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COGNITIVE BIAS IN DEFENSE FINANCIAL MANAGEMENT: A MARINE CORPS PERSPECTIVE

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COGNITIVE BIAS IN DEFENSE FINANCIAL MANAGEMENT: A MARINE CORPS PERSPECTIVE

by

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December 2023

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Cognitive bias can diminish judgment and decision-making in resource management decisions. However, limited cognitive bias research has extended to these decisions in Defense Financial Management (DFM). We conducted a literature review and interviewed senior Marine Corps Financial Managers to examine how biases might affect resource management decisions. We identify some of the ways that cognitive biases can lead to the ineffective allocation of defense resources. We also conducted a literature review on cognitive bias mitigation practices and discuss ways to apply them in the DFM environment. Finally, we provide a practical exercise to expose decision-makers to cognitive bias in DFM by adapting existing cognitive bias exercises and questionnaires.

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COGNITIVE BIAS IN DEFENSE FINANCIAL MANAGEMENT: A MARINE CORPS PERSPECTIVE

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ABSTRACT

Cognitive bias can diminish judgment and decision-making in resource management decisions. However, limited cognitive bias research has extended to these decisions in Defense Financial Management (DFM). We conducted a literature review and interviewed senior Marine Corps Financial Managers to examine how biases might affect resource management decisions. We identify some of the ways that cognitive biases can lead to the ineffective allocation of defense resources. We also conducted a literature review on cognitive bias mitigation practices and discuss ways to apply them in the DFM environment. Finally, we provide a practical exercise to expose decision-makers to cognitive bias in DFM by adapting existing cognitive bias exercises and questionnaires.

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LIST OF ACRONYMS AND ABBREVIATIONS

CYD	Current-Year Deficiency
DFM	Defense Financial Management
DOD	Department of Defense
FM	Financial Management
JDM	Judgment and Decision-Making
MYR	Mid-Year Review
POM	Program Objective Memorandum
PPBE	Planning, Programming, Budgeting, and Execution
RMWG	Resource Management Working Group
USMC	United States Marine Corps

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I. INTRODUCTION

> The Marine Corps' success on emerging battlefields will depend upon our force being highly trained, cognitively mature, and operationally experienced.
>
> —Marine Corps Talent Management Campaign Plan (2023-2025)

> We can be blind to the obvious and we are also blind to our blindness.
>
> —Daniel Kahneman, *Thinking, Fast and Slow*

Much research has been done on decision-making in various contexts, including corporate finance, public policy, and military tactics. An important aspect of decision-making is human cognition, particularly its limitations. Cognitive bias has been proposed as an effect of our cognitive limits, often leading to suboptimal decisions. Naturally, cognitive bias research has extended to the contexts listed above, and others, many of which involve resource management decisions. Here, a suboptimal decision might result in lost profits, as in corporate finance, or reduced effectiveness, as in public policy. Military commanders and defense financial managers must also make resource management decisions, often with large consequences. Little cognitive bias research, however, has been applied to the Defense Financial Management (DFM) environment. To our knowledge, only Mortlock and Dew (2021) have directly applied cognitive bias research to DFM, specifically to defense acquisition. To help address this apparent cognitive bias research shortfall, this paper attempts to apply existing literature to the DFM environment and, more specifically, to Marine Corps Financial Management.

A. PROBLEM STATEMENT

Cognitive bias can diminish judgment and decision-making in the effective allocation of defense resources.

B. RESEARCH OBJECTIVES

We have three objectives for our research:

1. Identify potential decision-making biases in the DFM environment.
2. Explore how these biases can inhibit the effective allocation of resources.
3. Identify mitigation techniques for these biases.

C. RESEARCH QUESTIONS

This project accomplishes these objectives by answering the following questions:

1. **Primary research question:** How might cognitive bias affect decision-making in DFM?
2. **Secondary research question:** What are effective mitigation efforts for these biases?
3. **Secondary research question:** What is an effective way to embed cognitive bias training into USMC financial management workforce development?

These objectives and questions help address the research problem by familiarizing readers with various decision-making biases, discussing bias-mitigation methods, then exploring how bias can emerge in DFM and how mitigation methods might be incorporated in resource management decisions. Furthermore, this project is designed to address the absence of this subject within current Marine Corps financial management training and education.

D. DEFINING KEY TERMS

Heuristics are "simplifying shortcuts of intuitive thinking" that people rely on to make decisions, especially in the absence of perfect information (Kahneman, 2011, p. 8).

Heuristics may lead to **cognitive bias**, which refers to "systematic but purportedly flawed patterns of responses to judgment and decision problems" (Wilke & Mata, 2012, p. 531). **Judgment** is "forming an idea, opinion, or estimate about an object, an event, a state, or another type of phenomenon," and **decision** "refers to making up one's mind about the issue at hand and taking a course of action" (Bonner, 1999, p. 385). Some of the literature combines judgment and decision-making into one term and applies the acronym JDM, which will be used throughout this project. The **effective allocation of defense resources** is defined in this project as the process of ensuring every dollar is spent where it is needed most.

E. PROJECT ORGANIZATION

We begin by discussing some of the history of cognitive bias research. Next, we review the literature to determine how cognitive biases may emerge in various decision-making environments including accounting, investing, and auditing, while also discussing bias-mitigation techniques. We then review the literature to help describe the DFM decision-making environment, including decision events and policies governing these decisions. Following the literature review, we discuss experience-based insights on cognitive bias from Marine Corps financial management personnel. Based on the literature review and interview responses, we analyze how bias can affect judgment and decision-making in DFM and include a practical exercise (Appendix A) designed to expose students to cognitive bias in the DFM environment.

> So this is my aim…improve the ability to identify and understand errors of judgment and choice, in others and eventually in ourselves, by providing a richer and more precise language to discuss them.
>
> —Daniel Kahneman, *Thinking, Fast and Slow*

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II. BACKGROUND

The philosophical and academic roots of cognitive bias research are expansive. This section narrows the discussion to a handful of concepts: utility theory, bounded rationality, prospect theory, and fast-and-frugal heuristics. These concepts are discussed in the order they entered academia and are relevant for this project because they offer various explanations for human decision-making. This background promotes awareness of potential influences during judgment and decision-making (JDM) and insight into the decision-making environments discussed in this project.

A. UTILITY THEORY

In the early 1870s, European thinkers[1] proposed an alternate explanation for the "exchange value of commodities" or the price of a product measured in comparison to an alternative (Moscati, 2020). The explanation is known today as utility theory, and it held center stage in explaining economic decision-making for nearly a century. Utility theory is the "assumption in neoclassical economics that individuals are rational *Homo oeconomici* ["economic man"] that always seek to maximize their utility and follow their 'true' preferences" (Reisch & Zhao, 2017, p. 190). Utility theory asserts that decision-makers select between alternatives based on maximum possible value relative to each alternative and "actively engage in a search for information on the best available option, know[ing] and consider[ing] all costs and benefits" (Reisch & Zhao, 2017, p. 191). For instance, an investor would select among stock options by identifying the option with the highest possible return relative to the alternatives. Levy (1992) writes, "[t]he expected-utility principle asserts that individuals attempt to maximize expected utility in their choices between risky options: they weight the utilities of individual outcomes by their probabilities and choose the option with the highest weighted sum" (p. 173).

[1] William Stanley Jevons in England, Carl Menger in Austria and Leon Walras, a Frenchman at the University Lausanne in Switzerland (Moscati, 2020).

B. BOUNDED RATIONALITY

As early as 1955, *bounded rationality* has been offered as an alternative theory to the economic man (Gigerenzer, 2020; Simon, 1957). Humans must commonly make decisions involving "risk and uncertainty," where risk involves knowing possible outcomes and their probabilities of occurring, and where uncertainty involves "ambiguity and intractability," which includes unknown probabilities (Gigerenzer, 2020, p. 56). In other words, uncertainty encompasses most decisions humans make, including those with uncertain outcomes and probabilities. Kahneman and Tversky (1974) explored how people make probability assessments under uncertainty using heuristics, or as Kahneman later described "simplifying shortcuts of intuitive thinking" (Kahneman, 2011, p. 8) to reduce the complexity of making these judgments. Heuristics can cause biases which can lead to beliefs expressed in statements such as "I think that…" or "chances are…" (Tversky & Kahneman, 1974, p. 1124). Kahneman (2011) used the following example:

> "Steve is very shy and withdrawn, invariably helpful, but with little interest in people, or in the world of reality. A meek and tidy soul, he has a need for order and structure, and a passion for detail." Is Steve more likely to be a librarian or a farmer? (p. 7)

When completing this task, people might unknowingly employ the representativeness heuristic to assess the degree to which Steve fits an existing stereotype (a simplifying shortcut), then lean toward that assessment (a bias) to arrive at the belief "I think Steve is a librarian" (a judgment). This process can occur without the participant being aware of it and can also overlook valuable considerations along the way. For instance, approximately how many male librarians are there compared to male farmers? In this exercise, participants may have guessed Steve to be a librarian, a judgment of probability made despite the fact "that there are more than 20 male farmers for each male librarian in the United States" (p. 7). Kahneman and Tversky (1974) observe that "in general, these heuristics are quite useful, but sometimes they lead to severe and systematic errors" (p.1124).

C. PROSPECT THEORY

Kahneman and Tversky (1979) built upon their previous work about judgment in a paper about decision-making. Instead of examining the rationale behind probability

assessments under uncertainty, they examined the rationale behind specific choices under uncertainty. They developed and introduced Prospect Theory, "an alternative theory of choice in which value is assigned to gains and losses rather than to final assets," defining a prospect as "a contract that yields outcome x_i with probability p_i" (1979, p. 263). Like their previous work, Kahneman and Tversky developed choice problems observing "systematic biases in our own decisions, intuitive preferences that consistently violated the rules of rational choice" (Kahneman, 2011, p. 10). To help illustrate their observations, consider the following exercise detailed in Tables 1 and 2:

Assume that you have invested $18,000 in the stock market. Over the past few days, the market has shifted significantly, and you are expected to lose all $18,000 if you do nothing. You consider one of two options:

Table 1. Investment Scenario 1

Option	Money Saved	Likelihood
Sell only	$6,000	100%
Sell then reinvest	$18,000	33%
	$0	67%

Which option do you select? Record your answer, then consider the options listed in Table 2:

Table 2. Investment Scenario 2

Option	Money Lost	Likelihood
Sell only	$12,000	100%
Sell then reinvest	$0	33%
	$18,000	67%

Which option do you select? Record your answer, then compare Tables 1 and 2, and consider that the corresponding options between the tables result in the same outcome. Did your selection differ between the two tables? This is a minor variation of Tversky and Kahneman's (1981) Asian disease experiment which found that responses to two sets of the exact same choices differed significantly when framed in losses instead of gains. Levy (1992) observes, "Prospect theory posits that individuals…give more weight to losses than to comparable gains, and that they are generally risk-averse with respect to gains and risk-acceptant with respect to losses" (p. 171). Accordingly, "utility theory, as it is commonly interpreted and applied, is not an adequate descriptive model and we propose an alternative account of choice under risk" (Kahneman & Tversky, 1979, p. 263). A common feature throughout Kahneman and Tversky's research is the examination of judgment and choice under uncertainty, a feature relevant to this project given the frequency with which military decision-makers face choices and judgments under uncertain conditions. As Joint Publication 5-0 *Joint Planning* (Joint Chiefs of Staff, 2020) asserts, "determining military risk is more art than science. Planners use historical data, intuitive analysis, and judgment. Military risk characterization is based on an evaluation of the probability that the commander's end state will be attained" (p. III-25).

