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**BEHAVIORAL DECISION BIASES IN  
THE NAVY POM PROCESS: EVIDENCE FROM  
THE LITTORAL COMBAT SHIP**

by

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June 2023

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**BEHAVIORAL DECISION BIASES IN THE NAVY POM PROCESS:  
EVIDENCE FROM THE LITTORAL COMBAT SHIP**

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## ABSTRACT

The purpose of this study is to identify areas that may exhibit potential for systematic cognitive biases in a decision-making process, discuss forms these decision biases may take, and present ways in which they may be mitigated, based on behavioral economics literature and using the case of the Navy's acquisition of the littoral combat ship (LCS) between 2002 and 2022. The scope of this study is within the intersection of the Defense Acquisition System (DAS), Joint Capabilities Integration and Development System (JCIDS), and Planning, Programming, Budgeting, and Execution (PPBE) process. The analysis framework in this study is rooted in behavioral economics, which departs from classical economics to incorporate psychological and social influences into explanations of human behavior and decision-making. The study finds that the anchoring effect, loss aversion, and sunk-cost fallacy cognitive biases may have contributed to suboptimal outcomes for the Navy. Military and civilian Department of Defense leaders can apply the lessons learned from this study to other acquisition programs, including the new Constellation-class frigate, and the Next-Generation Guided-Missile Destroyer program, to recognize the potential for such decision biases, communicate and educate stakeholders involved, and attempt to mitigate their potential effects on decision-making processes such as the Program Objective Memorandum (POM).

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## LIST OF ACRONYMS AND ABBREVIATIONS

CJCS	Chairman of the Joint Chiefs of Staff
CNO	Chief of Naval Operations
DIB	Defense Industrial Base
DOD	Department of Defense
DON	Department of the Navy
EUL	End of Useful Life
FY	Fiscal Year
HASC	House Armed Services Committee
JDM	Judgment and Decision-Making
LCS	Littoral Combat Ship
MILCON	Military Construction (Appropriation)
MILPERS	Military Personnel (Appropriation)
MSRP	Manufacturer's Suggested Retail Price
N-8	Deputy Chief of Naval Operations for Integration of Capabilities and Resources
N80E	Office of the Chief of Naval Operations, Programming Division, Strategic Fiscal Analysis Branch
NAVSEA	Navy Sea Systems Command
NDS	National Defense Strategy
NPR	Nuclear Posture Review
O&M	Operations and Maintenance (Appropriation)
OPNAV	Office of the Chief of Naval Operations
OSD	Office of the Secretary of Defense
POM	Program Objective Memorandum
PPBE	Planning, Programming, Budgeting, and Execution
PPBS	Planning, Programming, and Budgeting System
PRC	People's Republic of China
PROC	Procurement (Appropriation)
RDT&E	Research, Development, Test, and Evaluation
SECNAV	Secretary of the Navy

SLCM-N	Sea Launched Cruise Missile-Nuclear
SLEP	Service Life Extension Program
SSBN	Ballistic Missile Submarine

## EXECUTIVE SUMMARY

Suboptimal decision biases exist within the defense acquisition decision support systems, and they negatively impact the Navy's Program Objective Memorandum (POM) build. Decision biases contribute to unrealistic program requirements that increase the amount of time and money needed to develop the future fleet and have contributed to cost overruns and schedule delays for major acquisition programs such as the Littoral Combat Ship (LCS) program. Navy financial programmers and war-fighting community leaders can learn from behavioral economics to mitigate decision biases, thereby improving the Navy's strategic financial decision-making. Understanding decision biases in the POM process, and then doing something about them, is in perfect alignment with the Chief of Naval Operations (CNO) "Get Real, Get Better" campaign (Gilday, 2022).

The purpose of this study is to identify systematic cognitive biases exhibited during the Navy's acquisition of the littoral combat ship (LCS) from 2002 to 2022 to inform civilian and military acquisition professionals that operate within the intersection of the Defense Acquisition System (DAS), Joint Capabilities Integration and Development System (JCIDS), and Planning, Programming, Budgeting, and Execution (PPBE) process. The analysis framework is rooted in behavioral economics, which deviates from mainstream economics and incorporates psychological and social influences into explanations of human behavior. The framework used in this thesis is different from previous technical reports on LCS from the Navy, RAND Corporation, Congressional Budget Office (CBO), and Congressional Research Service (CRS). The study found that the anchoring effect, loss aversion, and sunk-cost fallacy cognitive biases contributed to suboptimal outcomes for the Navy.

