rather a super coordinator? The brain coordinates all of the body's functions. For example, it governs our emotions, our intelligence, our memory, and much more.

Is our brain adaptable? Yes. Our brain never stays the same. Neuroplasticity – or brain plasticity – is described as the brain's capacity to undergo biological changes due to the experiences in life that we encounter. Indeed, psychological experiences and learning can change the brain's structures. Thanks to this ability, the brain can develop from infancy to adulthood or even recover from brain injuries.

The brain is made of fat and proteins. The average adult human brain weight is between 1300 to 1400 grams (around 3 pounds). Protected within the skull, the brain is comprised of 4 main regions: the *cerebrum* (cerebral hemisphere), the *cerebellum*, the *brainstem*, and the *diencephalon* (Fig. 4).

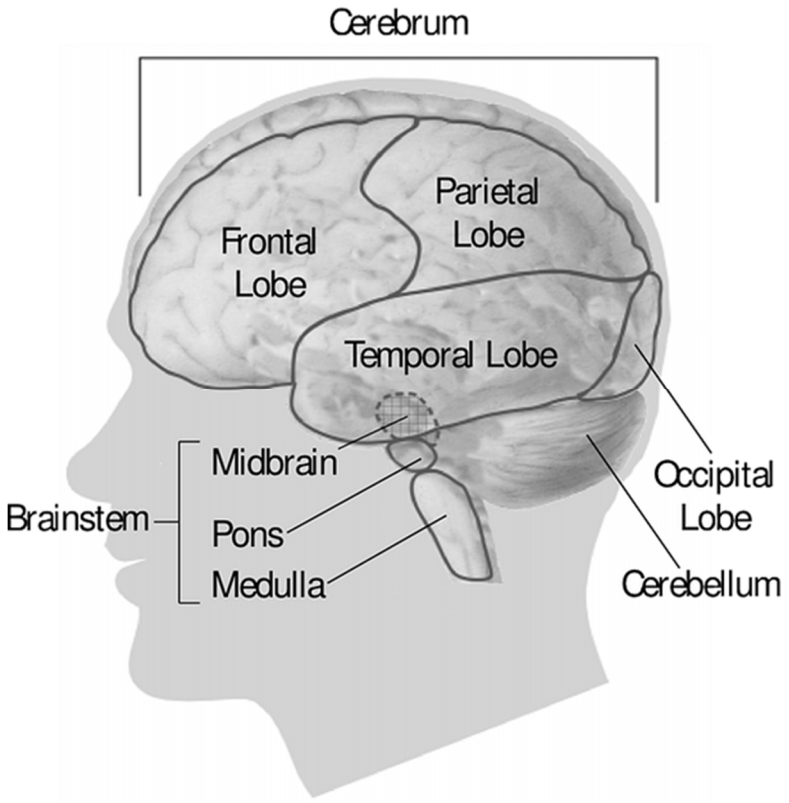

Figure 4. View of the major parts of the brain.

Each area of the brain controls specific tasks:

- The **cerebrum** is the largest region of the brain. It controls higher functions, such as thinking, learning, reasoning or speech. Our memories are part of the cerebrum, both short-term (what you drank last night) or long-term (when you obtained your high-school degree). In addition, the cerebrum consists of two hemispheres or halves that the corpus callosum connects. Researchers consider the left half as the abstract part (i.e., colors, music, creativity, emotions) and the right half as the analytical part (i.e., logic, reasoning, speech, math). In addition, the right half of the cerebrum controls the left part of the body, and the left half controls the right part.

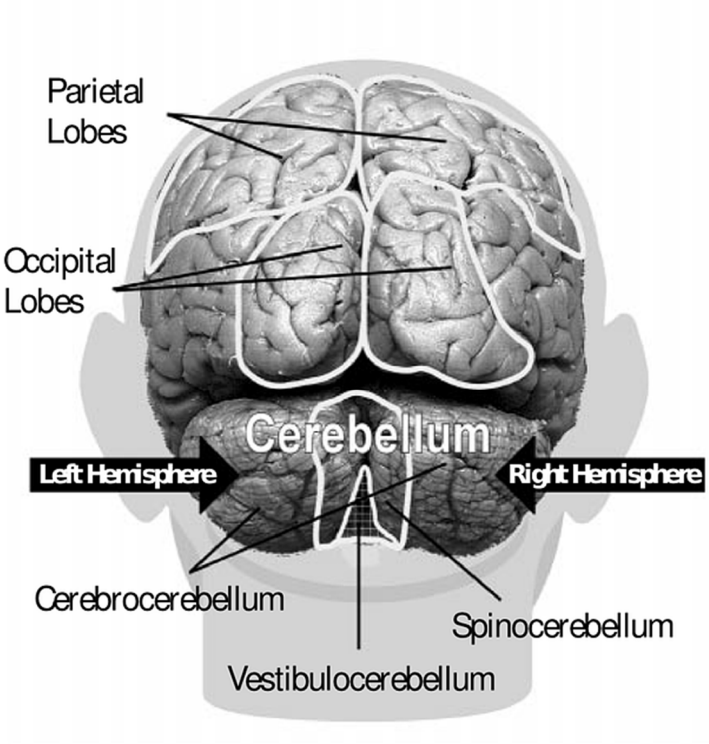

Figure 5. Left and right hemispheres of the brain.

- The **cerebellum**, as the second-largest region, is responsible for coordination, movements, and balance. Thanks to the cerebellum, we can stand upright, move around, or do sports.

- The **brainstem** lies in front of the cerebellum and connects the rest of the brain to the body via the spinal cord, which runs down your back and neck. The brainstem is in charge of all the functions that the body needs to stay alive: breathing, digesting food, circadian cycle, sleeping, and so on. The brain stem contains the following three structures:

  - The *medulla oblongata* connects the brainstem to the spinal cord; It is essential for survival (e.g., vital functions, reflexive actions).
  - The *pons*, or bridge, connects the midbrain and the medulla oblongata. It contains several cranial nerve nuclei (e.g., head and face sensations, motor control of eyes/mouth, equilibrium, autonomic functions).
  - The *midbrain* contains the superior and inferior colliculi (e.g., sensory information and auditory processing). In addition, it contains the ventral tegmental area and the substantia nigra that are involved in dopamine production and reward (as well as motivation).

- The **diencephalon** is a small region that is located between the brainstem and the cerebrum; it is a grouping of four structures: the thalamus, epithalamus, subthalamus, and hypothalamus.

  - The *thalamus* is a relay station for all sensory information (e.g., important for sleep, consciousness).
  - The *hypothalamus* is as small as an almond and is responsible for maintaining homeostasis (e.g., body temperature, blood pressure).
  - The *epithalamus* regulates the circadian rhythms responsible for regular sleep and wake cycles.
  - The *subthalamus* is responsible for movements (connected with the cerebrum).

Furthermore, the *cerebrum* is divided into 4 lobes: the frontal lobe, the parietal lobe, the occipital lobe, and the temporal lobe (Fig. 7).

- The **frontal lobe**, as its name says, is located behind the forehead. It is the governor of human intelligence, taking care of cognition (complex thinking, decision-making, reasoning, planning,

and imagining). This particular brain region is what is primarily responsible for much of the decision-making in predictions in project planning.

- The **parietal lobe**, behind the frontal lobe, is in charge of perception and sensory information (touch, taste, temperature).
- The **occipital lobe**, at the back of the brain, is responsible for our vision (processing light and any information from the eyes). Visualization has also been shown to increase reliability in project predictions.
- The **temporal lobe**, located near our ears, is involved in audition (hearing).

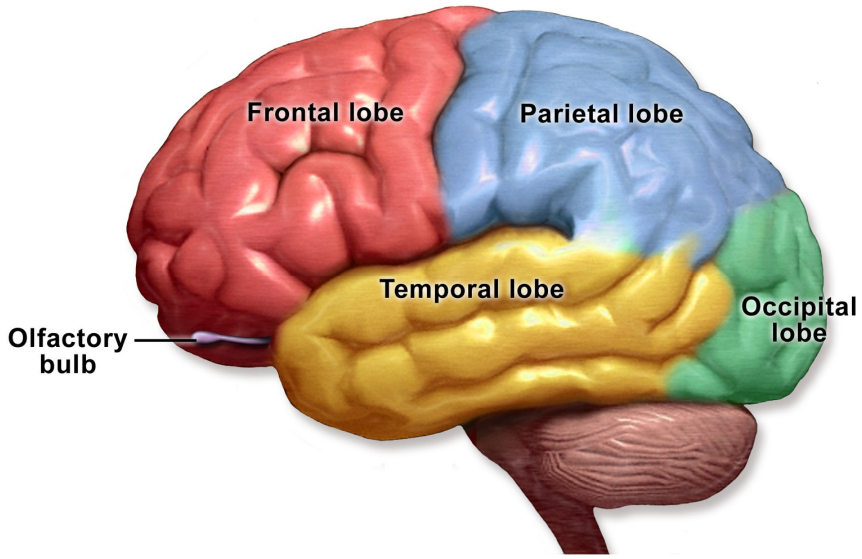

Figure 6. Representation of the four lobes of the cerebrum.

Understanding the brain can help us to understand the complexity of human behavior better. Different parts of the brain influence our daily choices. Have you heard of Phineas P. Gage? This American railroad construction foreman became famous for the survival of an accident in the 19th century. A large iron

rod projected through his skull in an accident and destroyed parts of his left frontal lobe. Figure 7 shows his reconstructed brain injury.

Figure 7. Representation of Phineas P. Gage's injury in the brain.

After his accident, his friends and family described him as a different man: a drastic change from a pleasant, hardworking person to an aggressive person with difficulties at work. He no longer had an easy-going personality. This injury in the frontal lobe was groundbreaking for science, leading to new discoveries in neuroscience and, more specifically, the linkage to various brain regions of specific functions. Nowadays, many brain imaging studies have reconstructed Gage's skull to understand his lesion better. They concluded that the injury destroyed a part of the prefrontal lobe that was responsible for rational and emotional decision-making. In addition, the brain lesion was associated with personality changes such as impulsive behavior.

However, recent studies have noted that some of the conclusions reported by the doctors that were involved in his case, may have exaggerated their findings. Additionally, it is now known that Gage recovered, at least partially, his social understanding and personality in the years that followed. This is a

relevant finding in itself, as it indicates support for neuroplasticity (the adaptation of our brain during the course of our life, including other brain structures taking over tasks of damaged sections of the brain).

The frontal lobes are the hallmark of human intelligence. From an evolutionary perspective, the human's prefrontal cortex is very large in comparison to other primates. When thinking of the Nobel Prize winner Daniel Kahneman and his *dual-system* model to understand human decision-making, we find a direct link with the brain regions. While System 1 is rapid and automatic, System 2 is slow, analytical, and rational. As we will refer to System 1 and System 2 (dual-system theory) quite frequently in this course (e.g., in the biases chapter), it is prudent to pause and offer a description of the two systems.