D. FAST AND FRUGAL HEURISTICS

There is an unsettled debate between what has become known as Kahneman and Tversky's heuristics-and-biases approach (HBA) and Gigerenzer's fast-and-frugal heuristics approach (FHA). HBA argues that heuristics always result in biases and irrational decisions (Polonioli, 2013). Gigerenzer's FHA argues that heuristics, when employed in the same environment in which they are developed, will often result in efficient, if imperfect, decision-making, and do not necessarily lead to worse decisions than "what would be considered 'rational'" (Gigerenzer, 2020, p. 60). Gigerenzer also argues that heuristics are not necessarily the only way to diagnose errors in human judgment and that they have "directed attention away from detailed models of cognitive processes and toward post hoc accounts of alleged errors" (Gigerenzer, 1996, p. 20). Thus, a potential limitation of cognitive bias research is that while we may be able to test for evidence of cognitive bias in an experimental capacity, it is difficult to assess with certainty whether

biases played a role in the decisions made during a previous event. This is one of Gigerenzer's issues with HBA: it is unclear that irrationality as explained by cognitive biases remains outside of a lab environment (Polonioli, 2013). For the purposes of this project, we will view cognitive bias as but one way of explaining possible irrational or suboptimal decision-making while also recognizing that heuristics may be useful to decision-makers in an age of information saturation.

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III. LITERATURE REVIEW

This chapter is divided into three sections. The first section reviews the literature on several cognitive biases to establish an understanding of how they can impact decision-making in various environments, while the second section discusses methods to help mitigate these biases. The third section reviews several publications to describe the DFM decision-making environment and to help inform our analysis on cognitive bias in DFM.

A. COGNITIVE BIAS IN VARIOUS DECISION-MAKING ENVIRONMENTS

This section discusses six cognitive biases, chosen for this project due to their prevalence in the literature and potential relevance to decision-making in DFM. The biases are discussed alphabetically, and each section contains a brief description of the bias, a definition, variations of the bias (when applicable), and applications of how the bias manifests in decision-making environments, many of which may be easily associated with DFM.

1. Anchoring Bias

Tversky and Kahneman (1974) write that individuals may be subject to anchoring bias when developing an estimate. They may start from an initial value (the anchor) "that is adjusted to yield [a] final answer" (p. 1128). Anchoring bias is accompanied by an adjustment bias, wherein an individual fails to adequately adjust their estimate when confronted with subsequent values. The result of these two biases is that individuals will tend to weigh initial values more heavily than subsequent values. Jacowitz and Kahneman (1995) conducted an experiment in which they asked subjects questions that involved estimating 15 different values. One such value was the length of the Mississippi River. Fay and Montague (2015) drew from this particular question for their classroom exercise. Half of the students were to be given a questionnaire with a high anchor (the first set of questions listed below), and the other half a second set with a low anchor. Anchoring bias would predict that the group receiving the high anchor will guess a higher estimate on average, which is consistent with Jacowitz and Kahneman's results.

Group 1 (high anchor):

"(a) Is the length of the Mississippi River greater or less than 3,000 miles?

(b) What is the length of the Mississippi River?"

Group 2 (low anchor):

"(a) Is the length of the Mississippi River greater or less than 300 miles?

(b) What is the length of the Mississippi River?" (Fay & Montague, 2015, p. 21)

a. Variations of Anchoring Bias

Mechanisms. Variations of anchoring bias consist of the proposed mechanism of the anchoring effect. As previously noted, Tversky and Kahneman (1974) proffered a two-part explanation: an initial anchor effect combined with an insufficient adjustment. Alternatively, Chapman and Johnson (1994) presented evidence that there is a confirmatory search mechanism. Not to be confused with confirmation bias (discussed in this chapter), confirmatory search refers to the process of considering how an anchor is compatible with the sought-after estimate, which causes an emphasis on the anchor. An example of this is the decision of how to value a vacation. If presented with a high value anchor, a person might try to justify the anchor by associating the vacation with luxurious vacation characteristics. Lastly, Battaglio Jr. et al. (2019) suggested that anchoring could be linked to recency bias (also discussed in this chapter) to the extent that an initial value may be the easiest value for someone to recall.

b. Applications of Anchoring Bias

Finance. Studies generally show that financial experts exhibit lower but still significant anchoring affects (Kaustia et al., 2008; Puttonen et al., 2008). Puttonen et al. (2008) performed a study which involved asking subjects (both financial experts and students of varying financial expertise) questions about 20-year future stock market returns. They found that subjects with more education and experience exhibited lower anchoring effects (the average future return estimates from high and low-anchor expert groups were closer), leading to the conclusion that anchoring "may not be so important in

practical decision-making contexts" (Puttonen et al., 2008, p. 392). However, our primary audience for a practical exercise (Appendix A) is inexperienced financial managers. Thus, we believe that anchoring is nonetheless relevant to this project. The relevance of training and education also has implication for bias mitigation, which we discuss in our Analysis chapter.

Legal outcomes. Anchoring is a well-studied and acknowledged effect in the legal environment. Robbennolt and Studebaker (1999) found that higher damage caps tend to lead to greater punitive damage awards. Guthrie et al. (2001) found that even judges exhibit significant anchoring effects. In an experiment containing a hypothetical injury lawsuit, judges given no anchor awarded the plaintiff $1,249,000 on average, while judges given a low anchor of $75,000 (low meaning obviously lower than the actual damages) by the defendant's lawyer awarded the plaintiff $882,000 on average.

Project management. Anchoring in project management can take different forms, including likelihood of project being on schedule or within budget (McCray et al., 2002). Ansar et al. (2014) proposed that anchoring on North American dam project costs could explain "systematic cost overruns" (p. 48) commonly present in large dam projects across the globe. Such cost overruns were not as prevalent in North American dam projects, suggesting planners outside of North America were not properly considering local cost factors but rather over-relying on easily accessible information.

2. Confirmation Bias

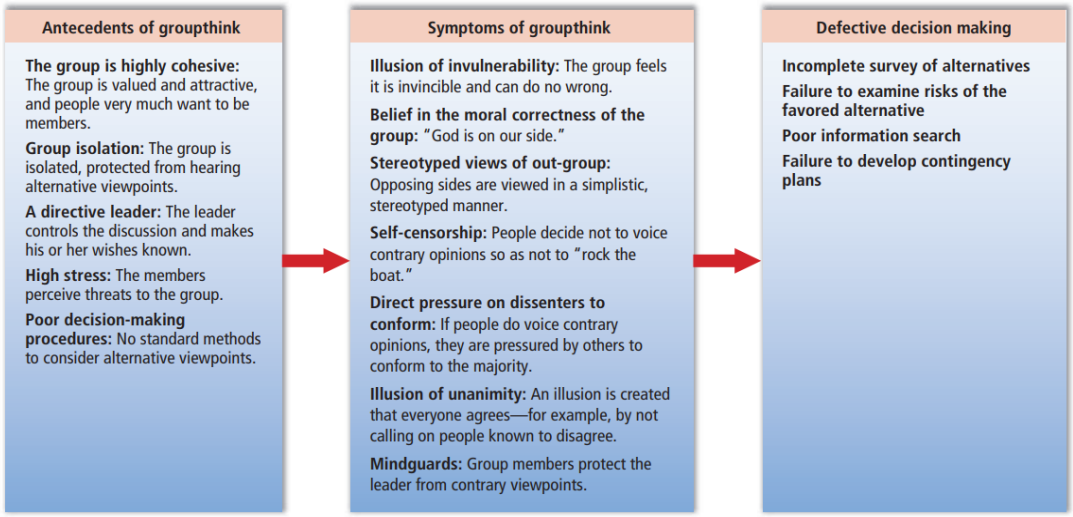
Confirmation bias is the tendency to look for information that reinforces or supports current beliefs. Nickerson (1998) defines this bias as "the seeking of or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis at hand" (p. 175). Conservative-minded U.S. voters may frequently watch Fox News or read the Wall Street Journal, and liberal-minded voters may watch MSNBC or read the New York Times. Note that in both cases, the respective news sources espouse values and messaging which likely already align to the viewer's preferences. The risk for decision-makers is the perpetual reinforcement or galvanizing of false beliefs, leading to low-quality or under-

informed decisions. In this case, voters may choose a candidate with only partial or inaccurate information.

a. Variations of Confirmation Bias

Groupthink. One form of confirmation bias emerges from groupthink, in which "maintaining group cohesiveness and solidarity is more important than considering the facts in a realistic manner" (Aronson et al., 2016, p. 285). Groupthink is a phenomenon which can emerge for many reasons and in almost any group decision-making environment. Aronson et al. (2016) provide several antecedents and symptoms of groupthink and describe how it can result in defective decision-making (Figure 1). Note that for this project, defective decision-making should be viewed as aspects of decision-making which do not promote or result in the effective allocation of resources.

Figure 1. Groupthink Flowchart



Source: Aronson et al. (2016)

Illusion of Pattern.[2] Assume you flip a coin five times and each flip results in heads. How likely will the coin lands on heads on the sixth toss? If your answer was not 50/50, you may have built a pattern into the data where none existed, a tendency which can arise from a misunderstanding of chance.[3] The belief that this next one *must* be tails is a phenomenon which can manifest in many decisions, ranging from staying longer at the slot machine to selling that high-performing stock because it's "about time" for poor returns.

Optimism and pessimism bias. Sharot (2011) writes "the optimism bias is defined as the difference between a person's expectation and the outcome that follows. If expectations are better than reality, the bias is optimistic; if reality is better than expected, the bias is pessimistic" (p. 941). Where confirmation bias might seek information to validate beliefs, optimism and pessimism bias more specifically form expectations about outcomes. For instance, optimism bias can emerge when developing expectations about starting salaries, estimates on time needed to complete a project (Sharot, 2011), and forecasts about market performance. Sharot's proposed explanation for optimism bias is that individuals tend to revise their outlook when confronted with "positive information" more so than when confronted with "negative information" (2011, p. 943). Accordingly, optimism and pessimism bias might be linked to confirmation bias in two ways: first, decision-makers might tend to assume an outcome based on personal preference, and second, they may favor information that supports their preferred outcome and undervalue or dismiss information that does not.

b. Applications of Confirmation Bias

Government Policy Decisions. Senior governmental decision-making is not immune to groupthink. During discussions over whether to conduct the Bay of Pigs Invasion, Arthur Schlesinger Jr., a special assistant to President Kennedy, had concerns about the operation but never voiced them for fear "others would regard it as presumptuous

[2] Kahneman (2011) discusses illusion of pattern in *Thinking, Fast and Slow* as part of a misunderstanding of randomness, which describes the tendency to look for patterns from among random events. For this project, the illusion is included under confirmation bias because it leads to interpreting information in ways which support what we may *want* to be true or something we feel *must* be true.

[3] Adapted from a similar exercise from Kahneman (2011) in *Thinking, Fast and Slow*.

of him, a college professor, to take issue with august heads of major government institutions" (Janis, 1982, p. 32). The Bay of Pigs Invasion failed to achieve its political objectives and "on the day the group voted whether to invade, President Kennedy asked all those present for their opinion—except Schlesinger" (Aronson et al., 2016, p. 286).

Accounting. Fay and Montague (2015) posited that accounting "is a product of the judgment and decision making (JDM) of individuals such as investors, managers, and auditors" (p. 13). These individuals may need to process vast amounts of data and can unknowingly employ heuristics to help reduce the burden of their tasks. Perera et al. (2020) tested confirmation bias in 92 accountants during their application of revised financial reporting standards, finding a potential bias because of their tendency to apply previous standards. "The results indicate that IFRS [the International Financial Reporting Standards] for SMEs [Small and Medium-Sized Entities] will lead to improved financial reporting quality only when the financial statement preparer's mindset shifts and when all preparers apply IFRS for SMEs…independent of their prior knowledge and beliefs about full IFRS" (2020, p. 4116). The accountants naturally applied existing knowledge and skills to the problem, but either didn't or chose not to recognize the need for a different skill set to address a different problem.

Military investigations. The dangers of pattern illusion extend beyond gambling and stock trading losses, even serving as the rationale behind launching an investigation, illustrated in the following vignette from Kahneman (2011):

> The Yom Kippur War broke out in 1973, and my only significant contribution to the war effort was to advise high officers in the Israeli Air Force to stop an investigation.…I was told of two squadrons flying from the same base, one of which had lost four planes while the other had lost none. An inquiry was initiated in the hope of learning what it was that the unfortunate squadron was doing wrong. There was no prior reason to believe that one of the squadrons was more effective than the other, and no operational differences were found.…My advice was that the command should accept that the different outcomes were due to blind luck, and that the interviewing of the pilots should stop. I reasoned that luck was the most likely answer, that a random search for a nonobvious cause was hopeless, and that in the meantime the pilots in the squadron that had sustained losses did not need the extra burden of being made to feel that they and their dead friends were at fault. (p. 116)

Indeed, decisions to begin or persist in an endeavor can be influenced by a misperception of pattern. Decision-makers should not dismiss the possibility of patterns among data but instead encourage the consideration of outliers. In cases like the investigation described above, pursuing a cause for a potential outlier event can needlessly strain valuable funding, time, labor, and morale. A simple check or consideration for anomalies can help minimize the expenditure of resources on a fruitless venture.