One cognitive bias exhibited between the U.S. Congress and Department of Defense (DOD) in naval acquisition is the anchoring effect. Aspirational shipbuilding goals act as a cognitive anchor that may negatively impact decision-making. The Navy has been incentivized to procure against the battle force fleet goal of 355 manned ships rather than a combination of manned and unmanned platforms. The logical question from Congress then centers around when will the shipbuilding goal be achieved, or why the

Navy cannot build to the goal within the POM cycle. The anchoring effect is not limited to the battle force fleet number as it exists within program executive officer offices and service internal POM build discussions. If something is taken away from a warfighting community or otherwise reduce a program's funding, then program sponsors may fight harder to keep it, even if it lacks funding, does not meet expectations, or there is a change in priorities; and in behavioral economics this is called the endowment effect. Risk aversion and loss aversion are other cognitive biases reflected in the LCS program. The sunk-cost fallacy influenced the decision to continue to buy the LCS even though it did not meet cost, schedule, or performance requirements at different times during its evolution from a concept to two different ship types.

The Navy can apply the lessons learned from the twenty-year LCS acquisition history to other acquisition programs including the new Constellation-class frigate, Columbia class submarine, and the Next-Generation Guided-Missile Destroyer program. The LCS program provides lessons for the naval surface warfare community, Department of the Navy, DoD acquisition community, and Congress. It is important to remember the program because its story from its inception as a competition of ideas in the 1990s to a seemingly economical program in the early 2000s in a DOD that was encouraged to think differently; to a troubled acquisition program whose twists and turns are better chronicled in numerous newspaper articles, GAO reports, and congressional hearings. Recommendations for leaders are based on the concepts of the anchoring effect, loss aversion, and the sunk-cost fallacy.

## References

Gilday, M. (2022, January 11). *CNO delivers remarks at the 34th Surface Navy Association National Symposium*. United States Navy. <https://www.navy.mil/Press-Office/Speeches/display-speeches/Article/2899352/cno-delivers-remarks-at-the-34th-surface-navy-association-national-symposium-ja/>

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## I. INTRODUCTION

Suboptimal decision biases exist within the defense acquisition decision support systems and they negatively impact the Navy’s Program Objective Memorandum (POM) build. Decision biases contribute to unrealistic program requirements that increase the amount of time and money needed to develop the future fleet and have contributed to major acquisition programs including the Littoral Combat Ship (LCS) exceeding their planned costs and schedules. Navy financial programmers and war-fighting community leaders can learn from behavioral economics to mitigate decision biases, thereby improving the Navy’s strategic financial decision-making. Understanding decision biases in the POM process, and then doing something about them, is in perfect alignment with the Chief of Naval Operations (CNO) “Get Real, Get Better” campaign (Gilday, 2022).

Existing literature about behavioral economics shows that people can learn to make better decisions for themselves. The Navy can increase awareness of selected theories from behavioral economics to improve decision-making in its warfighting, acquisition, and resourcing communities. Potential solutions to the identified problem exist if organizations combine self-study with purposeful teaching and group learning. Economists in the field today include Dan Ariely, Daniel Kahneman, Olivier Sibony, Cass Sunstein, and Richard Thaler; these economists were influenced by older economists including Milton Friedman and Gary Becker (Kahneman, 2013, pp. 411–413). The literature review will cover important works by economists and scholars in other relevant fields.

Few research studies have investigated the decision biases within the Navy’s POM build. Naval Postgraduate School students have explored unique military concerns with a behavioral economics lens. These studies have used behavioral economics to analyze a wide range of issues, including human resources decisions, nuclear policy, and health education. Additionally, the Navy’s financial programmers called for an investigation into the main elements of Navy budget decision-making. Therefore, the objective of this study is to understand how to improve the quality of the financial and

strategic information needed to facilitate better informed decisions, while accounting for the unique environment in which the Navy builds its budget.