> *System 1 describes our automatic thinking mode. We use automatic thinking the majority of the day, such as when we are driving our cars, for example. When one drives a vehicle, there are a lot of automatic tasks that we do not think about. When we approach a stop-light at a traffic intersection, we may think about the fact that we need to stop, but we do not put a lot of effortful thinking into how much pressure we are putting on the brake pedal. When we are navigating a turn on the road, we likely are not putting much effortful thinking into how much pressure we put on the wheel with our hands, which hand grabs the steering wheel first, or the fact that our feet are constantly adjusting the pressure on the brake and accelerator to ensure the turn is smooth and safe. This is just one example of System 1 in action.*

> *System 2 is the opposite of System 1. It describes our mental function of slowing our thinking down and processing information deliberately. To use the driving scenario again, System 2 would be engaged to study the map of where we are going and determine which route to take. Deciding the best route on the map takes more effortful and deliberate thinking that requires mental engagement. As we slow our thinking down in System 2, we have an opportunity to reduce mental shortcutting, thereby decreasing reliance on cognitive biases.*

Interestingly, slow thinking primarily engages the frontal lobes. For example, brain imaging studies have shown that solving a mathematical problem (usually with System 2) activated regions in the prefrontal lobes. However, fast thinking (usually System 1) relies on more primitive brain structures in the lower parts of the brain; the part that decides on the 'fight or flight' response. In the temporal lobe, the amygdala is an almond-shaped region that is involved in our ability to feel emotions, typically in "fight or flight situations" where fear plays an essential role. Are you afraid of spiders? If yes, seeing a spider will probably activate your amygdala.

Damage to the amygdala can influence people's emotions and risk behavior. Unlike the automatic response of the amygdala, the frontal lobes can control our response to it, judging the actual risk. In situations where the threat is mild, the frontal lobes usually override the amygdala. In cases where fast-acting is necessary (fight, flight, or freeze), our frontal lobes may become overpowered. Figure 8 illustrates the connection between the prefrontal cortex and the amygdala.

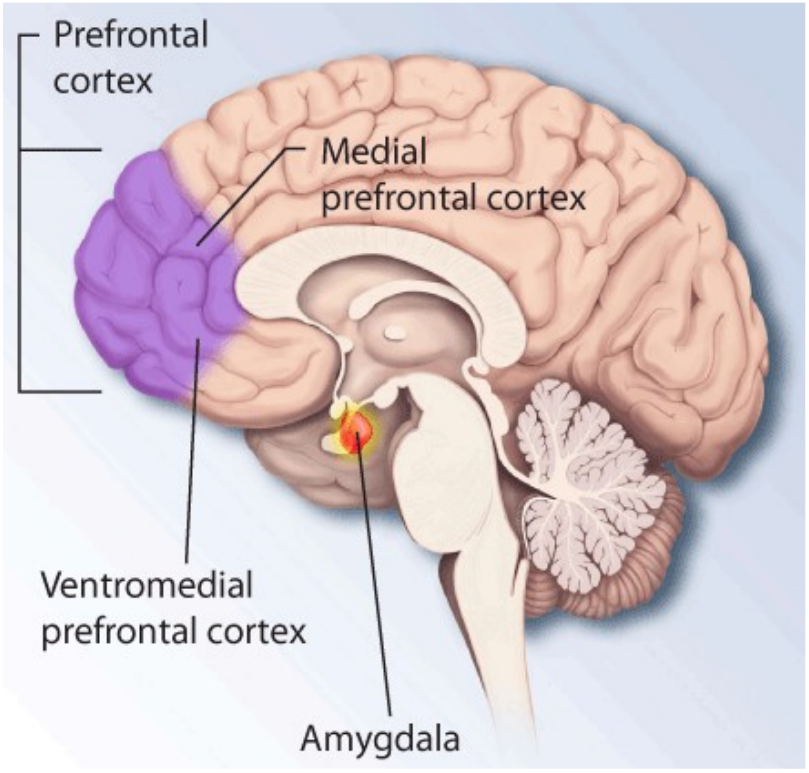

Figure 8. Representation of the connection between the prefrontal cortex and the amygdala.

The main takeaway of this introduction to neuroscience is that our reactions are based on the neurological working of the brain and even associated with specific regions of the brain. The psychology and behavior described in this course are thus not just theoretical conclusions – they are grounded in neurological science and can often be directly shown in EEG and fMRI studies. The evidence shows the stereotype that behavior is just a soft skill or art should now be seen from a different perspective. Research has shown through neuroscience that hard science indicates how our brain works, performs, and which errors it is prone.

Chapter 5

5.1 Introduction to Cognitive Moderators

This chapter is an introduction to some of the moderators of rational cognition. While this chapter introduces each of these concepts, some will be covered in greater depth in later training.

You can think of cognitive moderators as those core elements in thinking that keep your brain from making purely logical and rational decisions. To compare the brain to a computer again, a computer takes in inputs, stores the information in its memory, processes it, and sends the outputs from processing. The processing takes place in a linear, logical fashion, computing data without bias or any other impacts on accuracy. Each process is dry, void of emotion, and purely logical. The brain, on the other hand, does not operate like a computer. The processing of information through the brain is affected by a need to maintain its own survival and maintain the need for perceived survival. The brain constantly tries to conserve energy, maintain a state of comfort, avoid situations that seem dangerous (real or perceived), and protect itself from challenges to what it thinks is real. Thus, this processing keeps it from being completely rational or logical, as its survival is a higher priority than anything else. While the priority for survival was still of vital importance when we lived on the savanna and the reaction is thus in some way rational, these left-over instincts from earlier times can now interfere with decision-making in a modern context, which makes the decision irrational.

We present here an introduction to many of the different ways that pure rationality may be moderated by the brain. It's important to note that the cognitive moderators are not cognitive biases, but may be viewed as those elements of thinking that cause, moderate, or contribute to, cognitive biases.

5.2 Time-Pressure and Rushing

Imagine driving at about 200 miles per hour past a road sign. What did the sign say? You probably could not read it. What about driving 200 miles per hour past another street where you could have turned? You may not have even seen the street. You may have completely missed it because you were going so fast. This is what time-pressure can do to your planning. When you are rushed to make predictions, the brain does not have enough time to consider all alternatives, risks, resources needed, downstream implications, etc.

It's like driving past all the potential exits at 200 miles per hour and never seeing the options of car stops, information signs, and billboards as they flash by you. Similarly, in making predictions, we can set ourselves too many tasks at too tight deadlines, which causes us to overlook things and make mistakes. It's like trying to forecast 300 activities in one day. There's not enough time to ask questions or gather information, so you rush judgments on each forecast item. You never see the complete picture.

5.3 Time-Pressure and Automatic Thinking

Time-pressure causes automatic thinking, otherwise known by cognitive scientists as System 1 thinking (Forstmann et al., 2008; Kahneman, 2011). Due to the time constraint of a project, personnel on the project experience a higher degree of automatic thinking. This automatic thinking causes us to default to our intuition and the feeling that something is right or wrong. But intuition cannot be fully trusted. Intuition is informed by memories of past events in the brain, whether or not those events were correctly remembered, biased, or informed by incorrect beliefs. An increase in time-pressure causes us to default to automatic thinking, which results in us subconsciously relying on heuristics (discussed in section 5.4), and thus possible cognitive biases, to make decisions.

However, not all heuristics are inherently 'evil.' While Kahneman stresses the effects of biases due to heuristics, Klein stressed the benefits that may arise from relying on your fast processing System 1 thinking, or in other words, your intuition. He sees intuition not as something fluffy, but as intuition based on expertise. It is imperative that the intuitive decision is based on people who have already extensively developed their skills, relevant to the task at hand.

It is repetition that improves our System 1 thinking. One example Klein gives is firefighters: they often know when a blowout is about to happen (an explosion in a fire due to oxygen increase) and pull everyone out of the building just in the nick of time. When asked afterward what the indicators were that the blowout was about to happen, they couldn't say. All they said was that they had an uncomfortable feeling and decided to pull their firefighters back.

Let's take a look at a project example to help explain System 1:

> *Thomas, the risk officer, has the risk identification portion of phase 1 of the ICUBES plan system due in two weeks. He is feeling a lot of pressure from the impending deadline. And like most people, this pressure lingers even when he is not actively working on planning activities. Thomas does not want to spend a lot of time thinking about the details of the risk in the plan.*
>
> *He just assumes he has enough experience with construction projects that he knows the risk. Thomas sits down to complete the risk identification and has a lot of other tasks he also has to do, so he hurries through writing down all the risks. He relies on his intuition to complete the list.*
>
> *Due to the time-pressure, Thomas ended up missing three major risks that were discovered 6 months after the project started, causing a total of 3 weeks schedule delay and $280,000 in cost overruns. The risks were known and predictable.*
>
> *However, because Thomas had relied on his intuition during planning, he automatically defaulted to identifying risks he had experienced in the past and failed to consider other options*

that would have taken more deliberate thought to consider. His brain had defaulted to past experience only, and had thought it had all the information it needed.

Time-pressure causes the brain to react intuitively without considering alternatives. Under significant time-pressure the brain considers far fewer alternatives and takes the shortest path to a decision while missing many decision gates along the way. Thomas unknowingly experienced this by considering risks while under significant time-pressure, causing schedule delays and cost overruns. Thomas could have potentially avoided the

3-week delay and $280,000 overrun if he had completed his risk analysis by reducing the time-pressure and spending more time in deliberate thought about the risks. An additional 2 or 3 hours spent in risk identification could have prevented the risk from occurring or reduced the impact.

5.4 Heuristics

Heuristics are the brain's way of automatically referencing information in a split second without having to thoroughly think through a situation (Tversky & Kahneman, 1973; Tversky & Kahneman, 1981). Heuristics are like a mental rule of thumb. There are several heuristics that are especially relevant when forecasting. One, the *representativeness* heuristic, is where the brain compares the current object to past objects that are remembered. For example, if you are looking down a hallway and see a dark rectangle object at the end of the hallway, you might guess that it's a door. Your brain made an instantaneous comparison against hundreds of memories of dark rectangular objects at the end of hallways. And based on your past experiences, those objects seemed always to be doors. Therefore, your brain quickly made a visual comparison against those memories and informed you that what you saw was a door, and you had to put no effort into thinking about it. This is a heuristic.

Heuristics are like a computer or Google Search engine that provides suggestions of phrases once you start typing in the search bar. The computer is constantly making comparisons as you put in more

information. Heuristics are doing the same thing; your brain is continually indexing what it sees and hears against what it thinks it knows and giving you split-second feedback for you to make a decision. As you notice, heuristics aren't always a bad thing. They ease our cognitive load. Imagine having to think consciously about every object you face all day long. The danger lies in applying heuristics where we should not; this leads to biases.