3. Framing Bias

Framing bias can arise from the way decision-makers receive information. Doring and Oehmke (2020) define framing bias as "being influenced by the way a decision-making scenario is presented" (p. 61). Consider an everyday consumer choice: is a shopper more likely to purchase a product labeled *80% fat free* or *20% fat*? Politicians may develop frames for issues that favor their political objectives: is that proposed tax cut described as a much-needed break to the American working class, or is it another instance of the rich getting richer? Framing can also be unintentional: *the Americans won* and *the Soviet Union lost* are both true statements for the conditions at the end of the 1980 Winter Olympics hockey game. However, the two descriptions can evoke different discussions on the same subject, for instance *what did the Soviet Union do to lose?* instead of *what did the Americans do to win?*[4] The risk for decision-makers in framing is to unknowingly consider only the information presented to them, which may be inaccurate, partial, or biased.

a. Variations of Framing Bias

Choice Architecture. Architecture is concerned with the practice of design and construction. Choice architecture is aptly named for the design of choices to produce desired outcomes. Thaler and Sunstein (2021) write that "a choice architect has the responsibility for organizing the context in which people make decisions" (p. 3). Doctors who provide options to patients, webpage designers who try to sell a product, and even parents imparting educational options to their children can all be choice architects (Thaler & Sunstein, 2021). We can therefore be surrounded by choice architecture in almost every

[4] Adapted from a similar exercise from Kahneman (2011) in *Thinking, Fast and Slow*.

aspect of our daily lives. Lewin (1951) theorized that culture – even our food habits – are influenced and maintained by forces such as where we live and the groups to which we belong. Habits of a group are then determined in the same way that "the amount of water supply and the nature of the riverbed determine from day to day the flow of the river" (p. 173). Indeed, the underlying design of choices can influence which decisions are made.

For instance, consider the difference in the following scenarios:

- Please complete Form A to opt-out of automatic paycheck withdrawals for your retirement account. You can make this decision later.
- Please complete Form A to opt-in to automatic paycheck withdrawals for your retirement account. You can make this decision later.

In both cases, the decision-maker must determine whether completing Form A is worth the time now, later, or at all. Let's assume they postpone the decision; even with every intention to follow-up later, 'later' may never actually occur. Therefore, the structure of this choice can translate to considerable financial impacts in the future. "All these forces imply that if, for a given choice, there is a default option – an option that will prevail if the chooser does nothing – then we can usually expect a large number of people to end up with that option, whether or not it is good for them" (R. H. Thaler & Sunstein, 2021, p. 108).

A second comparison:

- Please complete Form A to opt-in to automatic monthly savings.
- Please check this box ☐ to opt-in to automatic monthly savings.

Similar yet distinct observations arise from this set compared with the first. The first set focuses more on the default position presented to the decision-maker, where this set focuses more on the degree of effort required to make the decision. How hard is it to check a box compared to filling out a form? "Our primary mantra is a simple one: if you want to encourage some action or activity, Make It Easy" (R. H. Thaler & Sunstein, 2021, p. 106). The implications of choice architecture in decision-making can be far-reaching: organizations can structure choices to positively influence behavior toward achieving

desired objectives, and businesses can structure choices to encourage consumers to purchase their product. This phenomenon carries an ethical component, and for this project, benevolence in this regard should always be sought.

The Goldilocks Fallacy. Recall that framing bias arises from how decision-makers receive information. The goldilocks fallacy is a unique variation of this bias, and the following scenario helps illustrate how it occurs: Office Inc. has rented unused workspace for a few years. The company might expand next year and require *some* of the unused workspace, but management is confident it still needs to downsize. The possible expansion also creates a budget-constrained environment with considerable scrutiny over operating expenses. Management knows that potential future workspace requirements must be balanced with the need to reduce costs. They request the staff to provide downsizing options and receive the following options, detailed in Table 3:

Table 3. Office Downsizing Options

Option 1	Option 2	Option 3
Reduce by 800 Square Feet	Reduce by 1600 Square Feet	Reduce by 2400 Square Feet
Money saved: $250K/year	Money saved: $500K/year	Money saved: $750K/year
Lower risk, lower return	Medium risk, medium return	Higher risk, higher return

Without recognizing the unintended framing trap, a decision-maker might gravitate towards Option 2 solely because it's a nice "middle ground" – it features better cost-reduction compared with Option 1 and it's not as risky as Option 3. This is the goldilocks fallacy at work and can be a subtle and problematic framing trap in decision-making. Vanden Bosch (2014) writes:

> Generally, we don't use [the Goldilocks heuristic] consciously; we simply apply it, and with good success. In the presence of conflict, we seek compromise. We keep to the middle of our lanes when driving, without calculating that this decision creates a safety margin….But we also apply this Goldilocks heuristic in questionable ways….in decision problems

> where there are conflicting objectives, choosing a middle path often fails to give you the best decision, and sometimes leads to the worst. (p. 28)

Information Saliency. Framing bias can also stem from salient information (that which is most noticeable or important). In a discussion on salience heuristics, Reisch and Zhao (2017) highlight others' work on how consumer food choices can be "nudged" by proximity or order (Bucher et al., 2016), "unhealthy surcharges" combined with labeling can reduce the decision for unhealthy food (Shah et al., 2014), and altering renewal notices can increase the use of a specific service (Castelo et al., 2015). In all these cases, information is presented to decision makers in a deliberate manner in order to produce a desired outcome.

b. Applications of Framing Bias

Investments in Group Decision-Making. In our background chapter, we modified Kahneman and Tversky's (1981) Asian disease scenario to provide a simple example of how framing can impact individual investment choices. Cheng and Chiou (2008) studied the same phenomenon in the context of group decision-making. They collected individual responses to four investment scenarios, then compared these responses to those received by the same participants when making investment choices in decision-making groups of three people. They found that groups exhibited the same framing effects as individuals and that group polarization which is "the tendency for groups to make decisions that are more extreme than the initial inclinations of their members" (Aronson et al., 2016, p. 288) may have led them to adopt increasingly risky positions.

Auditing. Emby and Finley (1997) tested the framing effect among 129 auditors by providing identical background information about an internal control system to different experimental groups, then changing only one word in the task prompt between the groups:

- "[T]o consider the effect of the additional evidence on the *risk* of a client's internal control system" or
- "[T]o consider the effect of the additional evidence on the *strength* of a client's internal control system" (p.65).

The auditors were then asked to identify the amount of substantive testing appropriate for the internal control system. The results of the experiment suggested that judgments in a frame of risk produced more conservative recommendations than those in a frame of strength.

4. Loss Aversion Bias

Kahneman et al. (1991) say that loss aversion bias may exist in an individual when "the disutility of giving up an object is greater than the utility associated with acquiring it" (p. 194). In other words, people tend to value losses more than equal gains. Thus, loss aversion is similar to the endowment effect described by Thaler (1980), which describes the phenomenon of an individual requiring a larger money sum to part with an item than they would be willing to pay to acquire the same item (Kahneman et al., 1991). Loss aversion bias can be linked to framing bias in that how a problem or question is framed can draw out loss aversion (Kahneman & Tversky, 1984).

a. Variations of Loss Aversion Bias

Status quo bias. Status quo bias is the irrational preference to maintain one's current position. Status quo bias is closely linked to loss aversion, because an "implication of loss aversion is that individuals have a strong tendency to remain at the status quo, because the disadvantages of leaving it loom larger than the advantages" (Kahneman et al., 1991, pp. 197–198). But where loss aversion involves weighing losses highly, status quo bias involves inertia, that is, any movement away from the current state (a loss or a gain).

b. Applications of Loss Aversion Bias

Investing. Loss aversion may become more likely when investors analyze performance over short timeframes (Hardin & Looney, 2012; R. H. Thaler et al., 1997). This is called myopic loss aversion and has been used to explain why there is such a large difference in returns between stocks and less risky assets, such as bonds. This difference is known as the equity premium, but it doesn't fully explain the difference between the returns. This is because the risk associated with holding stocks over bonds diminishes over longer timeframes. Thus, while some investors may be acting rationally when considering

short timeframes, such as those at or near retirement age, other investors may be irrationally overemphasizing short term performance when making investment decisions.

Consumer behavior. Consumers can view a reduction in consumption as a loss. Consumers resist adjusting spending downward in response to an expected decrease in income and they are faster to increase spending in response to an expected increase in income (Bowman et al., 1999). Under a behavioral framework that considers loss aversion, consumers are assumed to have a reference level (status quo, perhaps) of consumption and would prefer to remain at or above that level. This implies that consumers will tend to save only if their income is above their reference level of consumption.

5. Recency Bias

This bias can occur when decision-makers focus more on recent or near-term events, discounting information from the greater past. For instance, after viewing a local news segment about crime, viewers may start to believe that crime is "on the rise" in their area despite the fact the event falls within the statistical average. Brody et al. (2022) wrote that recency bias is "a type of memory bias where individuals disproportionately focus on and weight recent events over older, historical events when evaluating causes and trends" (p. 59). Recency bias can stem from what Tversky and Kahneman (1974) describe as the availability heuristic: "There are situations in which people assess the frequency of a class or the probability of an event by the ease with which instances or occurrences can be brought to mind" (p. 1127). Like framing bias, salience of information is also relevant for recency bias because salience might, at times, relate to the order in which information is presented, impacting how decision-makers might value that information.

a. Applications of Recency Bias

Auditor Judgments. Tubbs et al. (1990) tested a belief-adjustment model which predicted that the order in which evidence was presented would generate a recency effect. Their test involved 251 experienced auditors across four experiments and found "no order

effects for consistent evidence" and "a recency effect for mixed evidence" (p. 459).[5] In other words, auditor judgment was impacted based on when they received certain information. Auditors can also employ heuristics when selecting auditing approaches for a client. For instance, auditors may employ the availability heuristic if they follow the same testing strategy used in a prior or recent engagement, regardless of whether it is best for the current one (Fay & Montague, 2015).

Using Auditing and Accounting Information. Decision-makers who work with vast quantities of audit and accounting information may need to resort to effort-saving strategies to reduce the burden of their tasks. Cognitive load theory discusses the phenomenon of increasingly diminished performance in processing and learning information as the volume of information increases (Sweller et al., 2011). Regarding audit evidence, Libby and Trotman (1993) observe, "[b]ecause of the volume of [audit] evidence typically recorded, and the time frame over which it is gathered, auditors must rely on retrieval from long-term memory…when testing the implications of further evidence" (p. 561). Kida et al. (1998) apply the same observations to decisions involving accounting data. In managing such memory demands, decision-makers might retrieve affective reactions to data (that which they have feelings or attitudes about) instead of numerical values, resulting in suboptimal investment decisions.

Investing. Consider a "fluke year" which generates poor returns for an investor with an otherwise strong investment history. Because of the weight of the fluke in recent memory, the investor modifies their investment strategy (Brody et al., 2022). In hindsight, the decision to modify the strategy was unnecessary, and may have created further losses.

Fraud Examination. High-profile fraud may influence how examiners conduct local investigations. Auditors in Fort Myers, Florida began searching for fraud cases involving Russian organized crime following its publicity in Miami. The auditors later concluded their efforts were fruitless because despite being only two hours away from Miami, Fort Myers lacked the same level of Russian organized crime (Brody et al., 2022).

[5] In the context of Tubbs' study, "consistent evidence" was either *all* positive or *all* negative evidence, while "mixed evidence" was positive *and* negative evidence.

6. Sunk Cost Fallacy

The sunk cost fallacy involves irrationally including already-incurred costs into a present decision when in fact only future costs are relevant. The tendency to include sunk costs in decision-making can be explained by Prospect Theory, which, as noted in our background, says that people will tend to value losses more than equal gains (Kahneman & Tversky, 1979). Individuals or organizations might be tempted to continue a course of action because they have already invested significant resources into it. In economics, relevant costs are called opportunity costs, which is the cost of the best alternative course of action. A firm deciding whether to continue project A or to halt project A and undertake project B, should consider only the future costs of each project. Whether the firm continues project A or elects to undertake project B in its stead has no bearing on whether the firm experiences its previous costs; they have already occurred and are thus irrelevant. Nevertheless, people find sunk costs difficult to ignore. People are more likely to continue investing the larger their current investment (Arkes & Blumer, 1985), and people who paid more for a good or service more will tend to use it more than people who paid less (Arkes & Blumer, 1985; R. Thaler, 1980).

a. Variations of the Sunk Cost Fallacy

Types of sunk costs. While sunk costs most commonly refer to monetary costs, they may also include effort, time, and emotion (Arkes & Ayton, 1999; Ronayne et al., 2021). This may be relevant when discussing public resources, where public resource managers may have relatively low emotional ties to sunk monetary costs compared to their private sector counterparts who may be pursuing profitability (or the appearance thereof).

Alternative explanations. There have been attempts to rationalize the sunk cost fallacy. Mcafee et al. (2010) write that reputation, both for commitment and ability, could partially explain decisions to invest more resources after sunk costs. However, it is not clear that these reputational explanations suggest that directly including sunk costs in analysis is always rational. Rather, there may be switching costs (often non-monetary) associated with pursuing a new course of action, and considering these is entirely rational, though not necessarily globally optimal. Arkes and Blumer (1985) show that the desire to

not appear wasteful could explain sunk cost bias. They also point out a logical extension of the wasteful explanation: that personal responsibility for a decision should increase the tendency to consider sunk costs. Other studies also support this view (Brockner, 1992; Staw, 1976). Thus, there may be other sunk cost factors at play for those making decisions about public resources including time, effort, emotion, and reputation.

b. Applications of the Sunk Cost Fallacy

Public Policy. Arkes and Blumer (1985) proposed that the desire to not appear wasteful may explain why elected officials appeal to sunk costs in order to defend the continuation of costly public projects. Ending the projects would solidify them as failures and have negative political consequences. Cole (2003) contends that courts may consider sunk costs when ruling on the legality of a government project on the basis that to cancel a project would mean a waste of public funds. Accordingly, a government agency might continue spending on a project with an impending court decision to bolster the likelihood of the court ruling in its favor.

Voter Opinion. Sunk costs may also be relevant to public attitude toward war, possibly suggesting that experiencing casualties will increase the desire to continue a conflict. However, we only found one source that provided experimental evidence of this view: Schott et al. (2011) aimed to "unobtrusively prime the don't waste goal" (p. 1136) in experiment subjects who were asked to read factual articles about the Iraq and Afghanistan wars. Subjects who read an article listing casualties in one or the other war were more likely to express support for the war than those who read an article that did not list casualties. Much literature, however, supports the conventional wisdom that casualties reduce support for war (Gartner, 2008; Miller & Barber, 2016).

B. COGNITIVE BIAS MITIGATION

Fischoff (1981) made an important distinction regarding bias-mitigation efforts: "when there is a problem, it is natural to look for a culprit….the most important distinction is whether responsibility for biases is laid at the doorstep of the judge, the task, or some mismatch between the two" (p. 3). Accordingly, mitigating cognitive bias may require a combination of efforts which address 1) the potential biases in the decision-maker and 2)

the system in which the decision-maker operates. Here, *system* refers to the collection of procedures, methods, techniques, or other mechanisms used to facilitate decision-making. Mitigation methods discussed in this section are organized by the individual and the system. At the end of this section, we also summarize which bias-mitigation techniques are known to mitigate various biases (Table 4). We acknowledge that some of these techniques could mitigate biases that we do not associate with them. Thus, Table 4 should not be viewed as exhaustive but rather as representative of the literature we reviewed.

1. Mitigating Biases in the Decision-Maker

In this section we discuss four methods of mitigating cognitive bias in the decision-maker. The first method involves increasing decision-makers' training and experience, which might make their heuristics more accurate or condition decision-makers to be more efficient at processing information and thereby reduce their need to rely on heuristics. The second and third methods involve inducing more critical thought into the decision-making process. Finally, the fourth method involves drawing attention to the possible existence of a bias (or intent to exploit a bias) and countering the bias with new, offsetting information.

Relevant training and education. There is conflicting evidence showing whether sunk cost bias decreases with education (Arkes & Blumer, 1985). However, Tan and Yates (1995) showed that having previous accounting or business education can decrease an individual's sunk cost effect. The study also sought to determine whether situational context might influence whether individuals apply their knowledge of sunk costs. The study's accounting subjects exhibited sunk cost effects no different from their non-accounting peers when confronted with a non-business problem. However, when confronted with a business problem, the accounting subjects showed significantly reduced sunk cost effects compared to their non-accounting peers. Kennedy (1993) observed that auditors, familiar with the task of judging "a client's ability to continue as a going concern"[6] (p. 236) did not display recency effects when evaluating evidence compared to inexperienced MBA students.

[6] Various literature sources identify "going concern" as an evaluation by auditors as to whether there is reasonable evidence the auditee will be able to sustain business operations.

Morewedge et al. (2015) found that preemptive training can reduce anchoring and confirmation biases. Through several tests, they examined the effectiveness of training interventions on reducing various cognitive biases. Participants watched a video describing bias and played a computer game designed to "elicit and mitigate" (p. 133) confirmation bias. They found that all training reduced the bias, and that the computer game provided the best results. Additionally, they found that both techniques somewhat mitigated anchoring, and both techniques were similarly effective when retesting subjects three months after their initial training.

Consider-the-opposite. Considering-the-opposite may be considered similar to red-teaming, which is, broadly, to play devil's advocate and act "as a bright light we shine on ourselves to expose areas we can improve effectiveness" (Mulvaney, 2012, p. 63). The consider-the-opposite method entails deliberately "taking into account evidence that is inconsistent with one's initial beliefs" (Mussweiler et al., 2000, p. 1144) and has been shown to mitigate anchoring. In one experiment, car experts (who were either dealers or mechanics) were asked to value a used car. These experts displayed lower anchoring effects when asked to list reasons why their first estimate may have been high or low.

Similarly, decision-makers may find value in using the consider-the-opposite method to mitigate framing bias. This may apply when considering proportionally framed data such as percentages, fractions, or decimals. We know of course that a 90% success rate also means a 10% failure rate. Both claims are true, but failing to actively consider the inverse of the first claim can have different impacts on what we do with the information and how we perceive the risk. J. P. Rose et al. (2014) wrote that, "the likelihood of experiencing side effects from a medication can be said to be a 20% chance of happening or an 80% chance of *not* happening. Although logically equivalent, such positive and negative frames can differ in their consequences" (p. 2259).

Seek active choice decision-making. Walsh et al. (2011) described active choice as one in which decision-makers explicitly choose a plan, and passive/no choice as one in which decision-makers take no action. They researched active and passive choice in a survey of approximately 1,000 Medicaid beneficiaries regarding health insurance plan selection, finding that "when consumers engage in active decision making, there are few barriers to

selecting a wellness-based health plan with greater prescription coverage" (p. 191). They further explain how passive choice may result from insufficient knowledge or understanding of a situation or from heuristics which dismiss a decision. Active choice might therefore mitigate framing effects of choice architecture because decision-makers seek to understand their choices before deciding what to do with them.

Make Decisions for Others. Studies generally find that making decisions for others reduces loss aversion with some caveats. Andersson et al. (2016) found that loss aversion is lessened when making choices for others and suggests that such decision-makers are more likely to be dispassionate. Polman (2012) examined several scenarios and found that making decisions for others reduced loss aversion in cases involving riskless choice, gambling, "when people were rewarded for making desirable (i.e., profitable) choices for others…and when real money was at stake" (2012, p. 148).

Identify and Counter. *Identify* refers to drawing attention to a person's intentional use of a high anchor to sway decision-makers, while *counter* refers to providing a second anchor to offset the first, possibly manipulative, anchor (Stein, 2018). In a series of survey experiments involving mock criminal trials, Stein found that the defense strategy of identifying (that the prosecution is trying to manipulate the jury by anchoring them to a high sentence) and countering (with a low sentencing anchor) was the most effective strategy tested in reducing jury anchoring on the prosecution's proposed sentence.

Reframe the decision. Reframing a decision may be used to reduce status quo bias and harness loss aversion bias to override the former. Pulling from the concept of choice architecture, Martin (2017) found success in reducing status quo bias by changing the stated status quo (frame of reference) in the choice design. In two experiments subjects were given the option to implement teleworking (as opposed to traditional, in-person work) in their hypothetical department. When traditional work was listed as the status quo, about 50% of the subjects opted to implement teleworking in both experiments. When telework was listed as the status quo, more than 60% opted to implement teleworking in the first experiment and more than 80% in the second. For one group in the second experiment, Martin attempted to harness loss aversion to overcome status quo bias. To do this, he framed the failure to implement teleworking as a perceived loss by appealing to teleworking as environmentally

friendly compared to traditional work. This increased telework implementation to 77% compared to the control group's 50%.

2. Mitigating Biases by Altering the System

System bias mitigation differs from individual bias-mitigation as it recognizes biases may be inherent in the *environment* of decision-making, unknowingly or unintentionally exerting influence on the decision-maker. For instance, a decision-maker may correctly identify and avoid framing bias when choosing among alternatives, but the system may be the culprit for producing that set of alternatives. This section offers several bias-mitigation methods linked to the environment in which individual decision-makers operate.

Alter group decision-making practices. Recall that groupthink is a variation of confirmation bias. To help mitigate this bias, leaders of decision-making teams should habitually encourage diverse opinions and discourage promoting specific solutions. Flowers (1977) concluded that leaders who did not adopt these two practices "received fewer suggested solutions to problems from their teams and less use of available facts when compared with open leaders" (p. 895). Additionally, leaders should consider the degree of power they hold over group members. Flowers suggests that the degree of power group leaders hold over members, such as legitimate, expert, and referent power (French & Raven, 1959) might be an important variable in susceptibility to groupthink. Accordingly, leaders holding multiple types of power over members may be less likely to receive valuable dissent and constructive criticism.

Following the Bay of Pigs Invasion, President Kennedy sought to mitigate groupthink among his advisors during the Cuban Missile Crisis. He would absent himself from the group to avoid inhibiting discussion and brought in outside experts who were not members of the typical group (Aronson et al., 2016). Such efforts may have reduced groupthink pressures by lowering the perceived risk of proposing a 'bad' idea, leading to a more open forum for the exchange of ideas, and potentially contributing to the successful resolution of the Cuban Missile Crisis.

Implement accountability in decision-making. Accountability is defined as "the requirement to justify one's judgments to others" (Kennedy, 1993, p. 231). Requiring that

decisions be openly rationalized can provide valuable scrutiny and expose faulty thinking, and "may induce individuals who resort to effort-saving strategies such as Step-by-Step [SbS] processing to supply the requisite effort for End-of-Step [EoS] processing, thereby overcoming recency" (p. 236).[7] Effort-saving can be beneficial in many settings but can also create problems during acts of judgment and decision-making, for instance, weighing recent information over older information simply because it's the easiest to recall. In a study involving 58 MBA students about an audit client's ability to continue as a going concern, Kennedy (1993) found that after accountability was required of the MBA participants, "no recency effects were noted" (p. 243). Decision accountability is already used in professional auditing, signaling the importance of identifying and addressing recency bias in environments requiring frequent acts of judgment.

Holding people accountable by increasing their expectation that they will have to explain their decision may also reduce sunk cost bias (Simonson & Nye, 1992). Cushing and Ahlawat (1996) conducted an accountability-related experiment by testing the effect of a documentation task on mitigating recency effects among audit professionals: "…subjects in the documentation treatment group were asked to draft 'a memorandum to the senior audit partner for ABC Corporation providing as many reasons as you can that would support your recommended audit opinion'" (p. 115). They found that subjects who performed the documentation task exhibited no recency effects.