Let's take a look at a project example to help explain heuristics:

> *Valerie, the PM, is still in the initiating phase of the project. She is working with the Project Sponsor, Jill, on developing the Project Charter. Valerie has to get a list of major risks together for the charter. She remembers past projects and lessons learned from her years of experience. She recalls when engineers were not available because of a delay in the vendor's schedule, when she and the superintendent got in an argument over the overtime needed on a change order, and when they had weekly cost overruns for 25 weeks in a row. However, she has trouble remembering any other significant events before adding a list of risks from lessons learned.*
>
> *The PM is experiencing the availability heuristic. She can only recall those things that are immediately available in memory. This is because the significance of those events was salient in her mind due to their vividness, repetition, or emotional impact. Her memory is only recalling things that are available in memory, and the availability of those memories has been increased by their vividness to her. Due to Valerie's heuristic, the project may miss other potential lessons learned for the project charter.*

5.5 Cognitive Load

If the person doing the planning is under high cognitive load (Sweller & Chandler, 1991), they may not have the mental capacity to seek additional information. Studies have also found that cognitive load can

cause errors in estimation (Hamamouche, Keefe, Jordan, & Cordes, 2018). Imagine running your computer all day long, and as you go about the day, you open more and more programs. It's late in the afternoon, and you now have a writing program open, a spreadsheet open, your email is running, a YouTube video is in the queue, and you are editing photos. Meanwhile, your computer is also running all the background programs to keep the computer functioning, such as automatic update programs, the controls for your mouse, screen color, watching your battery power, etc. Your computer is now bogged down and slow because the Random Access Memory (RAM) is almost completely full. Because the RAM is full, the computer cannot run at full capacity, and its performance is compromised.

Cognitive load in the brain is the same—the more information you put into throughout the day, the lower and slower the performance. You may have heard about the myth that we only use 10% of our brain, which is blatantly untrue. Why would we do that while we have so much more capacity? However, what is true, is that our working memory is limited. The standard working memory can hold between 5-7 items. Note that the working memory is fleeting and short and does not store the same amounts of information as our long-term memory.

The limits of our working memory have been extensively tested in a simple manner: researchers had participants learn random numbers by heart, e.g., 4-5-8-6, and have them repeat it. They found that between five and seven was the average series people could remember. However, this theory has been put under question as experts in certain tasks can far outperform this figure. Chess players, for instance, can run over a big series of moves in their heads while playing. This distinguishes them from novices, who only see a few options. How do they do that?

As an example, expert chess players have played so much that they no longer see individual moves, but patterns on the board. This enables them to think ahead and process more information. We do the same thing: we divide up our phone numbers in separate sections and learn them by heart this way. In project management, it is important to take the limits of the working memory into account. Do not

overload your employees with a variety of information, but structure it – this way they will process and remember it better, facilitating the process of storing the information in the long-term memory.

> *Elaine, the project controls analyst, is in a planning session with a few subject matter experts (SME). The SME has been running calculations for the first part of the day prior to coming to the planning session. There are still dozens of complex calculations left to do that day, and the planning session is quite inconvenient for the SME at this time. Needless to say, there are many tasks on the mind of the SME, creating high cognitive load. Due to this, the SME cannot think of much to tell Elaine when she asks for estimates of resources for the ICUBES engineering project activity. His mental resources are already taxed and he provides just basic information for Elaine's estimate. The end result turns out to be significantly underestimated resources when they start to execute the project.*

5.6 Decision Fatigue

Similar to cognitive load, decision fatigue is what occurs when your brain is making decisions and loses energy due to those decisions (Vohs et al., 2008). While cognitive load represents the memory being used throughout the day, decision fatigue is like the computer using that memory to take action. Each decision, large or small, builds up throughout the day, and every decision is burning calories and using oxygen (about 20% of your body's oxygen is used by your brain). As the day goes on, your energy for decisions decreases, similar to what happens when you are using your muscles and your arms or legs get tired. And just like a muscle, even small actions can have a cumulative effect on decreasing energy. Though you may only be making small decisions, like what to have for breakfast or deciding which route to take to work, those decisions are adding to your decision fatigue as the day goes on.

As decision fatigue increases, the quality of the decision can be reduced, which can decrease rationality and logical outputs of the brain, with an increase in automatic thinking, which also results in an

increased reliance on cognitive biases to make decisions. It is important to remember that our conscious thought, our System 2, requires a great deal of energy to function. That is why it is so hard to be attentive the whole time during a two-hour project meeting. Depending on the person (some of us are night owls and suffer less from afternoon dips), meetings at the end of the day that requires a lot of brainstorming, initiative, and complex thinking are generally not very productive.

> *Conan, the cost estimator, has to make several decisions of whether to send back resources estimates to the SMEs for further input. Conan has the responsibility of determining whether initial estimates may need further analysis. He has about 15 estimates left to complete, and it is already late in the afternoon. He has already had 5 meetings with SMEs where they had a lot of questions for him regarding what they should do in estimate scenarios. Conan has spent hours making a series of small decisions to help his SMEs. Now, at the end of the day, decision fatigue is really starting to set in, and he still has 15 estimates left to wrap up and determine whether he needs to contact the SMEs for further input. Because of decision fatigue, Conan is having a hard time making the determination of whether the resource estimates need more data. He thinks he is just tired and can push through it, but what he doesn't realize is that his brain is physically performing at a much lower rate than earlier that day. No amount of coffee can change his brain's performance. He may push through the estimates and may think he is processing information better after a cup of coffee, but in actuality his brain is considering fewer alternatives, considering less risk, and relying more on automatic processing (System 1) to make decisions.*

5.7 Cognitive Dissonance

Cognitive dissonance is the mental discomfort experienced when someone holds two or more contradictory beliefs, ideas, or values in their mind at the same time, and experiences psychological stress because of it (Hinojosa, Gardner, Cogliser, Gullifor, & Walker, 2016). With cognitive dissonance,

when two actions or ideas are not mentally consistent with each other, people try to change them until they become consistent. To explain dissonance, imagine this scenario: you made a plan for a project and handed it off to the project manager to deliver. After the project was delivered, you find that there were major errors in the plan which caused it to finish behind schedule and over budget. Because you believed that you were good at planning, you now have two conflicting pieces of information that are causing cognitive dissonance: 1) you are a good planner, and 2) you aren't as good at planning as you thought you were. When people experience this dissonance, they have to make a decision of how to disposition it, which usually results in one of the following actions:

- Accept the new information
- Reject the new information
- Discredit the new information
- Minimize the new information

The mental discomfort associated with cognitive dissonance causes people to make decisions that may be less logical or rational. This is because people will often make the choice that reduces mental discomfort over the decision that is correct.

Cognitive dissonance is the underlying precipitator of many cognitive biases and resulting decisions in error. For example, if our planner above chose to discredit the new information about their planning skills, they would likely not learn new methods to improve.

> *Ann, the CEO, is in a meeting with the planning team. They are discussing some of the major risks for the project charter. The ICUBES lead engineer is well aware of the major risks with such a complex endeavor. He starts to tell Ann about the complexities of a system that links with so many systems, and how this kind of system that has never been built before will take more effort during the planning phase. Ann starts to become frustrated with the lead engineer's 'pessimistic'*

outlook on the plan. Though the engineer is just trying to ensure they are successful, the CEO feels like the engineer's outlook challenges her positive view of the project. Though the pessimistic view can be used to find more risks to mitigate (thus increasing the probability of success), the engineer's statements have introduced cognitive dissonance with Ann. She now has two things in her mind that are in conflict with each other: 1) the feeling that this project is very doable, and 2) the project has many complexities which challenge successful completion. Though the engineer is not saying the project is not possible, his pessimistic view about risk is still causing cognitive dissonance. Ann's brain needs to disposition this dissonance.

She chooses to minimize the engineer's analysis of the issue and closes the meeting minutes later. The engineer's concerns do not make it to the risk register, and receive no further consideration by the planning team.

5.8 Social Pressure

Social pressure is the phenomenon that causes many decision errors in humans. Social pressure explains the pressure experienced from other people to make decisions or perform actions that correspond with their will or desires (Cialdini & Goldstein, 2004; Epley & Gilovich, 1999). There is so much literature on social pressure, peer pressure, compliance, and conformity, that there is no way we could possibly cover it all here. But to provide a basic overview, this pressure can be real or perceived, and can be based on social expectations of the culture, organization, or small group within the organization. It can also occur in temporary groups, such as in a project meeting.

The pressure from other people causes humans to often make decisions that are not completely logical. For example, in a planning meeting a subject matter expert may introduce a project risk to people in the meeting, but the risk is considered too uncomfortable to discuss. Because of the common understanding of the discomfort with discussing the risk, the subject matter expert decides not to push the issue and the risk is no longer discussed. However, that did not make the risk go away, it just kept the risk from

being discussed or mitigated. In this case, the social pressure increased risk to the project because the pressure decreased the logical decision.

Note that cognitive moderators such as these may be more or less important for others than for you. Where culture is concerned, some significant differences can exist. “Loss of face” in Asian regions is extremely important and much effort is put into avoiding singling out an individual with negative feedback. Other cultures, like American's, for example, are much more used to being open in their feedback in the group. Europeans and people from African nations fall somewhere in the middle.

> *The PM, Valerie, has just had a meeting with the project sponsor, Jill Stillway. Immediately following the meeting she went to a planning meeting to begin the Phase 2 baseline. Elaine, the project controls analyst, has a series of activities the team has been working on ready for Valerie to review. Valerie is feeling a lot of pressure from Jill to bring the project in by a certain date. When Elaine shows Valerie the initial estimated timeline, the milestone is 9 months past when Jill wanted the project to finish. Valerie instructs Elaine to cut all the durations by 20 percent in order to fit the project within Jill’s timeline.*
>
> *Valerie is exhibiting the classic signs of strategic misrepresentation, a behavioral phenomenon associated with social pressure and incentive to estimate projects outside of realistic predictions. Though Valerie is under pressure to plan the schedule within a timeframe, the correct approach is not to arbitrarily cut durations. Instead, the team should work the process of realistic predictions, then once the correct estimates are formulated begin looking for ways that efficiencies can be gained, resources increased, and risks mitigated to try to shorten the schedule.*

5.9 Framing

Why do we refer to framing so often? Because it is that important! A frame can influence your choice or decision to a great extent. The same thing can be framed positively ("We're halfway through our work people, good job!") or negatively ("We're only halfway, there is still so much work to do").

Framing is often used by politicians. They are experts (or their speechwriters are) in giving the truth a twist so that the frame matches their and their constituent's viewpoint. Framing is especially important when we have to make decisions under uncertainty or conditions of risk. This is the case within project management: a certain level of risk and uncertainty is present in every phase. Positive framing can lead to the identification of opportunities, while negative framing can lead to perceived threats. Loss aversion can also be used as a reframe to help identify more risk in planning.

5.10 Inertia

The *inertia* human phenomenon explains the tendency for people to maintain a stable state associated with inaction or persistence in a certain direction (Jung, 2019; Madrian & Shea 2001). Let's use the example of a car in motion. Once the car starts moving forward in a certain direction, the inertia keeps it going. Any steering, either left or right, introduces friction and causes the inertia to slow the car. The brain operates in a similar fashion. As people start to move in a certain direction in decisions, actions, or mental state, any change in direction introduces friction and discomfort. Because it takes more energy to deal with the friction or change in inertia, the brain resists this change. Inertia is associated with status quo bias, and can be one of the causes of resistance to change. Inertia can also be used to improve decision-making by setting defaults (see choice architecture or nudge theory) so that the inertia causes people to make better decisions by putting the right decision in the path of movement, either physical or mental.