Implement a credible-source step in decision-making. Druckman (2001) studied whether a perceived credible source, such as input from a political party, could overcome framing effects for respondents presented with framed data. He designed an experiment mirroring Kahneman and Tversky's Asian disease scenario in which participants endorsed policies supported by different political parties serving as the 'credible source'. Druckman found that people overcame framing and acted rationally when given access to perceived credible advice, such as how they should decide. Druckman also acknowledged a built-in risk of credible-source techniques, writing that "it remains unclear if people generally form

[7] SbS "revises judgment after each piece of evidence is received" and EoS "results in a judgment after all the evidence is received and aggregated" (Kennedy, 1993, p. 235).

accurate perceptions of advice givers; for example, it may be the case that people misperceive credibility and are thus misled" (p. 78). Thus, credible source selection is essential because sources can either mitigate or perpetuate bias. Finally, Druckman observes that findings about framing effects in the experimental environment may overstate the extent of the phenomenon. "It seems plausible that outside of the laboratory, people do in fact access and use advice from others, especially in situations where they have ill-formed preferences" (p. 77), giving credence to Gigerenzer's conclusions about the positive benefits of heuristics discussed in our background chapter.

Table 4. Bias and Mitigation

Bias	Definition	Mitigation
Anchoring	Making an estimate by "starting from an initial value that is adjusted to yield a final answer" (Tversky & Kahneman, 1974, p. 1128)	• Consider-the-opposite • Identify and counter • Relevant training and education
Confirmation	"The seeking of or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis at hand" (Nickerson, 1998, p. 175).	• Consider-the-opposite • Alter group decision-making dynamics • Relevant training and education
Framing	"Being influenced by the way a decision-making scenario is presented" (Doring & Oehmke, 2020, p. 61).	• Consider-the-opposite • Seek active choice decision-making • Implement a credible source
Loss Aversion	Valuing losses more than equivalent gains (Kahneman et al., 1991).	• Make decisions for others • Reframe the decision
Recency	"A type of memory bias where individuals disproportionately focus on and weight recent events over older, historical events when evaluating causes and trends" (Brody et al., 2022, p. 59).	• Implement decision accountability
Sunk Cost	The tendency for people to pursue additional investment based on the resources they have already invested in a decision	• Implement decision accountability • Relevant training and education

C. THE DEFENSE FINANCIAL MANAGEMENT DECISION-MAKING ENVIRONMENT

This section discusses various aspects of the DFM decision-making environment, including objectives, some of the typical decision events made in support of these objectives, and policies and directives governing these decision events. This information provides a basis upon which to analyze how bias emerges and affects decision-making in DFM.

1. Resource Justification and Allocation

This section identifies some of the events and decisions associated with resource justification and allocation in DFM. Resource justification involves articulating the rationale behind resource requirements. It may also involve managing current spending, because higher echelons often use past performance to analyze the validity of a request. Resource allocation involves the assignment of resources to defense requirements, ideally in accordance with defense priorities.

The Program Objective Memorandum (POM) is the main product of the programming phase of the DOD's main resource allocation process, the Planning, Programming, Budgeting, and Execution (PPBE) system. The POM updates the DOD's Future Year Defense Program (FYDP), which contains budget estimates for the next five years including the Budget Estimate Submission (BES) for the upcoming fiscal year (Candreva, 2017). Broadly speaking, programming decisions are about resource allocation: how to best support national defense priorities and objectives given fiscal constraints. The earlier stages of the POM may be less constrained (i.e., have lower budget ceilings) because planning this far out entails more uncertainty, and fewer constraints allow decision-makers to consider all possibilities when making final resource-allocation decisions. Explicit programming decisions include how to justify a program's existence (how they align with defense priorities), what programs should be funded, and to what level they should be funded. These decisions involved both individual and group decision-making. Commands may also passively decide how much effort to invest into these decisions. Where programming broadly entails allocating resources over a longer timeframe, budget

formulation involves developing a more detailed plan for the upcoming fiscal year as informed by the POM. Decisions made during budget formulation are broadly similar to those made during the POM.

2. Budget Execution

Budget execution is concerned with the management of an appropriation throughout its period of availability, i.e., the period in which obligations against that appropriation can be incurred (Candreva, 2017).[8] This section identifies some of the decisions associated with three execution events of an appropriation: continuing resolution operations, mid-year review, and fiscal year closeout. These three events are not an exhaustive list but act as "mile markers" for the beginning, middle, and end of an appropriation's period of availability, highlighting some of the decisions made at various points during budget execution.

Continuing resolutions (CRs) are temporary funding bills that act as a stopgap measure in the absence of a full appropriations act. During CR periods, agencies are prevented from starting new programs that were not previously provided for in the appropriations act for the preceding fiscal year (Candreva, 2017). Agencies typically receive only a portion of their requested budget under a CR, so one of the main decisions is determining how to distribute the partial funding among subordinate agencies. For instance, an agency could decide to fund each of its departments at a flat percentage of their requested funding or prioritize and fully fund certain departments or operations. Such a decision could be further complicated by delays in congress passing a final appropriations act. Spending agencies, especially those at the lowest levels, may not know what program cuts or additions the final appropriations act will contain and therefore may often need to make assumptions in their decisions.

Mid-Year Review (MYR) is a "status check" on current spending across the enterprise, typically conducted around March 31st. MYR is designed "to review execution rates, capture funding shortfalls, develop proposals for realignments of funding, identify

[8] An obligation is "a formal order legally committing the federal entity to ultimately pay a future liability" (U.S. House of Representatives, n.d.).

remaining or potential funding issues, and provide recommended courses of action for…potential omnibus reprogramming actions" (U.S. Marine Corps, 2014). The implied function of MYR is to help achieve enduring DOD FM objectives, such as meeting the congressionally imposed 80/20 rule[9] and setting conditions for a successful fiscal year closeout. Decisions during MYR often consist of whether to adjust the current spending plan (when funding is spent and who spends it) and whether to fund current-year deficiencies (CYDs), also known as unfunded requirements. Agencies which meet spending targets by MYR might be viewed more favorably when deciding where to send additional funds, and meeting targets can generate the perception that things are going well.

The fiscal year closeout period is designed to reduce unobligated balances and ensure all existing obligations remain valid prior to October 1st. In other words, agencies try to re-align and obligate all available money before the period of availability on that money expires (Balances Available, 1982). Such efforts should theoretically occur throughout the fiscal year, however, the end-of-year deadline means these efforts typically heighten from August through September. For example, the Marine Corps typically adopts a soft-close date around September 15th, in which a nearly 100% obligation target is established with only minor obligation changes expected from September 16th – September 30th. Decisions during fiscal year closeout share similarities with decisions made during MYR, with the primary difference being a looming deadline of October 1st. Depending on current obligation rates, agencies may also face the decision of whether to spend unobligated funding or return it to higher headquarters. This pressure to spend all available funds translates to a "use it or lose it" mentality which may result in spending on low-priority "requirements" that don't align with defense priorities (Candreva, 2021).

[9] Volume 6A, Chapter 4 of The Department of Defense Financial Management Regulation (DOD FMR) identifies that the "'General Provisions' of the DOD Appropriations Act requires a certification that not more than 20 percent of the appropriations in that act, which are limited for obligation during the current FY, will be obligated during the last 2 months of the FY" (Department of Defense, 2019, p. 4-22).

IV. ANALYSIS

This chapter is divided into two sections. The first section analyzes how cognitive bias can emerge in DFM and lead to the ineffective allocation of resources. This analysis is based on applying the findings from our literature review and incorporating experienced-based insights from interviews with senior Marine Corps financial managers. Appendix B contains our interview questions.[10] The second section of this chapter uses the same two sources to explore how the Marine Corps might incorporate bias-mitigation practices in resource management decisions and FM workforce development.

A. COGNITIVE BIAS IN THE DEFENSE FINANCIAL MANAGEMENT DECISION-MAKING ENVIRONMENT

This section uses a question-driven format to guide discussion on how cognitive bias impacts decision-making in two areas of DFM: (1) resource justification and allocation and (2) budget execution. The questions are designed to replicate the day-to-day decisions made in the allocation of defense resources. Next, we identify some of the biases which can influence these decisions and discuss how the biases can inhibit the effective allocation of resources.

1. Resource Justification and Allocation

Question: How much funding do we request (or approve)?
Relevant biases: anchoring, loss aversion, framing, pessimism,

Discussion: During budget formulation, agencies may anchor on prior-year data when generating their requests.[11] Budget reviewers might also consider that such requests

[10] These interviews occurred from October 2023 – November 2023. All interviewees were Marine Corps commissioned officers in the rank of Major or above with a financial management occupational background. The interviews were conducted in accordance with the NPS Institutional Review Board protocols. Each interviewee received Appendix B prior to the interview.

[11] Budget formulation occurs well before the end of the current fiscal year. Thus, agencies will not have complete data about the previous fiscal year until well after budget formulation concludes. Agencies may thus rely on either the prior year's budget *submission* (i.e., not actual spending), or they are using incomplete data, or a combination of the two.

may stem from potential loss aversion or pessimism bias in which agencies ask for a higher number than their actual requirement. If this is true, the anchor could be an inaccurate estimate and there is a risk of under-adjusting for additional information. Budget reviewers may also consider the experience of the budgeter when scrutinizing a budget. For example, one interviewee noted that a brand-new Supply Officer (who, in the Marine Corps, budgets for their command) may not have a lot of experience or time to properly budget, so they might rely heavily on prior-year budget data. Alternatively, a seasoned budgeter or reviewer might exhibit less anchoring because they know how to interpret prior-year budget execution data and what factors will most influence requirements. They may tend to rely less on a weak heuristic, because their experience has granted them the knowledge of what they need to consider when building or reviewing the budget. As one interviewee said, "we look at starting [budgets] and we should just pay as much attention to finish points and understand what the changes were and why…missions change." While heuristics can be useful, especially when used in the environment in which they were developed (Gigerenzer, 2020), an underdeveloped heuristic might be more likely to provide a bad estimate.

Agencies may also experience loss aversion when deciding how much funding to request. As one interviewee noted, "seldom will we ever go backwards, and that's more of a loss aversion bias….most commanders are not going to stand for less [funding] because inflation is real." Just as consumers might have a reference point for consumption, under which they would strongly prefer not to reduce consumption (Bowman et al., 1999), defense agencies could have established reference points for spending (also see status quo bias).

Agencies may also experience framing bias. Consider a commander deciding the level to fund her subordinate units and what size budget reserve to hold to mitigate risk. The comptroller has proposed three courses of action: 1) fully-fund subordinate units and hold a small budget reserve, 2) fund units at 95% of their requests and hold a medium reserve, and 3) fund units at 90% of their requests and hold a large reserve. Notice that there is a medium course of action (95% funding, medium reserve) which might invite an application of the Goldilocks Fallacy, a variation of framing bias.

Funds requests may also be influenced by a pessimism bias. One interviewee said there may be a belief that "you're never going to get what you ask for, [so a command may] always ask for more than [they] probably need." Commands may or may not be justified in holding this view; there are plenty of factors that should affect an estimate of future funding levels compared to requests.[12] Such evidence includes historical spending performance and the historical differences between prior-year budget requests and approved budgets; it also includes an estimate of congress's current disposition toward the DOD's funding level.

Question: How do we justify and present this requirement?
Relevant biases: sunk cost, framing, loss aversion

Discussion: Sunk cost bias might influence how an agency or program manager justifies its requirements. This can apply to POM, budget formulation, and CYD requests. As discussed previously, politicians might be tempted to appeal to sunk costs to gain or maintain support for a project. There are three possible explanations for this. The first is that a politician might be falling for the sunk cost fallacy themselves. The second is that a politician might believe that appealing to sunk costs is an effective way of maintaining or gaining project support. In other words, a politician may think his constituents will fall for the sunk cost fallacy. The third explanation is that politicians do not want to appear wasteful, so they continue to support a failing or underperforming project despite the possibility that the fiscally-responsible (i.e., least wasteful) course of action is to shut down the project (Arkes & Blumer, 1985). The last explanation likely has a greater influence the more responsibility a person has for a project.