> *Conan, the cost estimator, has just gathered estimates from SMEs. He is in a 'flow state' when an error is caught in 5 of the 9 estimates. If left uncorrected, the error means underestimation of*

several work packages. Conan knows there is an error, but thinks it may not be that big of a deal to leave it uncorrected because he does not see any major impacts. Because Conan is already processing estimates smoothly, an interruption of his process interrupts his inertia. Not only would he have new actions to perform, but he would also have to think about how to fix the errors. Interrupting his flow of thought and having to change directions causes resistance, which is the key in inertia.

5.11 Psychological Safety

One of the most basic moderators of cognition, and probably the most popular, is the brain's response to threat; most of us have heard of "fight, flight, or freeze." All humans and other mammals are constantly evaluating the environment for threats. Before we lived in civilized towns with a relative degree of safety, humans were more exposed to the elements, to predators, and other dangerous situations. In a dangerous situation, the brain is on high alert, and if there is an immediate threat, we respond by fighting the threat, fleeing the danger, or in some cases freezing and not responding (a natural reaction if one did not want to be seen by a predator). Above all, the brain is trying to survive in every situation. And just because we are now in more civilized environments with reduced levels of threat, does not mean the brain has shut off the function of threat detection. It is now just looking for other threats that may be more subtle; in the office, in a conversation with the boss, or in a project team meeting. Psychological safety is most simply explained as being safe from perceived threats at work.

Key take-aways for master planners:

- One way to improve decision-making, in general, is to recognize (and mitigate) cognitive moderators in your work environment
- Prediction is full of decisions, and by reducing cognitive moderators biases are reduced, thus planning and forecasting accuracy can be improved

Chapter 6

6.1 Introduction to Biases

Here is a list of major cognitive biases that apply to project management, with their brief definitions. There are hundreds of different categories, constructs, theories, and biases, but we focus on the most applicable biases in this chapter.

A cognitive bias is a systematic deviation from what would normally be rational decision-making behavior. They can lead to systematic errors, deviations from what is real, distortion, and faulty perception. Biases are part of human decision-making, whether we like it or not. They are actually the consequence of something positive: heuristics. Heuristics are mental shortcuts that we take to lighten our cognitive load. They are part of our System 1, which has fast, intuitive processing. Without these mental shortcuts, our System 2 (slower, more deliberate), would overload fast. Sometimes we just need to be fast in our decision-making, so heuristics come into play. For instance, it can help us recognize objects fast. Whether it's an office chair, a couch, a table chair, or any other kind, we don't have to deliberately think "what are these for?" System 1 tells us instantly: these are made for sitting. However, these heuristics or mental shortcuts can also make our decision-making faulty. We trade off speed and ease of thought with accuracy. Many biases exist that influence our decision-making.

Biases are not stereotypes. There is a common misconception of the term cognitive biases, where people generally think the word bias means the same thing as a stereotype. A stereotype is generally defined as a widely held but fixed and oversimplified image or idea of a particular type of person or thing. This is significantly different from a cognitive bias. A cognitive bias is a mental systematic error in

judgment and decision-making and applies to all information processing in the brain. A stereotype is generally an error in assumptions about particular people.

6.2 Ambiguity Aversion

Ambiguity aversion, or uncertainty aversion, is the tendency to prefer the known over the unknown. It's especially applicable in risk identification where people may prefer known risks over unknown risks, and may cause attention to be focused away from considering unknowns in a project.

Ambiguity is a type of uncertainty. It is common to distinguish between three degrees of uncertainty: Ignorance, which implies no knowledge at all, risk in which uncertainty is expressed by an exact numeral, and ambiguity which marks a condition in between the former two (Keren & Gerritsen, 1999).

Ambiguity aversion is a preference for known probabilities (risk) over unknown probabilities (uncertainty), or in other words, the desire to avoid unclear circumstances, even when this will not increase expected utility. Low ambiguity outcomes cover a range of situations: (a) a constant act that results in the same outcome in every situation, (b) a constant act that results in an outcome with the same probability (risk) in every situation, or (c) a constant act that results in an outcome in every situation that is associated with familiar sources of uncertainty (Blavatskyy, 2012). The latter is termed source preference, referring to the fact that not only the degree of uncertainty matters, but the source as well (Abdellaoui, Baillon, Placido, & Wakker, 2011; Tversky & Fox, 1995).

An illustration of source preference is the classical two-color paradox by Ellsberg (1961): one urn (or source) contains fifty black balls and fifty red balls (the known urn), while another urn contains a hundred red and black balls in an unknown proportion (the unknown urn). Ellsberg found participants willing to exchange bets both within the known and the unknown urn (red for black or vice versa). However, participants were not willing to exchange a bet from the known urn to the unknown urn. The

willingness to exchange within, but not between urns, suggests that people distinguish between different sources of uncertainty. In testing the two-color paradox with the general audience (N = 1935), Dimmock, Kouwenberg, & Wakker (2012) found the majority of people to be ambiguity averse for events with moderate and high likelihood. However, for events with low likelihood, the majority of people were ambiguity seeking. This is inconsistent with the assumption of universal ambiguity aversion, but has previously been found in laboratory settings as well (Wakker, 2010).

Ambiguity aversion has been adopted to explain, among others, limited participation in the stock market (Cao, Wang, & Zhang, 2005; Easley & O'Hara, 2009), increased tax compliance when the uncertainty of the probability of being audited rises (Snow & Warren, 2005), and the preference for established brands over new ones (Muthukrishnan, Wathieu, & Xu, 2009).

6.3 Anchoring Effect

The anchoring and adjustment effect is a cognitive bias where people begin with a suggested reference value which later becomes an anchor against which future estimates are based. In other words, if you hear the number 10, for example, and then you are asked to estimate an activity duration, your brain will subconsciously reference that anchor of 10 which may cause you to estimate the activity closer to 10 days. Varied beginning points generate altered estimations with a bias toward the original values (Tversky & Kahneman, 1974). The anchoring effect was first studied in the 1970's (Tversky & Kahneman, 1974). Numerous researchers have studied this cognitive bias, from experiments with product purchase prices (Dodonova, 2009) to guesses on the number of physicians in a given geographical area (Wilson, Houston, Etling, & Brekke, 1996).

One behavioral experiment asked people to write down the last three digits of their phone number and multiply by one thousand (for example, 678 = 678,000). The results indicated that people's subsequent estimation of house prices were influenced by the phone number anchor.

Anchoring can occur in a myriad of ways. For example, each proceeding number used in estimation will be compared against the initial value or number referenced, and can bias judgment toward clustering around the initial value. Experimental results indicate the anchoring effect may occur when there is no logical reason to consider the number. Results showed neither offering participants an incentive to be accurate or warning participants in advance about the anchoring bias eliminated the effects (Epley & Gilovich, 2006; Wilson et al., 1996).

The effects of anchoring were reviewed in one study of 40 years of literature on the bias (Furnham & Boo, 2011). The study showed anchoring to be relevant, but not as impactful when extreme values are used to anchor the subjects in experiments. In cases of extreme values, the effects are not as prevalent as when moderate anchors are used (Wegener, Petty, Detweiler-Bedell, & Jarvis, 2001).

In project management, research has shown the way activity estimation questions are asked may change the outcome and accuracy of the estimate. Inducing an anchor value changes the estimate output based on how one frames the question (Jorgensen, 2004). Anchoring was a crucial component in the experiment, where framing the question in different ways on a set of anchors was found to change the accuracy of the overall estimate.

Further support for anchoring was shown in research on question framing for estimating effort in project activities. Results indicated providing an initial time frame for activity estimation resulted in the creation of an anchor around that time frame, and thus an underestimation of effort. Removing the anchor by instead asking how much effort was required to accomplish an activity resulted in less underestimation of effort (Jørgensen & Halkjelsvik, 2010).

An underestimation of effort may be a significant problem for projects, as projects rely on estimates of activity durations, resources, and cost. Before projects are planned, business cases are developed for cost-benefit analysis, with rough estimates of the schedule and cost of project completion to determine return on investment. This initial estimate may become an anchor from which future project planning efforts are projected. The initial anchored value may present a risk to the accuracy of the final output with a skew to the original anchor, as individuals are prone to stay with initial values and make inadequate modifications to the anchor. A change in an initial value, then, results in a relative changed final value (Son & Rojas, 2011). To reduce the effects of anchoring in duration or resource estimates, the estimator or predictor should not be given a suggested estimate in advance. For example, telling the estimator to stay within 50 days duration, or suggesting that it is thought the activity will only take 50 days, will anchor the estimator's mind to the 50-day number, thus causing an inaccurate and potentially optimistic plan.

6.4 Attribution Error

People suffer from self-serving attribution bias, whereby they overestimate the importance of their own judgment when making adjustments to statistical forecasts (Hilary & Hsu, 2011; Libby & Rennekamp, 2012). But what is attribution error exactly? It is a very recognizable bias, of which we all have been guilty at one time or another. Attribution error is the tendency for people to attribute another's actions to factors internal to the person (e.g., character, motivation), while attributing one's own actions to factors external to the self and out of one's own control (e.g., getting sick and missing a deadline, being distracted because of troubles at home).

A recognizable example is the project employee that arrives late at the project meeting, or you yourself arrive late for the project meeting. We tend to attribute the other person's tardiness to their own fault: they are lazy, they didn't get up in time, and they didn't keep track of their agenda. While if you are late, you attribute it to the traffic jam, the telephone call that held you up, or a family emergency.

Fundamental attribution error can lead to friction between colleagues, as it disturbs the image you may have of each other. While you know everything that happens in your life and can play a role in events such as being late for a meeting, you do not know the entire collection of life events from your colleague that may have led to their tardiness. You never see the whole picture. In this sense, it is a heuristic: we make a mental shortcut based on the few things we know of the other person, in order to form a complete picture.

Overcoming attribution error is difficult, as it is so ingrained in our thought process. However, there are a few actions you can take. One, of course, is getting to know the other person better, thereby gaining empathy and knowledge about their lives. Sharing a coffee in the break room is always a great place to start. Second, and perhaps a bit more formal, is noting down five positive characteristics of the person you are starting to view in a negative light. This may reset your attitude towards them. And third, as with all biases, it is important to simply be aware of what you are doing and how you are making your attributions. This self-awareness can help in mitigating your attribution error response.

6.5 Confirmation Bias

Confirmation bias (Wason, 1960) explains the tendency of people seek or evaluate information in a way that fits with their existing beliefs, thinking, and preconceptions. Confirmation bias has also been shown to be related to unmotivated processes, which include primacy effects and anchoring; a reliance on information encountered early in a process (Nickerson, 1998). This bias has often been considered one of the most dangerous biases as it tends to direct people away from rational and logical conclusions, and can sometimes be intentional in nature.

As people evaluate risk and other uncomfortable facts in the project, watch for the occurrence of confirmation bias, as it is one of the most prevalent and may be a way for people to avoid the mental discomfort associated with cognitive dissonance.

Confirmation bias is often mitigated by considering the opposite. In other words, when faced with confirming what you already believe, consider the alternative to what you believe. What is the opposite viewpoint, and could that be more accurate?

6.6 Hot-Cold Empathy Gap

Humans have a difficult time predicting how they will behave in the future. A hot-cold empathy gap happens when people underestimate the impact of visceral states (e.g. being angry, in pain, or hungry) on their behavior or preferences (Loewenstein, 2005).

In projects, the hot-cold empathy gap may be seen when making predictions regarding project work. For example, people may not anticipate how they will feel when they get behind schedule in the future. The hot-cold empathy gap can be responsible for plans or forecasts that are significantly pessimistic or optimistic because the person making the prediction is not accurately estimating the impact of their feelings in the future when their predictions are off.

6.7 Gamblers Fallacy

Gambler's fallacy relates the independency of subsequent observations. Let us explain with an example: a dice rolls three times 6 in a row. We see this as being highly improbable and are sure that a fourth role will not be a 6. However, every event, or every throw of the dice, is independent of the previous throw. Thus, rolling 6-6-6-6 is as likely as rolling 1-5-4-2.

We find that hard to believe, though, as often we think that events are interrelated. Sometimes we consciously know that they are not (as you now know about rolling dice), but our intuition insists that

they are (Rogers, 1998). People may, for instance, not choose numbers in a lottery that were the winner last time, yet the numbers of the previous time are in no way related to the next time. It would be if the winning numbers were taken out of rotation, but the 'pot' of numbers stays the same every round.

6.8 Halo Effect and Horn Effect

The halo effect refers to the fact that when we have certain positive impressions about a person or company in one area, this positivity spills over into other areas. When this happens with negative impressions, we talk about the horn effect. If people are shown a picture of a well-groomed man with expensive-looking clothes, they may infer from this that the person is intelligent. However, this information is based on nothing but appearance and is not supported by any reliable information.

Attractiveness especially is a cause of the halo effect and has been linked to perceived life success and personality (Wade & Dimaria, 2003). In daily work life, the halo (or horn) effect may have an influence on performance appraisals, for example. An enthusiastic employee may receive a positive appraisal, even though their work is not up to par (Schneider, Gruman, & Coutts, L. M., 2012). As you may suspect, this halo effect is heavily subject to a person's beliefs and perceptions, be they positive or negative (e.g., stereotypes).

6.9 Herd Behavior

Herd behavior is a phenomenon from the study of social psychology. It states that people in a group may act differently than they would on their own, to conform to social rules. This confirmation of social rules leads to social acceptance. Individuals also believe that the group as a collection of people has a larger chance of being right than the individual itself, leading them to accept a collective decision or viewpoint.

A famous investigation of this phenomenon has been done by Solomon Asch (1951). He invited participants for a 'simple visual experiment,' where they were asked to judge what the longest line out of three was on a blackboard. The difference with the shorter lines was obvious, so there would be no confusion. The participant, however, was not alone. He was in a group of people who were, unbeknownst to the participant, all collaborators of Asch. When asked the question on which line was the longest, all collaborators chose an obviously shorter line.

Asch found that about one-third of the participants tended to follow the group's faulty judgment and repeat their choice of the short line. Over several trials of the experiment, three-quarters of the participants conformed to the majority rule at least once. Herd behavior and group conformity play an important role in decision-making. Think, for instance, of stock market bubbles in the domain of finance (Banerjee, 1992). Herd behavior is influenceable: it can be increased by fear (e.g. Economou et al., 2018), uncertainty (e.g. Lin, 2018), or a shared identity of decision-makers.

6.10 Hindsight Bias

I knew it all along! We have all uttered this phrase at times. This is, in fact, called hindsight bias, where the probability of an event occurring seems higher after the event has occurred than before. Think of the financial markets crash several years ago. Many books have been published stating it was unavoidable and that they saw it coming. You would expect this to be published as a warning before the event, not after. The bias is connected to the availability and representativeness heuristic.

Another effect of hindsight bias is that it can change our memory. Our recollection of events can be influenced when we are given new information and incorporate this into our existing recall (Mazzoni & Vanucci, 2007). Hindsight bias can form a significant problem in areas where accurate recollection is important, such as court cases. In project management, the premortem technique can be used to employ hindsight bias to our advantage: we are asked to imagine being in the future after a project has

failed. What could have caused the failure? Were there risks that could have been avoided? This way of remembering has been shown to improve risk detection.

6.11 Information Avoidance (Deliberate Ignorance)

Information avoidance (Golman et al., 2017) refers to situations where people choose not to obtain knowledge that is available. In behavioral finance, for example, studies have shown that investors are less likely to check their portfolio when the stock market is down than when it is up, which has been studied under the term the *ostrich effect* (Karlsson et al., 2009).

Have you ever turned your head away from something you don't want to see? What about having a thought of potential project failure enter your mind from a known risk, and quickly try to clear that thought from your head in an effort to deny its existence?

Information avoidance has been studied in many domains and disciplines. It has also been researched under different names, such as:

- Deliberate Ignorance (Kutsch & Hall, 2010)
- Willful Ignorance (Ramasesh & Browning, 2014)
- The Ostrich Effect (Karlsson, Loewenstein, & Seppi, 2009)
- Strategic Ignorance (Van der Weele, 2012)

Information avoidance or deliberate ignorance isn't as obvious as one might think. Sometimes it happens so quickly in our minds we do not actively acknowledge its existence. Once again, think back to that time when you've wanted to shield yourself from that thing you just really didn't want to know about. Since 80% of us are more optimistic than we are pessimistic, this is natural. We want to forecast

our future in a positive light. Therefore we naturally shield ourselves from things that might challenge that belief. We keep ourselves in this state of positive forecasting every day, if not every minute. So, you might say we've become so used to it we don't even actively think about it. Now, if it is fairly natural to shield ourselves from things that might feel bad, why would we be any different on a project? In most cases, we are not.

There are really two ways to look at ignorance, according to Kutsch and Hall (2010): plain and simple error (unintentional), and irrelevance (more intentional). Kutsch and Hall (2010) break the irrelevance category down into three subdomains:

- Untopicability
- Taboo
- Undecidability

We will start with defining *untopicability*. This is information that is considered off-topic, which is the most obvious kind of irrelevance. This is more of a limiting of information on risks and other things that may be pertinent, but are considered out of the range of importance in the given scenario. Think of it this way. You're in a planning meeting and bring up an external risk to the project. The risk is perhaps out of the project's control, so it is declared to be something that doesn't need focus.

Next, we have the *taboo* category. Kutsch and Hall (2010) define this as a "moral and/or cautionary restriction placed on action based on what is deemed inappropriate." This is a big one. I'm sure you've been in meetings before where it just became really socially uncomfortable to bring up something that might challenge our unrealistic view of project issues. In this case, you've entered the taboo category, where exposure to potential project risk may cause anxiety, so no one discusses it.

The final category is *undecidability*. This one is explained by the search for a true or false answer. If there is a lack of data for predicting a risk, then it's easy for stakeholders to take the 'out' of not knowing which risks may be considered true. In this case, the team deems the risk as not pertinent, and it gets removed from the list.

There are often instances where either you have a choice, your manager has a choice, or everyone in the room has a choice to bring up the uncomfortable risk. And that choice may determine whether or not your project fails. But think about it this way. What if you bring up that uncomfortable potential risk? You may now have the option to mitigate it, and by mitigating it increase the probability of your project succeeding.

6.12 Ingroup Bias

Ingroup bias, a social psychological construct, is the preference of one's group over those in outgroups (Hewstone, Rubin, & Willis, 2002; Machunsky, Meiser, & Mummendey, 2009; Mackie & Smith, 1998; Taylor & Doria, 1981). Two primary theoretical viewpoints attempt to explain ingroup bias: realistic conflict theory and social identity theory. Realistic Conflict Theory assumes a demand for scarce resources that drives competition and intergroup conflict, resulting in ingroup bias (Jackson, 1993). Social Identity Theory assumes a person's need to identify with a social group as an underlying cause of ingroup bias (Tajfel & Turner, 1986). Ingroup bias can be characterized by behaviors such as discrimination, prejudice, and stereotyping, as members of the ingroup disfavor members of other groups (Hewstone et al., 2002).

Team diversity plays a role in the effect of ingroup/outgroup dynamics. A study of team projects showed a tendency for teams to favor ingroup members who are similar over outgroup team members who are dissimilar, with higher trust for ingroup members. Higher functioning of teams may occur with more

homogenous teams. However, as ingroups become more diverse within themselves, and the frame of reference dilutes, misunderstanding increases (Nygard, Bender, Walia, Kong, Gagneja, & LeNoue, 2011).

6.13 Less-is-Better Effect

When issues are evaluated separately rather than together, decision-makers focus less on important attributes and are influenced more by those attributes that are easier to evaluate. The less-is-better effect bias is a preference reversal when objects are considered together instead of separately (Hsee, 1998).

This bias can have a significant impact on breaking down activities into smaller components. People may exhibit this bias when having to choose between sets of complex information and sets of less complexity. This bias may sometimes prevent full evaluation of scope and breaking down Work Breakdown Structure (WBS) elements effectively.

This cognitive bias could easily be considered one of the most impactful to project planning. People desire simplicity. However, simple does not necessarily mean better, more accurate, or truer. Though our brain may have a "good feeling" about something being less or simple, our System 1 may just be fooling us.

The less-is-better effect can plague the project in many ways, including preventing the team from:

- Considering more risk
- Breaking down the scope
- Unpacking activities into greater detail
- Evaluating resource needs

6.14 Mental Accounting

First, a quote from The Big Bang Theory: (Series 04, Episode 22 – The Wildebeest Implementation)

> *Raj*: Here, go buy yourself a scone.
>
> *Sheldon*: All right.
>
> *Sheldon*: I'd like to buy a scone.
>
> *Server*: Oh, I'm sorry, we're out. We have muffins.
>
> *Sheldon*: They sound delicious, but this money is earmarked for scones.

Mental accounting, a concept from behavioral economics, states that people treat money differently, depending on its source or its intended use (Thaler, 1999). For instance, if you get a bonus at work, you may feel more inclined to spend it on frivolous things, more than you would with your regular paycheck. Or, Sheldon Cooper, once you have a destination in mind for the money you have, you may be reluctant to spend it on something else. Money is, in fact, interchangeable or fungible, and has no labels. However, due to mental accounting, we often treat money as being labeled. We think of the value of money in relative rather than absolute terms. We attach value to the deal and what we get out of it (transaction utility; Thaler, 1985).

Investors, for instance, see gains made often as a separate 'pot of gold' that can be used for more high-risk investments, thereby losing sight of the complete picture of the portfolio (Thaler & Johnson, 1990). Banks use this phenomenon to offer multiple bank accounts with different goals (Zhang & Sussman, 2018). In project management, the financial budget is partitioned into different goals across different phases. Once set in place, project managers may find it difficult to transfer money from one goal to the other.

6.15 Myopic Loss Aversion

Another financially important bias is that of myopic loss aversion. This occurs when we focus too much on the short term with regard to losses. This reaction can be at the expense of more long-term financial benefits (Thaler et al., 1997). It is a matter of framing (Kahneman & Lovallo, 1993), which we discuss further in future training about Reframing loss. In project management, losses can occur in earlier phases but can lead to financial gains in later periods. However, due to myopic loss aversion, we may focus too much on the initial losses and lose sight of the bigger picture. One can also experience the feeling of loss in many other circumstances as well, such as loss of status, reputation, missed milestones, etc.