It seems reasonable that all these explanations for appealing to sunk costs could apply to DFM. The risk in using a sunk cost narrative is that those reviewing such a justification at higher levels may see its roots in irrationality and view the program as a target for cutting funds. Alternatively, from the enterprise perspective, if budget reviewers

[12] Readers should not view this discussion as an endorsement of asking for more funding than is required, even if there is reason to believe that other commands do the same. It is our belief that the budget product, including its explicit justification, should stand as the primary determinate of funding level.

also fall for the sunk cost justification, there could be a risk of funding a program that should have instead been cut.

Framing bias may influence how decision-makers, such as unit commanders, perceive a budget proposal, options, and recommendations. In this way, financial management personnel acting in a decision support capacity may consider that how they present information can unintentionally persuade a decision maker to favor one alternative over another.[13] A course of action justified (or framed) by noting a risk reduction may inadvertently appeal to loss aversion and potentially be perceived favorably compared to one justified by an increase in effectiveness or performance.

Question: How much work do we invest in justifying this requirement?
Relevant biases: Status quo, optimism, pessimism

Discussion: Status quo bias can influence the degree of investment in resource justification through an overreliance on historical products and data. For example, one interviewee described an instance in which a command submitted a funding request which included a prior-year exercise not slated to occur during the request year. If the command opted to simply recycle a prior-year product for this request, then funding toward a real requirement might have been lost. Another interviewee cited long-standing assumptions in DFM which might perpetuate bias:

> We always assume growth and that is probably a bad assumption. While it may be historically true, it probably shouldn't be true for every program….So you know the way the POM process works, very few requirements are ever deleted and new requirements are always added. And so you have growth in two areas. You have growth in each individual line item and you have the addition of new line items which will then themselves begin to grow.

Operating with the assumption of growth during resource justification might be a timesaving strategy, but it can also lead to inaccurate and inflated resource requests.

[13] Decision support personnel could also *intentionally* frame information to support their own agenda, which may be considered manipulation.

Optimism and pessimism bias can also influence the degree of investment in resource justification. One interviewee described how optimism bias (where expectations are better than reality) might lead to the belief that resource justifications are not as important this year because 'we're going to get the money anyway.' Inversely, pessimism bias can deter decision-makers from investing in quality justifications because of the belief their work will have minimal influence on achieving desired funding levels. If reality does not match expectations in either case, the agency may lose out on needed resources.

Question: To what extent do we continue to invest in this program?
Relevant biases: Sunk cost, status quo, loss aversion

Discussion: Establishing programs can be complex and resource-intensive, including identifying needs, attaining buy-in, developing training, and hiring personnel. Under the sunk cost fallacy, decision-makers might favor maintaining investment in programs that "took a lot of time and money" to get started without recognizing that such costs should be omitted when weighing future alternatives. In a discussion on the sunk cost fallacy in DFM, one interviewee observed:

> It is very difficult for people to constrain their operations and exercises to their original budget because there's always an idea or way to make it better…. 'we've already put all this amount of work into getting this done, so we don't want to scale it down at this point.'

Such thinking can be prevalent in resource management decision-making and lead to the selection of suboptimal alternatives. For example, would using this money on a different requirement achieve more than trying to make this requirement a little better?

Status quo bias can emerge during program renewal decisions out of a penchant to maintain existing programs instead of considering alternative ones. In many cases, maintaining programs can be a sensible course of action. Again, new programs can incur significant start-up costs and existing programs might already effectively achieve agency objectives. The problem arises when proposed alternatives compete based on resource availability instead of program merit. This is a form of status quo bias which might ask the question, 'where are we going to find room for this in the budget?' instead of 'to what

extent will this proposed program better achieve our objectives?' One interviewee described the tendency during the POM process to merely "look inward" at justifying existing programs, a practice which might omit considerations over whether such resources could be better used elsewhere. Additionally, decision-makers who identify and desire change might be deterred by the resources required to do so—overcoming bureaucratic inertia might demand more time and effort than what is available. As such, agencies might retain programs which provide less value than those awaiting funding. Similarly, loss aversion might generate hesitancy about surrendering programs because doing so might translate to lower funding levels in future years.

2. Budget Execution

Question: We have leftover funding – what do we do with it?
Relevant biases: Loss aversion, optimism, pessimism, anchoring, recency

Discussion: Once an agency has funded all high-priority requirements (sometimes referred to as mission-essential requirements), decision-makers typically have two options with leftover money: either return it to higher headquarters or spend it on lower priority (mission-enhancing) requirements. Without a method to identify when subordinate agencies have funded all mission-essential requirements, the Marine Corps relies on agencies to self-report leftover money. Loss aversion may influence the decision over whether to self-report this information because of the perception or reality that unused money means lower budgets in subsequent years, an approach known as 'use it or lose it'. As such, agencies might decide to spend leftover funding on mission-enhancing wants, which translates to lost spending opportunities on higher agency needs.

Optimism bias can a play a troublesome role in the decision of how to use leftover funding. If the perception exists that available funding is "floating around" at higher headquarters, agencies may adopt aggressive spending habits to try to signal demand for more funding. One interviewee described a situation in which senior leadership continuously pushed for spending because more money was "on the horizon," however, the agency ended up receiving no additional funding. Inversely, one interviewee identified how pessimism bias may influence decision-makers to be overly conservative, that is, to

not spend funding when it might be necessary. Decision-makers might expect extended delays in receiving additional funding and therefore opt to save for a rainy day to the detriment of current requirements. This tendency can become exacerbated during a continuing resolution in which fiscal uncertainty is typically heightened.

Anchoring and recency bias might arise during funding decisions when agencies are pressed to meet monthly or quarterly spending targets. Spending targets are a near-term metric which can create an illusion that things are going well once the target is met. This mentality can ultimately steer an agency away from focusing on higher priority considerations such as mission readiness or being stewards of public resources.

Question: How do we adjust the spending plan?
Relevant Biases: Anchoring, recency

Discussion: During a CR, which is often characterized by higher fiscal constraints, suppose a level 1 agency decides to pass one of its subordinate level 2 agencies 80% of their budget request. The level 2 agency, confronted with a new constraint, will likely have to reassess how much funding it will pass its subordinate level 3 agencies. The level 2 agency could anchor on the 80% number it received and equally distribute a similar 20% cut (although equally distributing a budget cut may also be tempting because it is politically easier). It should be noted that 80% is a new constraint in terms of the top line the level 2 command has to work with, so it is not a completely arbitrary number. However, an equally distributed cut may not represent the best allocation of resources during the CR period. While we should expect that a yearly budget represents the most important requirements throughout the budgeted year that fall within the budget ceiling, the priorities of funded requirements are not necessarily spread equally throughout the year.

Budget execution could also be affected by recency. First, recall that recency bias can affect our assessment of trends (Brody et al., 2022). Now, imagine a budgeter overseeing the spending of several subordinate agencies, including Agency X and Agency Y. Agency X spent consistently with its monthly spending plan (i.e., hit its spending target) in October, November, and December. Then in January, Agency X spent only 80% of its

funding. During a MYR in February, the budgeter, with the information fresh in his mind that Agency X is under-spending, might look to it as a candidate for pulling funds to realign to other priorities. But compare Agency X to Agency Y, the latter of which has failed to hit its spending goals in November through December, and only just hit its spending target for January. In which agency spending plan should the budgeter have more confidence? An experienced budgeter may accurately recognize that timelines and requirements change, and a single month of under-spending does not necessarily indicate a trend or the start of one. Therefore, resource managers should recognize that the order in which people receive information can affect their understanding (Tubbs et al., 1990), and it is incumbent to first examine causes for apparent under-spending before arriving at a conclusion.

B. COGNITIVE BIAS MITIGATION IN DEFENSE FINANCIAL MANAGEMENT

This section applies the bias mitigation practices identified in our literature review and interviews to the resource management decisions discussed in the previous section. This section parallels chapter three by discussing bias mitigation efforts within two contexts: (1) individual decision-makers within DFM and (2) the system(s) in which they operate. This section provides a basis to formulate conclusions and provide recommendations in the last chapter.

1. Mitigating Biases in the Decision-Maker

In our literature review, we discussed various practices that can mitigate biases within the decision-maker. These practices are relevant training and education, consider-the-opposite, active choice decision-making, make decisions for others, identify and counter, and reframe decisions. In this section, we suggest how these practices may be applied within DFM by drawing from our previous analysis about how biases might influence resource management decisions.

Relevant training and education.

Our literature review discusses that relevant education and experience can mitigate sunk cost bias. The key is that training must be relevant to the areas in which we make decisions. In other words, education should relate to the likely decisions and contexts that

resource managers will face. We attempt to do this with Appendix A by adapting existing decision-making exercises to defense contexts. Additional education could also be easily adapted from postsecondary business and accounting programs. The Marine Corps could implement sunk cost training as a requirement for any personnel who make decisions or provide decision support about funds management. These personnel include acquisition program managers, commanders, comptrollers, and supply officers. We also discussed that relevant training and education could mitigate anchoring and confirmation biases (Morewedge et al., 2015). The literature we reviewed involved either watching a video about these biases or playing a computer game. Though less effective, the video method would be easier to implement as there are myriad publicly available resources.

Consider-the-opposite. Our literature review discussed how a consider-the-opposite practice may be used to mitigate anchoring, framing, and confirmation biases. We do not see this practice as linked a particular type of decision in DFM; rather, decision-makers may find that it is universally applicable. One way decision-makers may consider-the-opposite is by asking for dissenting views. One of our interviewees pointed out that "it's healthy to have a counter argument….and we should listen to understand rather than listening to respond." Recall the hypothetical situation we describe in this chapter of a commander who is considering three courses of action involving funding levels and a budget reserve. Suppose that the commander favors the medium (or goldilocks) course of action. In this scenario, the commander could explicitly ask for counter-arguments: what issues might arise if they choose the medium course of action, or alternatively, why should they choose another option. Another way to consider-the-opposite is by simply listing reasons why your preferred choice or estimate is wrong to yourself. This could be useful when the decision-maker expects some level of groupthink. As another example that may apply to events such as POM and budget formulation, it may be prudent to start with previous budget data. However, to reduce possible anchoring on this data, decision-makers may want to add a step to the decision-making process that considers why a budget request or cost estimate might be wrong before deciding on a final number.

Seek active choice decision-making. Recall that active choice is one in which decision-makers select an option and passive choice is one in which they take no action,

possibly stemming from an insufficient understanding of a situation (Walsh et al., 2011). In our analysis, we outlined ways that resource management decisions are susceptible to passive choice, for example, maintaining the status quo due to insufficiently challenging assumptions or considering alternatives. Resource managers can leverage knowledge about passive choice to signal when suboptimal optimal decision-making may be occurring. For example, if resource justification largely consists of recycling last year's product, then this can indicate the need to pause and consider "why are we favoring these options?" Furthermore, decision accountability can incentivize active choice because it requires decision-makers to first explore and understand their options before they can explain why they chose one.

Make decisions for others. In our literature review**,** we note that making decisions for others can reduce loss aversion, possibly because the agent decision-maker is more likely to be dispassionate (Andersson et al., 2016). In a DFM context, we might refer to this as delegation of authority. However, this could easily involve delegating decision-making authority to someone with a similar attachment to the decision. A similar practice to making decisions for others might be to solicit opinions from decision support personnel (e.g., a commander soliciting opinions from his staff) before deciding. It may also be good practice for the decision-maker to solicit opinions before revealing their own to avoid groupthink. Or, as President Kennedy during the Bay of Pigs, decision-makers might absent themselves from the discussion altogether. Arguably, the Marine Corps already implements opinion solicitation to some degree through staff estimates and estimates of supportability within the Marine Corps Planning Process (U.S. Marine Corps, 2020).