6.16 Naïve Allocation

Naïve allocation refers to people's preference to spread out limited resources evenly across possible locations. A project manager may be tempted to spread out the budget evenly across phases of the project, while the startup phase may warrant more budget than the end phase. A similar bias is related to naïve allocation: diversification bias – this is people's preference to spread out consumption choices across a variety of goods.

Both biases can be used to 'nudge' people in a certain direction. For instance, consumers can be steered towards choosing more healthy food if the menu is subdivided into different categories for the healthy items ("fruits," "vegetables") but not for the unhealthy ones ("candies and cookies"). This subdivision will lead the consumer to choosing more healthy options as it is displayed as a wider range of things (Johnson et al., 2012).

A predictor may be tempted to spread out the resources and cost across too many activities, reducing the focus and impact. The similar Diversification Bias can have the same effect. In an attempt to

mitigate discomfort with low resource availability, the predictor may opt for spreading out the resources. The planning facilitator should be aware of this, as it may be an indication that the resource quantities are not realistic from the start, causing the predictor to succumb to naïve allocation. If naïve allocation appears to be a problem, the facilitator should review the initial resource quantities again with the predictor.

6.17 Optimism Bias

Optimism bias (Costa-Font, Mossialos, & Rudisill, 2009), also known as unrealistic optimism (Weinstein, 1980), is the tendency to believe in the reduced risk of facing an undesirable event compared to others. People expect the future to be positive, with minimal evidence to support their expectations. Scans of the brain, with functional magnetic resonance imaging (fMRI), indicate decreased optimism when remembering past events, and increased optimism when thinking about the future. Past events may be more constrained, while future events are open to interpretation, allowing people to mentally detach themselves from possible adverse events (Sharot et al., 2007).

Optimism bias is prevalent in projects, with 20-45 percent of projects not meeting original cost and schedule baselines (Flyvbjerg, 2006). Optimism is problematic in that it may cause planners to delay other projects, resulting in the use of unanticipated resources (Min & Arkes, 2012). Optimism bias in project planning and control has also been examined in the context of organizational dynamics, where the organization plans many projects before the plans are transferred to the project team for execution and control. Furthermore, when a collective group of individuals are generally optimistic, group discussion makes them more optimistic, causing even more overly aggressive planning (Du, Zhao & Zhang).

6.18 Overconfidence Effect

Closely related to optimism bias is the overconfidence effect. This occurs when people's self-confidence is greater than their performance warrants (Pallier et al., 2002). How can we measure this? The usual way is to have people fill out a general knowledge test and have them indicate their confidence level. The actual score on the test can then be compared to the indicated confidence level – the latter is usually higher than the actual performance.

Overconfidence in project management can lead to the underestimation of risks and the overestimation of success. Moreover, it can increase the planning fallacy, further discussed in the Chapter on Unpacking and Premortem.

6.19 Pain of Paying

In the context of financially-related biases, there is the fact that people do not like to spend money. They experience 'pain of paying' (Zellermayer, 1996). This is because we are averse to 'losing' our money (see also Loss Aversion). While this is important for self-regulating our spending behavior (Prelec & Loewenstein, 1998), it may also lead to a frugal attitude when it's not warranted.

Imagine working as a project manager on a big construction project. It may be tempting to go for the cheaper option of materials, because the more expensive one causes the pain of paying. However, often we trade off money for quality. There are individual differences in people with regard to spending money. Some of us are very frugal, while others spend without a second thought. Even the method of payment can cause differences: the pain of paying is less when using a credit card as opposed to cash, because the loss of money is less visible.

6.20 Present Bias

The present bias refers to our tendency to give stronger weight to payoffs occurring in the now than those in the future (O'Donoghue & Rabin, 1999). When people in an experiment were asked whether they would like to receive $10 now or $50 in a year, the majority of them opted to go for the low, but instant, pay-off. As is the case with loss aversion and other financially related biases, we are myopic in our choices and preferences. In other words, we prefer instant gratification and we are impatient when it comes to money.

You will see the impact of present bias all throughout this manual, as the tendency for a preference for reward, positive feelings, and avoidance of mental discomfort is strongest in the present. Present bias, also known as Hyperbolic Discounting, can have a strong impact on the consideration of risk, because humans often seek satisfaction in the present moment with less consideration of future consequences. This causes an especially skewed view of the future, and risk consideration is most impacted because risk is something that belongs to future events.

6.21 Planning Fallacy

Kahneman & Tversky (1979) found that people have a tendency to underestimate durations of tasks. This finding is critical to project management, because projects and temporary organizations are made up of a series of tasks (Lundin & Söderholm, 1995), and rely on the completion of those tasks in order to deliver an outcome within a specific period of time. The planning fallacy can often take the form of optimism bias that influences unrealistic project planning (Peetz, Buehler, & Wilson, 2010).

It should be noted that there could be many elements that contribute to the planning fallacy, such as optimism bias, the overconfidence effect, deliberate ignorance (also known as the ostrich effect), and the anchoring effect, to name a few. While we could cover the planning fallacy a lot here, what you will find is that much of this training is about solving the planning fallacy. There are so many contributors to the planning fallacy, from the cognitive moderators, to almost all of the cognitive biases in this chapter.

The important thing to remember is that an optimistic plan *output* does not necessarily mean *optimism bias*.

6.22 Regret Aversion

The earliest foundation for regret theory is the minimax principle described by Savage (1954), which prescribes that one should select the option that minimizes one's maximum regret. Later on, Bell (1982) and Loomes and Sugden (1982) incorporated regret into a theory of choice. Regret is related to counterfactual thoughts about "what could have been" (Van Dijk & Zeelenberg, 2005) and can be defined as "a more or less painful cognitive and emotional state of feeling sorry for misfortunes, limitations, losses, transgressions, shortcomings or mistakes" (Landman, 1993, p. 36).

People make decisions that shield themselves from the possibility of regret (Van Dijk & Zeelenberg, 2007). To experience regret, the current condition is compared with what would have been if one had decided differently. If the choice is better than the other outcomes, people will rejoice; when a different choice would have led to a better outcome, people will experience regret (Kahneman & Miller, 1986). Indeed, the comparison is key in regret theory (D. E. Bell, 1982; Loomes & Sugden, 1982). This has been confirmed by neuroimaging studies: the brain region that lights up after having made a poor choice lights up as well before making the actual choice (Coricelli et al., 2005).

It has been argued that individuals are motivated to avoid regret because it calls into question whether they have made competent decisions (Josephs, Larrick, Steele, & Nisbett, 1992; R.P. Larrick, 1993). In general, people wish to avoid any negative feelings associated with regret and therefore choose the option associated with minimizing regret. Consequently, regret is most likely to influence risky decisions if feedback of their choice is present (Josephs et al., 1992; R. P. Larrick & Boles, 1995; Ritov, 1996; Zeelenberg, Beattie, van der Pligt, & de Vries, 1996). Indeed, the key to the anticipation of regret is the

presence of feedback regarding the alternatives that were not chosen (D. E. Bell, 1983; Josephs et al., 1992; R.P. Larrick, 1993; R. P. Larrick & Boles, 1995).

If, for instance, a person is asked to choose between a sure gain of $90 and a coin toss with $200 for heads and $0 for tails, there will be no knowledge about what could have been if the person chooses for a sure gain, and thus no possibility for regret aversion to influence the decision (unless the coin is tossed anyway). If, however, the coin toss is given and the person gets tails ($0), the person knows that choosing the sure gain of $90 would have been better. Accordingly, if the decision-maker wishes to avoid regret, the best alternative is to choose the sure gain and, thus, choose the risk-averse option (R. P. Larrick & Boles, 1995). In other words, whether or not a person makes risk-averse decisions depends on the expectation that one will receive feedback or not on the foregone alternatives.

When people avoid feedback on foregone options (by choosing a sure gain), they minimize their chance of regret in the short term, yet they also miss a chance on learning from their decisions in the long term. This is called myopic regret avoidance (Reb & Connolly, 2009). Myopic regret avoidance is associated with outcome regret avoidance, i.e., avoiding feedback with regard to immediate outcomes. Regret aversion can lead to paying a “regret premium,” or the utility that one is willing to give up in order to avoid future regrets (D. E. Bell, 1983). Indeed, people have been found to forego a direct gain if this prevents them from experiencing regret later on (e.g., Van de Ven & Zeelenberg, 2011).

Regret aversion has been shown to influence a wide range of decisions (Zeelenberg & Pieters, 2007). For instance, it has been found to influence cooperation in negotiation situations (R. P. Larrick & Boles, 1995), lottery participation (Zeelenberg & Pieters, 2004a), insurance buying (Hetts, Boninger, Armor, Gleicher, & Nathanson, 2000), the reluctance to exchange lottery tickets (Bar-Hillel & Neter, 1996; Van de Ven & Zeelenberg, 2011), immunization decisions (Wroe, Turner, & Salkovskis, 2004), and a wide range of laboratory gambles (e.g., Zeelenberg, et al., 1996).

6.23 Scarcity

When a resource, object, or time is not as readily available (e.g., due to limited quantity), we tend to perceive it as more valuable (Cialdini, 2008). Scarcity is often used in marketing to get people to buy. Marketing messages use appeals that indicate limited quantity and are thought to be more effective than limited-time appeals because they create a sense of competition among consumers (Aggarwal et al., 2011).

An experiment (Lee & Seidle, 2012) using wristwatch advertisements exposed participants to one of two different product descriptions “Exclusive limited edition. Hurry, limited stocks” or “New edition. Many items in stock”. The participants then had to indicate how much they would be willing to pay for the watch. The average consumer was willing to pay an additional 50% if the watch was advertised as scarce.

Scarcity can be used as a strategy by practitioners to nudge people who put off decisions (myopic procrastinators) to act (Johnson et al., 2012). Scarcity may have very large impacts on project prediction, especially in the domain of time scarcity. As the project gets closer and closer to its deadline, not only does time-pressure go up but so does the anxiety associated with time being a depleting resource.

6.24 Status Quo Bias

We like things the way they are and are reluctant to change. This is called status quo bias, where we prefer things to stay the same by not undertaking any action (closely related inertia). It could also mean that we have taken a decision and refuse to change it (Samuelson, & Zeckhauser, 1988), despite the importance of the decision and the potential of a changed decision to lead to a better outcome. Status

quo bias is closely related to loss aversion (see Prospect Theory), precommitment (see choice architecture), sunk cost fallacy (discussed below), cognitive dissonance, regret avoidance (see above), and feelings of control.

While changing ideas may lead to a better outcome, it's cognitively effortful and it is often considered 'safer' to just 'stick to your guns' and remain with the status quo. This is especially true given that we suffer from bounded rationality in our reasoning, scarcity, difficulty in information processing, etc. The effect of status quo bias can be enhanced in cases of choice overload (Dean et al., 2017) or high uncertainty and deliberation costs (Nebel, 2015).