Identify and counter. If there is a risk of anchoring on a given number, decision support personnel might try to point out the fact that "we could be anchoring" on a number and suggest a lower (or higher) number as a counter-anchor. Recall that a component of anchoring bias is the inadequate adjustment of an estimate upon receiving additional information (Tversky & Kahneman, 1974), so the purpose of this countervailing anchor is to compensate for the power of the anchor and the adjustment (Stein, 2018). To give an example of identifying and countering, suppose that during budget formulation a command submits a request for a particularly large budget (we discuss why a command might do this

earlier in this chapter). A decision-maker could anchor on this high number despite the fact that the command's spending has historically been lower. To reduce the anchoring effect, decision support personnel might *identify* that the potential for anchoring and proffer a significantly lower number to the decision-maker in order to *counter* the anchor. As a matter of practice, this counter should include justification, such as that the command's yearly execution hasn't been that high historically, and there aren't any radical program changes that supports increased funding. Of course, the overall aim of budget formulation is to identify the actual budget requirement of the command in question. Thus, this method might be best used in cases of unusually large and unjustifiable budget requests so as not to undermine honest requests.

Reframe the decision. With decisions that involve diverging from the status quo, decision-makers might try reframing decision options to appeal to loss aversion. Recall the experiment we discuss in our literature review that framed the failure to implement teleworking as a perceived loss by appealing to teleworking as environmentally friendly. This effort to reframe was an attempt to avoid the loss aversion that may be implied in status quo bias. Consider that Marine Corps decision-makers could experience a similar loss aversion during the POM, because the Marine Corps must at times make programming decisions that involve reducing or cutting programs. Programmers, when making these decisions or recommendations, might reframe the options into terms emphasizing what we gain (or can keep) by giving up a program rather than on the loss of a program.

Consider again the goldilocks budget scenario from earlier in this chapter. Decision support personnel might consider reworking the decision frame of reference (high-readiness, high-risk; medium-readiness, medium-risk, etc.) to avoid creating a middle ground option. Reframing does not involve simply creating two courses of action for comparison instead of three (remove the middle ground). Rather, it means listing the alternatives in terms of readiness and risk. Alternatively, decision support personnel might present decision options in non-ordinal terms, or they might try presenting the decisions using terms that change the ordinal comparison to create a new middle ground.

2. Mitigating Biases by Altering the System

In our literature review, we discussed three practices to help mitigate biases by altering the system: altering group decision-making practices, implementing accountability, and adding a credible-source step in decision-making. In this section, we discuss how these practices could be applied within DFM. Additionally, we introduce and discuss a fourth practice: building trust and transparency. Multiple interviewees cited this as a distinct bias-mitigation method, and we discuss some of their thoughts on how it can be applied in DFM.

Alter group decision-making practices. Recall that group leaders with multiple types of power over members might influence susceptibility to groupthink (Flowers, 1977). The U.S. Naval Postgraduate School recognizes this phenomenon in the academic setting, authorizing "the wear of civilian clothes for our military students with the intent of furthering appropriate academic thought and discussion without the barriers of overt rank-consciousness and military status" (B. Bryan, email to author, October 13, 2023). While the rank structure can promote unified decision-making, it can also form reluctance in dissenters to challenge established authority. Bad ideas do not improve with rank, and more seniority can make it harder to challenge a bad idea.

In DFM, Resource Management Working Groups (RMWG) function to review, validate, and recommend funding decisions, or perform other resource management-related activities. When formulating RMWGs or other decision-making teams, leaders might consider implementing group composition requirements to preempt and mitigate groupthink. For example, should there be minimum and maximum rank requirements for the group? Should there be a limit on the number of members from each stakeholder? Should groups rotate standing members? Should junior members share their opinions before senior members? Should civilian attire be the uniform of the day during group deliberations? Exploring these questions might seem like mundane micromanagement, however, groups without such guidance might produce suboptimal decisions such as favoring those with the most power instead of those with the most equity.

Leaders might also consider implementing group roles specifically designed to address groupthink, such as members who systematically solicit opinions from all members and contrarian roles to deliberately challenge ideas from the group. Finally, leaders might form two teams to independently evaluate a problem and compete their findings in an open forum. These practices can help minimize groupthink by promoting individual decision accountability, examination of opposite viewpoints, and consideration of other alternatives.

Implement accountability in decision-making. In our cognitive bias mitigation section, we identified that accountability in decision-making is the requirement to rationalize one's decisions to others (Kennedy, 1993) and can help mitigate recency and sunk cost biases. One method in which DFM currently incorporates decision accountability is impact-if-unfunded statements during resource justification. Impact-if-unfunded statements are a documentation task which places ownership on requestors to clearly explain the rationale behind a request and the risk in failing to fund it. This practice helps mitigate bias by inducing thorough analysis and potentially exposing faulty thinking.

How might decision accountability be further applied in DFM? One interviewee cited a case in which subordinate agencies submitted a budget request for a fiscally constrained period. The interviewee later engaged the agencies to determine whether they could spend the requested funds and to communicate that any request would generate an expectation that the funds would need to be used. Following this exchange, the total funding request dropped by nearly 50%. Here, the interviewee employed a form of decision accountability in which the expectation to justify and spend the requested money prompted a more thorough review of the requests. The same interviewee also described how knowing that senior leaders might review budget submissions could produce a similar outcome.

During budget execution, accountability might also be applied during the manual recording of bulk transactions, such as fuel. Bulk transaction recording could include accountability mechanisms such as reminding the recorder of the potential to be audited and requiring supporting documentation as a rationale for cost estimates. These two components can help induce the necessary effort to validate transactions before recording them.

In group decision-making, leaders could require that groups supplement decision narratives (a documentation task explaining the rationale for a recommended course of action) with individual member narratives. This practice can provide a place for dissenters to capture their thoughts which might be lost in a collective product. Additionally, individual responses can provide a more comprehensive analysis of risks and a more thorough reference to support decision-making if it is circulated by multiple senior leaders.

Finally, one interviewee discussed the benefits of creating open competition for resources. They described a practice in which requirement owners brief their needs among other competing peers who can evaluate and validate them before being routed to senior leadership. This creates an environment of accountability with an incentive to clearly articulate needs and expose insufficient or duplicative requests.

Implement a credible source step in decision-making. Credible sources are a frequent component of military decision-making. Leaders rely on experienced staff members and other advisors for decision support. These sources can be instrumental in overcoming biases, such as framing, by building understanding of a situation and exploring the impacts of alternatives. In resource management, credible sources can be considered those who can promote the effective allocation of resources in decision-making, such as subject matter experts and subordinate stakeholders.

A latent challenge associated with credible sources is recognizing when they are needed and how best to employ them. In resource management decisions, agencies might unknowingly omit stakeholders with equity in the decision or fail to engage them appropriately because of inefficient communication methods. The tendency might then arise to remain inwardly focused or fail to fully consider all interested groups. Resource managers might therefore begin the decision-making process by systematically incorporating stakeholder analyses with considerations such as "who is impacted by this decision, and to what extent are they affected?" This analysis can then drive decisions over who to include in decision-making.

For example, consider two adjacent military commanders supporting an operation, each with their own distinct perspectives, requirements, and capabilities. Time and space

limitations might place constraints on their ability to collaborate and thus lead to suboptimal decisions. To mitigate this risk, the commanders might embed liaison officers within each other's staff to represent and advocate for various interests. In resource management decisions, increased liaison functions might serve to illuminate funding needs or priorities. One interviewee described the importance of ensuring other staff weighs-in on financial decisions:

> Whenever you're making a financial decision, just make sure that you are not doing it in a vacuum, and you have representation from other elements of the command. You know, every time we propose a CYD list or a MYR….it's a staff decision and those items are staffed. Everybody has equal levels of input, so we try to eliminate any type of bias that we have by fully vetting it and allowing the staff to come to the conclusions they want.

Build trust and transparency. While not covered in our literature review, multiple interviewees identified building trust and transparency as a distinct bias-mitigation method. One interviewee described the importance of not penalizing commands for under-execution (not meeting a spending goal) where unused funding translates to lost funding. This approach might perpetuate a loss aversion where agencies feel pressured to spend just to prevent losing money in the future. Instead, financial managers should first evaluate the conditions driving under-execution. For example, is there a delay in a contract award or a change to the training plan? Both circumstances can translate to changes in a spending plan, and agencies should receive an opportunity to document these changes before funding is re-aligned elsewhere. Additionally, the interviewee identified that financial managers should be detail-oriented, pursuing an understanding of the bigger picture and communicating that to subordinate agencies. For instance, if higher headquarters is trying to fund CYDs, financial managers should understand and communicate all aspects of that deficiency, including dollar amount, who owns and validated the requirement, the impact-if-unfunded, and the command priority to which that CYD aligns. Another interviewee discussed the importance of transparency in explaining resource management methodology. For example, when their command incurred a budget reduction, they developed a plan for how that would be distributed across the subordinate agencies, then communicated the rationale to the affected agencies. They described how despite

delivering this news, they only received one response which included an in-depth explanation of the subordinate command's spending plan for the rest of the fiscal year.

These and other transparency-building practices can help relax loss aversion in DFM by normalizing information-sharing, thereby encouraging "honest broker" relationships collectively working toward the effective allocation of defense resources.

V. SUMMARY, CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

A. SUMMARY

We reviewed existing research on several cognitive biases, various contexts to which they have been applied, and practices that have been shown to mitigate them. Next, we described the resource allocation and budget execution aspects of the DFM environment and the types of decisions that commonly occur within them. Then, informed by our interview responses from several senior Marine Corps financial managers, we applied cognitive bias literature to DFM, to include how the Marine Corps might apply bias-mitigation practices to enhance decision-making.

B. CONCLUSIONS

Cognitive bias, born out of heuristics used to simplify decision-making, can result in suboptimal decisions. Cognitive bias has been shown to influence decision-making in many environments, and we believe DFM is no exception. The DFM environment, due in part to its unique pressures, size, and the complexity of its requirements, could increase decision-makers' need to rely on heuristics, leading to low-quality decision-making and the ineffective allocation of defense resources. The ways in which this may occur are numerous. Loss aversion might contribute to a tendency to spend leftover funding instead of returning it, which can result in lost spending opportunities on higher priorities. Anchoring and recency biases can contribute to a focus on meeting spending targets and, subsequently, create an illusion that things are going well once the target is met. Confirmation and framing biases can permeate everyday group and individual resource management decisions, potentially resulting in a failure to consider available alternatives. Additionally, the sunk cost fallacy might lead decision-makers to avoid investing in alternative programs that better-achieve agency objectives. These are just some of the ways cognitive bias can impact decision-making in DFM. Moreover, there are numerous bias-mitigation practices that can be applied with the aim of enhancing decision-making and resource management.

C. LIMITATIONS

While our interviewees represent a wide breadth of experience in the Marine Corps, they are ultimately few in number. Ideally, we would have been able to interview more experts to capture a wider experience base. However, we made this concession due to time constraints. This was not meant to be a quantitative project, however, and we are pleased with the insight we gained from our interviews.

D. RECOMMENDATIONS

First, we recommend that DFM decision-makers consider implementing our reviewed bias mitigation techniques in their decision processes. Secondly, we recommend that the Marine Corps offer cognitive bias training to those involved in resource management decisions, including program managers, commanders, financial management officers, and supply officers. Thirdly, we specifically recommend embedding cognitive bias education as a period of instruction in the Marine Corps Financial Management School for new Financial Management Officers. Toward this end, we have prepared a training module (Appendix A) for use in such a classroom environment. The training module is comprised of four exercises, three of which we adopted from similar exercises or questionnaires from our literature review. The biases covered in the module are those that we believe have high relevance to DFM while also being demonstrable in a short classroom session. We have not tested this training module, so future refinement may be required.

Future areas of research may include applying other cognitive biases (there are many) to DFM, identifying and applying other bias mitigation techniques, and testing the efficacy of bias-mitigation techniques in DFM practice. Finally, while our analysis attempted to identify where cognitive bias could arise in decision-making during several major events in DFM, our application was not exhaustive, and additional exploration could certainly be done in DFM areas such as defense contracting.

APPENDIX A. COGNITIVE BIAS PRACTICAL EXERCISE

Introduction

This collection of four exercises is designed to introduce the concept of cognitive bias and how it can impact resource management decisions. Outside sources and prior knowledge of this topic are not required to lead or participate in this practical exercise. The estimated duration is 35 – 50 minutes including discussion. We recommend that instructors do not assign the recommended reading prior to class. Having the students go in "blind" may help increase the impact of the exercises and promote students' awareness of each bias. Alternatively, assigning reading prior to class may make the exercises more a practice of identifying what bias each exercise is trying to draw out. This may help generate discussion after the students complete the exercise.