6.25 Sunk Cost Fallacy

We have all experienced sunk cost fallacy at one point or another. It's highly probable that you have experienced it with your first car. It's often second-hand, old, and barely running. Every few months there are additional costs that may occur from repairs. But at what point do you stop investing in your car and consider it a loss?

We tend to keep investing in something in which we already have financially involved ourselves. If we stop, we feel as if these costs were losses and we are generally loss averse. It can also be the result of status quo bias or an ongoing commitment. Sunk cost fallacy can refer to invested time, money, and even effort (Arkes & Blumer, 1985).

Sunk cost fallacy can also have an impact on project decisions in regard to invested resources. The bias can be especially impactful to failing projects, where stakeholders refuse to pull out of a doomed project because of the investment they have put into the project so far. The sunk cost fallacy should never be used to make project decisions.

Chapter 7

7.1 The Prediction Modalities

There are five major modalities of prediction mitigation that impact planning and forecasting accuracy (Aczel et al., 2015; Datta & Mullainathan, 2014; Eizakshiri et al., 2015; Dragicevic & Jansen, 2016; Killen, 2017; Tetlock, 2015). These categories represent major components of resolving low prediction accuracy. The definition of a modality: *a particular mode in which something exists or is experienced or expressed.* Therefore, we are defining five different modes in which prediction mitigation exists.

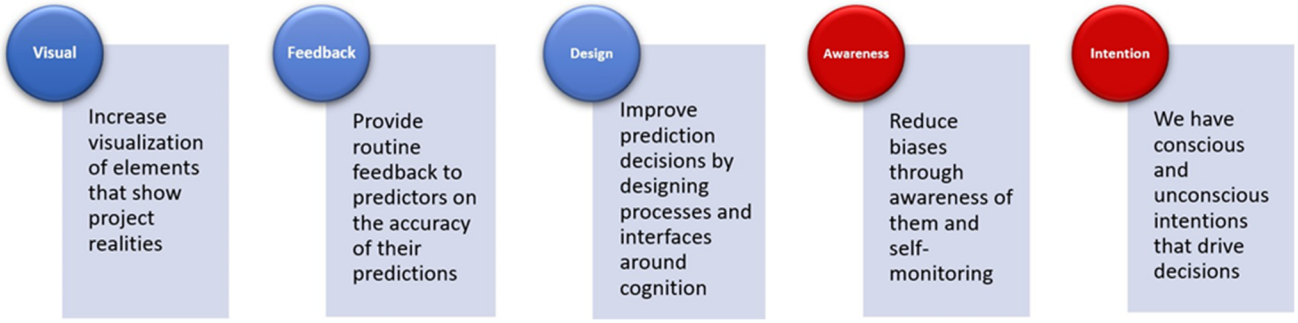

Figure 9. The five modalities of project prediction.

Simply stated, predicting a project outcome (planning and forecasting) determines the project, milestones, and activities' completion dates and cost prior to execution and delivery. A prediction is defined as *saying or estimating that a specified thing will happen in the future or will be a consequence of something*. Prediction is the central component of Behavioral Project Planning. Planning and forecasting is looking forward without knowing for sure what will happen. This is a prediction, and the core purpose of this course is to improve project predictions.

As a reminder, when we say the word *prediction*, we are referring to the general act of making a statement or decision about the future. When we say the word *plan* or *planning*, we are referring to the initial project target, formal plan, or baseline; the initial project prediction that occurs before execution begins. When we say the word *forecast* or *forecasting*, we are referring to interim predictions that occur during project execution.

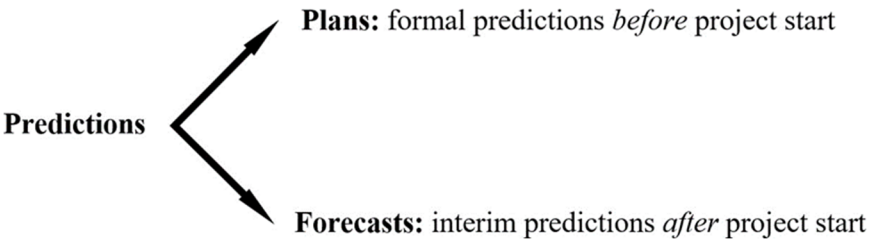

Figure 10. Predictions in planning and forecasting.

The 5 Improvement Modalities

Let's now look at the five improvement modalities that contribute to prediction accuracy:

> **Visualization** (passive). Planners and forecasters must be able to see what factors will impact their predictions, including the availability of resources, task obstacles, external controls, obscure risks, and predictable unknowns. Seeing these elements enables them to question optimistic and unrealistic plans and forecasts and correct their predictions. Research has shown that if people can see a visual representation of realities that impact prediction, they tend to predict more accurately. For example, if a plan or forecast shows there are not enough resources to do all the work in a short period of time, then a visual representation of the resource shortage is likely to cause people to adjust their plan or forecast to be more realistic and less optimistic (Killen, 2017; Dragicevic & Jansen, 2016).

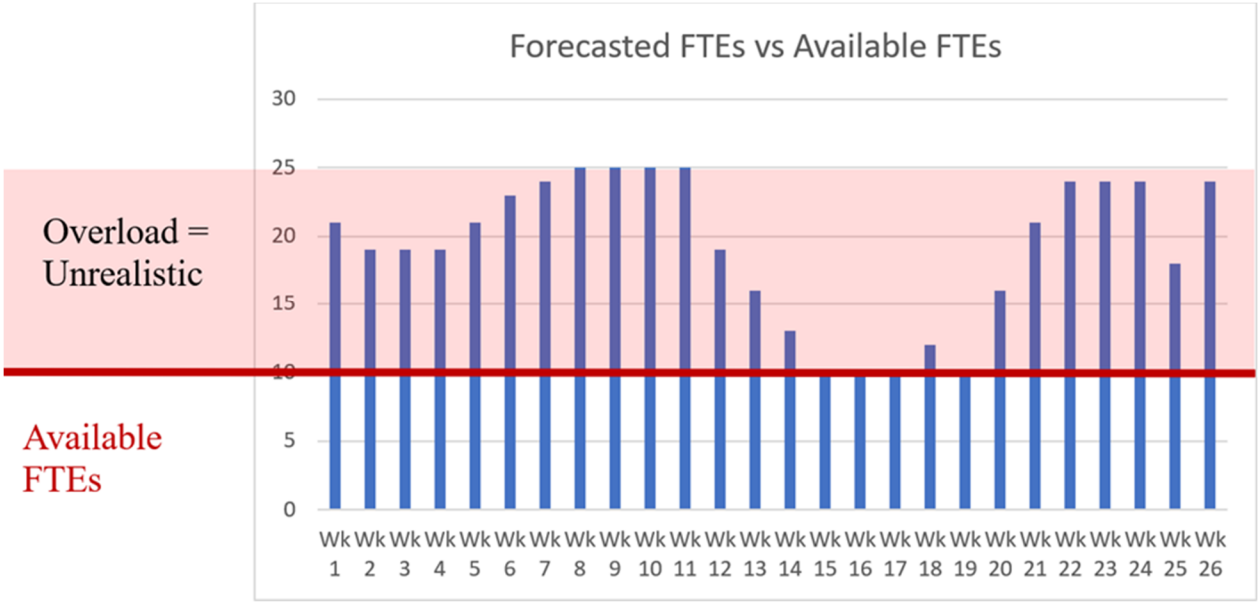

Figure 11. Example of resource usage visualization.

Feedback (passive). Forecasters and planners cannot improve on their predictions if they can't see how the actual results turn out compared to what was predicted. The more feedback they get on how accurate their plan was, and the more frequent that feedback is, the more chances they have to correct predictions and can start making adjustments in increasing their planning and forecasting (prediction) accuracy (Tetlock, 2015). Feedback frequency can be increased by using metrics to measure forecast accuracy during project execution and making those values available weekly or monthly to personnel who are making predictions. Measuring forecast accuracy during project execution can enable improvements without having to wait until the project is complete to determine the final variance.

Design (passive). Prediction decisions can be guided through appropriate design of the processes or interfaces (Datta & Mullainathan, 2014). Where awareness, for example, relies on the predictor to make corrections to their decisions by being aware of cognitive errors, design does not necessarily require the predictor to have knowledge of the cognitive errors in prediction (though knowledge of said errors helps debias prediction). The design modality helps reduce prediction errors by providing the predictor with a series of steps (processes) or interfaces (such as software) that are already predesigned to reduce thinking errors in planning and forecasting.

Awareness (passive). Planners and forecasters, as well as all of the rest of us, have cognitive biases and some obscure thinking errors (especially in time-constrained environments) that significantly decrease our ability to predict project outcomes and plan our work realistically. However, these can be corrected. These biases and errors can be decreased by building bias and error awareness through training (Aczel et al., 2015). Additionally, depending on the bias (see the respective chapters), certain measures can be taken to counter the effects. Many planners will self-correct to a degree after they have been made aware of the bias and its countermeasures.

Intention (active). These are intentional predictions in error. People have intentionality in many of their decisions, and their intentions can impact their planning and forecasting (Eizakshiri et al., 2015). Intention differs from other modalities in that it explains the potential for deliberate decisions in error; decisions that may be intentional because they are purposeful, incentivized, may be deliberate to avoid mental discomfort (cognitive dissonance), or may even involve lying (such as in strategic misrepresentation).

Intentionality may have to be improved by more calculated and deliberate mitigations, and can be more difficult to resolve in some cases. This is the second part of the intentionality modality.

> Where addressing the other four modalities can be thought of as passive, a customized mitigation to resolve the more complex problems associated with human intention can be considered a more active response.

Considering the active approach, we must intentionally improve project performance and recognize that passive measures rely only on a trust that we can coordinate or manage processes better and hope that everything works. Passive measures to improving project performance are passive because:

- *Visualization* provides the opportunity to make the right prediction choice, and the planner/forecaster may or may not choose to use the information.
- *Feedback* gives the planner/forecaster information on how they performed, and they may or may not make corrections.
- *Design* gives the planner/forecaster a series of processes or series of steps to follow, but they may or may not choose to follow them.
- *Awareness* of bias and certain countermeasures gives the planner/forecaster the chance to self-correct as much error as possible, but they may or may not self-correct.

Each one of these passive measures can improve planning and forecasting accuracy, but may not, depending on the choices and intentions of planner/forecasters. The important thing to note here is that it's best to have all four passive measures and the one active measure combined together in order to improve planning and forecasting, as well as project execution.

7.2 Practical Application

Visualization

If resources are shared across projects, make resource usage visual at the program or portfolio level. This can be done with resource loading programs at the project level that show peaks and valleys in resource usage and enable project professionals to see the realism of resource allocation.

Ensure logic between activities is visible to all who make predictions of project work. For example, line managers who may provide estimates of duration and handoffs between activities need to see how predecessors and successors impact their work in order to predict delivery realistically. Communication through visualization is a key component.