List of exercises and attributions

Exercise 1, on sunk costs, is adapted from Tan and Yates (1995).

Exercise 2 is on the goldilocks fallacy.

Exercise 3, on framing and loss aversion, is adapted from Tversky and Kahneman (1981).

Exercise 4, on anchoring, is adapted from Fay and Montague (2015).

Recommended reading

Enough, B., & Mussweiler, T. (2001). Sentencing under uncertainty: Anchoring effects in the courtroom. *Journal of Applied Social Psychology*, *31*(7), 1535–1551.

Tan, H.-T., & Yates, J. F. (1995). Sunk cost effects: The influences of instruction and future return estimates. *Organizational Behavior and Human Decision Processes*, *63*(3), 311–319.

Vanden Bosch, P. (2014). The goldilocks fallacy. *Phalanx*, *47*(1), 28–34.

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias. *Journal of Economic Perspectives*, *5*(1), 193–206.

Instructor directions

Before class

1. Before leading this practical exercise, we strongly recommend completing all four exercises on your own (including the sets of near-duplicate exercises for Groups A and B). Then, read the instructor notes for each exercise. This will help familiarize you with the goal of each exercise.

2. Print the exercises in accordance with the class size and the instructions provided in the next step.

During class

1. Provide each student in one half of the class with exercises 1, 2, and the *Group A* version of exercises 3 and 4. Provide each student in the other half of the class with exercises 1, 2, and the *Group B* version of exercises 3 and 4. Each student should have three pages with four total exercises. Exercises 3 and 4 differ between the two groups to help demonstrate how bias can produce different decisions or estimates.

2. Inform the students not to overthink the exercises and that all the information they need is in their handout.

3. Inform the students they have 15 minutes to complete the exercises in their handout (we recommend 15 minutes to help keep students from overthinking the problems). The two groups can remain in the same classroom. Individuals should not work together during this 15-minute period.

4. After 15 minutes have elapsed, or once all students are done, discuss each exercise as a group. The instructor should refer to the instructor notes for each exercise to help guide the discussion.

Exercise #1

You are the Program Manager (PM) for the Long-Range Unmanned Surface Vessel (LRUSV) being developed for the Marine Corps. The LRUSV is critical to the mission of the Marine Littoral Regiment. Your program office has invested $100 million and spent several years developing the LRUSV with Future Systems, Inc. (a U.S. defense contractor). The plan is to spend another $25 million to field the first 20 LRUSVs. A near-peer competitor has been seen testing a similar platform with double the range. Around the same time, you learn that a different U.S. defense contractor has proposed a design for the LRUSV 2 with capabilities at least comparable to the near-peer competitor's platform, but it requires more testing before production. You do not expect congress will appropriate enough funds to simultaneously develop both projects, and the LRUSV 2 technology is not able to be retrofitted to the current LRUSV.

As the PM, do you continue fielding the current LRUSV or invest in the LRUSV 2?

Why?

Exercise #2

Office Inc. has rented unused workspace for a few years. The company might expand next year and require some of the unused workspace, but management is confident it still needs to downsize. The possible expansion also creates a budget-constrained environment with a lot of scrutiny over operating expenses. Management knows that potential future workspace requirements must be balanced with the need to reduce costs. They request the staff to provide downsizing options and receive the following:

Option 1	Option 2	Option 3
Lower risk, lower return	Medium risk, medium return	Higher risk, higher return
Reduce by 800 Square Feet	Reduce by 1600 Square Feet	Reduce by 2400 Square Feet
Money saved: $275K/year	Money saved: $530K/year	Money saved: $760K/year

If you were the decision-maker, what option would you select?

Why?

Group A

Exercise #3

Assume that you have invested $18,000 in the stock market. Over the past few days, the market has shifted significantly, and you are expected to lose all $18,000 if you do nothing. You consider one of two options:

Option	Money Saved	Likelihood
Sell only	$6,000	100%
Sell then reinvest	$18,000	33%
	$0	67%

Which option do you select?

Why?

Exercise #4

Do you think the unit cost of the Joint Light Tactical Vehicle (JLTV) is more or less than $1 million?

What do you think is the unit cost of the JLTV?

Group B

Exercise #3

Assume that you have invested $18,000 in the stock market. Over the past few days, the market has shifted significantly, and you are expected to lose all $18,000 if you do nothing. You consider one of two options:

Option	Money Lost	Likelihood
Sell only	$12,000	100%
Sell then reinvest	$0	33%
	$18,000	67%

Which option do you select?

Why?

Exercise #4

Do you think the unit cost of the Joint Light Tactical Vehicle (JLTV) is more or less than $200 thousand?

What do you think is the unit cost of the JLTV?

Exercise #1 Instructor Notes

This problem is designed to draw out responses that appeal to sunk costs. However, sunk costs are those that have already incurred and are therefore irrelevant when comparing future alternatives. When leading the discussion, the instructor should ask each student to share their decision and explain why they chose it. The 'why' is the most important aspect of this exercise. Note that this scenario is designed such that there is no clear answer. Students can rationally justify pursuing either option. The instructor should listen for student responses that appeal to previous investments in the program (money, time, etc.) or a desire to recoup previous costs. Responses that appeal to sunk cost might include: 'we have already spent a lot of time/money/etc., on this program,' and 'cancelling the program now would be a waste.' Responses which do not appeal to sunk cost might be: 'drop the program and proceed with LRUSV 2' or 'maintain the current LRUSV program because we don't know how long it will take to field LRUSV 2.' Before pointing out the sunk cost fallacy, the instructor may either wait until a few students have shared explanations that appeal to sunk costs or wait until all students have responded. Next the instructor should ask students where they think the tendency to appeal to sunk costs might arise in their personal lives or in their jobs (Tan and Yates, 1995, provide a good personal example of this). The instructor may also consider discussing additional biases and how they might affect the decision. Examples include optimism, pessimism, status quo, and recency biases.

Learning Objectives

- Sunk cost bias suggests that there is a strong tendency to appeal to sunk costs when making a decision.
- Sunk costs are generally irrelevant when analyzing future alternatives.

Exercise #2 Instructor Notes

This exercise is designed to expose students to the goldilocks fallacy, which is the tendency to select the middle option despite there being a more rational option. The goldilocks fallacy is a form of framing bias, by which the decision-maker is influenced by how a problem or options are presented. In this exercise, the students receive three options, any one of which might be optimal, or all of which might be suboptimal. The point of the exercise is to determine whether students rationalize Option 2 because 'it seemed right' or 'it was the middle option'. This form of thinking can lead to suboptimal decision-making by failing to adequately consider available alternatives. Responses which do not appeal to the goldilocks fallacy might be 'I chose Option 1 because I don't want to take more risk just to save money' or 'I chose Option 1 because it's the best return per square foot'. To begin discussion, the instructor can ask the class who selected Option 1 and have a few students explain their rationale, then repeat for Options 2 and 3. After this discussion, the instructor can describe the fallacy, then ask how this fallacy might emerge in everyday life or discuss decision aids which might help improve the quality of the information in the exercise, such as a graph or adding information about the dollars saved per square foot.

Learning objectives

- The goldilocks fallacy might create a tendency for decision-makers to gravitate towards the "middle" option.
- This can result in suboptimal decision-making in which we don't fully evaluate the other options or fail to consider unlisted alternatives.

Exercise #3 Instructor Notes

This exercise is designed to further reinforce framing bias and expose students to loss aversion bias. Student Groups A and B receive different versions of this scenario. Group A choices are framed as a gain (money saved) and Group B choices are framed as a loss. Due to the tendency to weigh losses more than comparable gains, students with the "gain" frame might tend to select the "sell only" option because it's guaranteed money. Students with the "loss" frame might tend to select the "sell, then reinvest" option because the alternative results in a guaranteed loss. However, the corresponding options between the Group A and Group B sets of choices result in the same outcome. To start discussion, the instructor might begin by asking Group A to explain their choices and rationale, then move to Group B to do the same. After both groups have discussed, the instructor can explain the bias and then have students find someone from the opposite group to briefly compare the differences in exercise 3. The instructor can then ask how loss aversion might emerge in various contexts and how to address it (instructors might discuss 'use it or lose it').

Learning objectives

- People often tend to weigh losses heavier than comparable gains.
- Loss aversion can result in suboptimal decision-making when the potential for losses prevents us from recognizing the potential for greater gains.

Exercise #4 Instructor Notes

This exercise is designed to teach students about anchoring bias and how different starting values can result in different estimates. In the first questions, Group A is given a high anchor ($1 million), and Group B is given a low anchor ($200 thousand). The expected outcome is that the average estimate given for the cost of a JLTV will be higher from Group A (high anchor) than from Group B (low anchor).

When leading the discussion, the instructor may begin by pointing out the difference between Group A and Group B's question set. Then the instructor should ask Group A (the high anchor) to give their answers to exercise 4 and average Group A's results. The instructor should then do the same with Group B. The instructor should then point out (or ask students) why the difference occurred. The instructor should describe anchoring bias and then ask students where they think anchoring bias could arise in their future jobs. Some examples of values people might anchor on include a command's budget request, last year's budget, and a contract cost estimate.

Note that the values (anchors) listed in the first question are not offered as estimates. The purpose of this is to show that people can anchor on even arbitrary numbers. The instructor could try taking this concept further by changing the first question for each group to completely de-link the anchors from the JLTV. As an example, the instructor could change the question to a scenario that describes an exercise, mention its cost (the low anchor could be $500 thousand and the high anchor $2 million), and at some point merely reference JLTVs as being part of the exercise.

Learning Objectives

- Different starting values can yield different estimates.
- Even somewhat arbitrary numbers (such as in this exercise) can act as anchors.

APPENDIX B. INTERVIEW DOCUMENT

NAVAL POSTGRADUATE SCHOOL THESIS
"COGNITIVE BIAS IN DEFENSE FINANCIAL MANAGEMENT"

INTERVIEW DOCUMENT

Purpose of research: to strengthen decision-making in Defense Financial Management (DFM) by examining potential biases within the profession.

Purpose of interview: (1) to identify how cognitive bias could impact decisions in DFM and (2) to determine whether cognitive bias training is occurring and worthwhile to the DFM profession.

Cognitive Bias Definition: Heuristics are mental shortcuts that "reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics are quite useful, but sometimes lead to severe and systematic errors" (Tversky & Kahneman, 1974). These heuristics give way to biases, or errors in judgement, that may pose risks to decision-makers.

Definitions of a Few Cognitive Biases:

Anchoring Bias: the over-reliance on an initial value (or values), where people under-adjust their estimate when faced with subsequent values. Thus, "different starting points yield different estimates" (Tversky & Kahneman, 1974).

Loss Aversion Bias: "the disutility of giving up an object is greater than the utility associated with acquiring it" (Kahneman et al., 1991).

*Optimism and Pessimism Biases: "*the difference between a person's expectation and the outcome that follows. If expectations are better than reality, the bias is optimistic; if reality is better than expected, the bias is pessimistic" (Sharot, 2011).

*Sunk Cost Bias: "*the tendency for decision-makers to persist in an endeavor simply because they have already invested resources into it" (Meyers et al., 2019)

DFM Events: The following list outlines events in which financial managers engage in decision-making or decision-making support. This list is intended as a reference and is not exhaustive.

- Program Objective Memorandum (POM) submission and review
- Budget formulation
- Continuing resolution

- Mid-Year Review (MYR)
- Current-Year Deficiency (CYD) funding decisions
- Fiscal year closeout
- Contract award

Interview Questions

1. Describe any cognitive bias training and/or education the military provides the financial management workforce.

2. How have biases impacted the above DFM events in your current or previous organizations? In DFM events not listed above?

3. What institutional processes may perpetuate bias in DFM (for example, budget formulation predicated on last year's data)?

4. What truisms/assumptions/rules of thumb may perpetuate bias in DFM (for example, "use it or lose it")?

5. What bias-mitigating practices exist in your organization (for example, red-teaming) and how effective are they?

6. Which budget formulation method are most prone to cognitive bias (for example, incremental vs. zero-based budgeting)?

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