Feedback

Provide feedback on final project completion performance to professionals who input any estimations of time, resource, risk, or cost. Though the real performance of the project may cause some cognitive dissonance, the learning of where predictions went wrong provides an opportunity to make corrections. It is important to make a distinction between internal factors that influence performance (which can be changed) and external factors (which cannot be changed but can be accounted for in the next phase or project).

Feedback by measuring forecasting accuracy during execution can also provide two major advantages: by improving prediction during weekly or monthly forecasting, and indicating which forecasters are routinely inaccurate and may be contributing to inaccurate baseline planning. Feedback during execution can be implemented by using earned value or other similar measurements to show how forecasters are over or under-predicting activity durations or earnings. This percentage of over or under-prediction (i.e., their bias) can be provided routinely (weekly or monthly) to the predictors so that they can begin to learn their tendencies in prediction accuracy. Note that feedback should be (if possible) early and often, as a lagging indicator is more useful when data is available in time to make decisions on corrective action.

Design

Design company policy and procedures around mitigations to human prediction errors. This can be done by creating steps that predictors must use when planning and forecasting. Implement software (if available) that guides predictors through good decision-making when creating their baseline plans, evaluating risk, or updating forecast schedules.

Awareness (of thinking errors and biases)

Conduct training with all professionals in the organization who estimate durations, resources, risk, or cost. If a superintendent, for example, has training on optimism bias and deliberate ignorance, they become aware of common human tendencies that cause prediction inaccuracies and will self-correct to some degree. During this training, hand them the tools they need to counter biases and make better decisions.

Raise awareness in the organization by making behavioral decision-making errors part of the organizational conversation. For example, routine morning meetings may have a *behavioral minute* where one bias is discussed, or company communications may mention common human decision-making errors.

Intention

Actively monitor your feedback systems to gauge prediction accuracy and apply customized interventions by organization, project, or groups of individuals to address specific errors or biases that are prevalent. For example, if a specific department tends to have high error trends in its forecasts, that department can be considered for customized training that addresses contributors to bias in project environments. But beware of inter-departmental forecasting. An anecdote from one of the authors: "I once went to a company where the production crew was always overoptimistic (because they wanted to

avoid stockout at all cost), so the forecasting team started to pull the forecasts down because they knew production would pull them up. The production department found out and started pulling up more, after which the forecasting team found out and started pushing the forecasts down more, and so on... as an outsider, it was amusing, as an insider who had to deal with the constant adjustments, not so much."

Use choice architecture to customize processes and systems so that planners and forecasters have to take default routes to input data correctly or make better forecasting decisions. Examples of this include, but are not limited to, requiring obstacle identification before plans can be submitted, not allowing schedule activities longer than a specified duration, or customizing planning and forecasting systems to allow resource estimations in hourly units versus high-level costs.

Coach individual project managers or executives in specific areas that need improvement. For example, if a PM has an aversion to information that is realistic, causing overoptimism, and challenges realistic project delivery dates, coaching may include dealing with cognitive dissonance, negative emotions associated with risk identification, and communicating bad news to executives.

Below is a cross-section between the BPM Modalities and Prediction Modalities, with several examples.

	Processes	Metrics	Interfaces	Skills
Visualization	Resource usage visualization processes can be provided to reduce optimism bias			
Feedback			Providing prediction data through software	
Design	Completing risk analysis prior to predicting estimate values			
Awareness			Software and apps can provide reminders of specific biases to be aware of during prediction	
Intention		Measuring optimistic or pessimistic prediction trend data can indicate potential issues with intention in the organization		Planning facilitators can learn skills in reframing risks so that predictors want to resolve uncomfortable issues

Figure 12. BPM and prediction modalities matrix example.

Though we do not examine the prediction processes in depth in this training module, figure 13 represents the planning and forecasting (prediction) processes. These processes facilitate more accurate

and reliable plan outputs by reducing thinking errors through the design of the process flow (to reduce the anchoring effect), with the addition of other planning processes not found in popular project management methods. You will note that *design*, *awareness*, *feedback*, and *visualization* are referenced in the process diagram.

The processes have been broken down into three major areas: *prepare*, *predict*, and *finalize*. This distinction is essential, as the most impactful processes are those where the prediction is made. In terms of debiasing the final plan, predictors and facilitators that are assigned to the *predict* set of processes should be the most well versed in behavioral factors, as their decisions will most affect the final plan.

Prepare (processes associated with preparation for prediction):

- Exclude Anchors
- Identify & Include SMEs
- Monitor for Strategic Misrepresentation Throughout Cycle
- Reduce Time-Pressure
- Reduce Cognitive Load

Predict (processes associated with prediction, thus more sensitive to causing plan errors):

- Define Activity Scope
- Identify Assumptions
- Identify Exclusions
- Unpack Activities
- Define Quality Impacts
- Reframe Unidentified Risk and Obstacles
- Conduct Premortem

- Identify & Assess Risk
- Identify Obstacles
- Identify Resources
- Predict Resource Quantities
- Quantify Available Resources
- Formulating Durations w/out Resources

Finalize (processes associated with compiling, linking, and calculating the finalized prediction):

- Create Activities from Obstacles
- Insert Activity Logic
- Calculate Activity Durations
- Reference Predictor's Historical Accuracy
- Apply Reference Class as Necessary
- Run Resource Visualization Scenarios & Level
- Calculate Budget

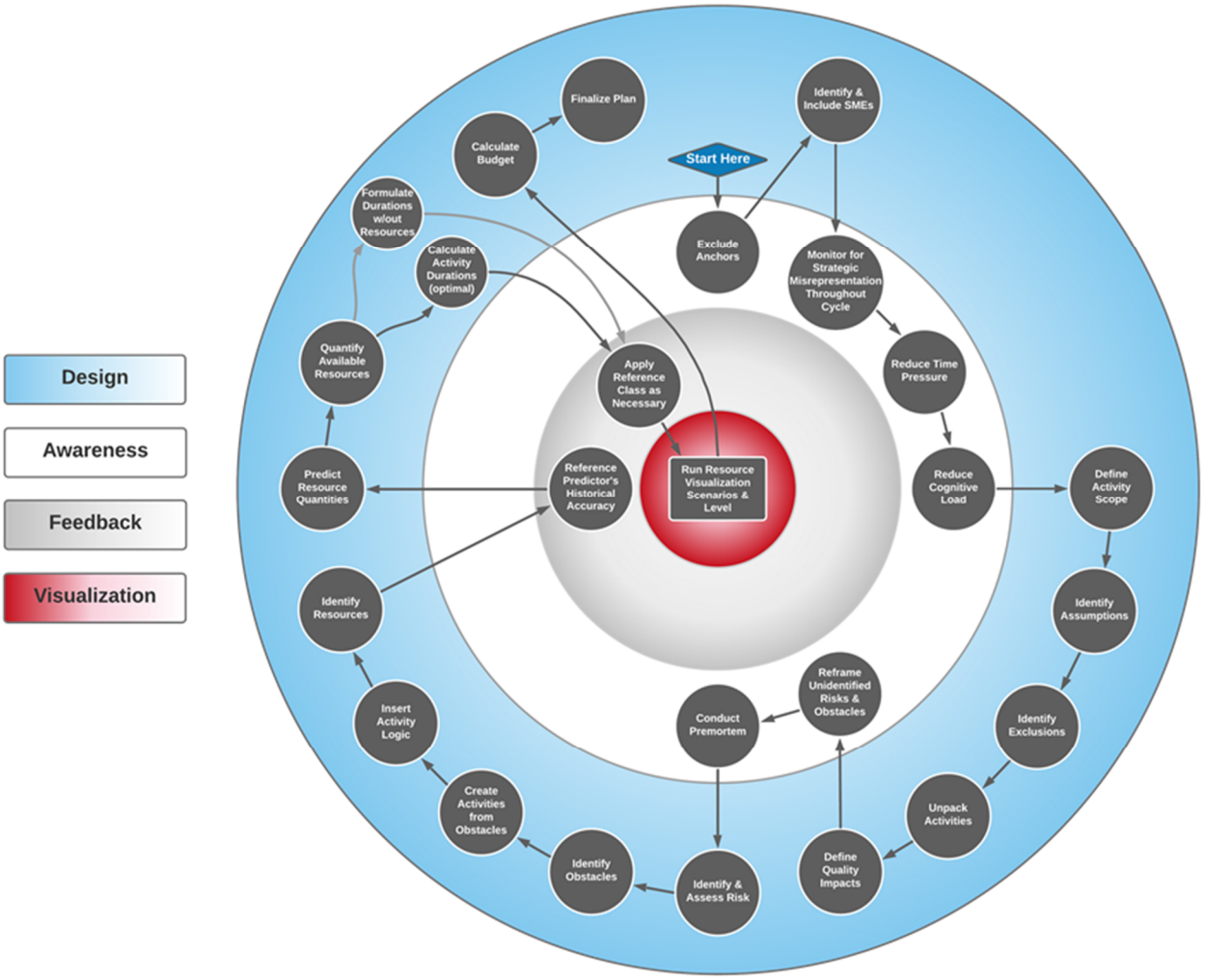

Figure 13. Project Prediction Processes.

Conclusion

This Behavioral Project Planning training has focused on the underlying foundations that drive error in project predictions in planning and forecasting. The Behavioral Project Planning primary focus has been the introduction of basic concepts for any project professional that is involved in project management, with specificity to predictions. The training should not be limited to project managers, but should instead be offered to any professional that makes decisions or assists in decisions in the project, including, but not limited to project controls, estimators, planners, earned value professionals, program managers, etc. The more people learn about the errors in planning and forecasting, the more touch points can have errors reduced in the project. This training should not be limited based on role or position in the organization or project.

The next series of training will cover additional topics in depth. Meanwhile, a few closing notes and recommendations are appropriate:

- In the project management field we tend to rely on data to solve problems, thus piling on more and more data as a solution. But data is only the first step to debiasing, and it must be data that enhances decision-making; focus on decision-data. Remember from the chapter on decision-data that data by itself cannot improve decision-making.
- Do not incentivize reducing planning and forecasting error. Incentivizing error reduction can lead to the social pressure to change the error indicator and not the underlying problem.
- When trying to improve errors in prediction from a behavioral perspective, start with tackling project risk and obstacles first. Because risk is a driver of human behavior, and the perception of risk causes mental discomfort, unaddressed risk is often the cause of the planning error because the humans involved in the prediction decisions had underlying causal biases and other human factors.
- Optimistic plans do not mean that optimism bias is the cause. As one may have seen in this training, many other contributors to an *optimistic output* are not necessarily *optimism bias*.

- Focus on the cognitive moderators. These are the underlying causes of many cognitive biases and the decision errors that follow. By focusing on the cognitive moderators, one can often reduce the errors that are associated with them. Deliberate ignorance and optimism bias, for example, are highly related to cognitive dissonance avoidance. If one can learn to reduce or reframe the dissonance, the associated biases may be diminished, thus yielding more reliable project predictions.

This training is the first part of a series of training documents that merges project management with behavioral and cognitive science, with an emphasis on improving planning and forecasting by understanding human cognitive errors. This document focuses on building awareness of the behavioral foundations that cause thinking errors. Future training in the series will go further into detailed processes and more depth in behavioral components and additional diagnostics for the organization.

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