This paper assesses the U.S. Navy's strategic fiscal analysis process using behavioral economics in order to highlight systematic behavioral biases that exist, and provide suggestions to improve behaviors, processes, and overall decision-making related to the annual budgeting and programming process. The Office of the Chief of Naval Operations, Programming Division, Strategic Fiscal Analysis Branch (N80E) supports the Deputy CNO for Integration of Capabilities and Resources, N8, who is responsible for the U.S. Navy's POM submission. This research supports the OPNAV N80E Strategic Fiscal Analysis branch by evaluating behavioral economics-based decision science approaches that are suitable to the unique Navy environment and identifying feasible decision science applications to implement with the goal to improve Navy budget processes, in particular building the POM.

Financial decision-making is important because the Department of Defense cannot afford everything, a fact everyone who has been part of a President's Budget request has faced. Annual budgetary pressures are compounded by inflationary pressures that have risen in recent memory, which diminishes the value of the dollar and the purchasing power of the Department. The Nation has limited shipbuilding capacity in the defense industrial base (DIB) that can support the unique requirements of the Navy, meaning that if a specific shipyard is not building a Navy or Coast Guard ship, then it may be forced to make the decision to re-tool its yard for civilian shipping, or close. Either way, the skills and tacit knowledge of military shipbuilders can be lost. The opportunity cost of not giving a military shipyard work can be the loss of the shipyard and its workers. However, the Department's needs change over time and the decision space of senior leaders can be hampered by external pressures from Congress and industry, and internal pressures from warfighting communities. The Navy's task during budget submission may be compared to a Strait of Hormuz transit with the maneuver space of the Panama Canal. If every interest group is not going to walk away happy, then that should be understood up front.

## II. BACKGROUND

### A. CONGRESSIONAL OVERSIGHT

The United States spends more on national defense than any other nation. While this is common knowledge, the way that the nation determines its defense budget is not common knowledge. The result of Defense Department’s planning, programming, and budgeting process is a president’s budget request that the Congress ultimately receives, marks, and then votes on. The Congress then directs their intent to the Defense Department through two laws: the National Defense Authorization Act and the Department of Defense Appropriations Act.

According to the Congressional Research Service (CRS), “FY2022 was the 61st consecutive fiscal year for which a defense authorization was enacted. This regular enactment of legislation for six decades depends upon adherence to process and consistency in procedures, schedules, and protocols” (Heitshusen & McGarry, 2022). Congressional oversight of the military is a critical component for American democracy and the members of House and Senate Armed Services Committees hold hearings and conduct other oversight activities to identify the Department’s issues and concerns with regards to policy and funding. Equally important is that Congress appropriates money to the federal departments and that the Defense Department can only spend what the Congressional Appropriators approve. The CRS notes the following:

The Constitution gives Congress the power of the purse in Article I, Section 9, which provides that “No money shall be drawn from the Treasury, but in Consequence of Appropriations made by Law.” To fulfill this duty, Congress annually considers appropriations measures, which provide funding for numerous activities—such as national defense, education, and homeland security—consistent with policies and priorities established through various enacted measures, such as the National Defense Authorization Act. (McGarry & Saturno, 2022)

The Congress authorizes, appropriates, and conducts oversight of the Defense Department’s budget during the Budgeting and Execution phases. Congress passes legislation on an annual basis and can pass legislation as needed to support military operations. While it is important to note that the Congress is ultimately responsible for

authorizing and appropriating funds to the Department of Defense, this paper will not focus on their participation in the budgeting portion of Planning, Programming, Budgeting, and Execution (PPBE) process. Rather, the paper will focus on the Department of the Navy's Programming process and how behavioral economics can improve the process.

## **B. NAVY STRATEGIC AND BUDGETARY CONCERNS**

The 2022 *National Security Strategy* states that “Our starting premise is that a powerful U.S. military helps advance and safeguard vital U.S. national interests by backstopping diplomacy, confronting aggression, deterring conflict, projecting strength, and protecting the American people and their economic interests” (The White House, 2022). The current administration concluded the war in Afghanistan in 2021; and the war in Ukraine in 2022 disrupted Europe and the entire world as Russia attacked with uniformed personnel and annexed Ukrainian territory. The Congress passed the Additional Ukraine Supplemental Appropriations Act, 2022 in May 2022 in response to Russian aggression (Additional Ukraine Supplemental Appropriations Act, 2022). This bill included \$939M in Operations and Maintenance funding for the Navy to deter further aggression in Europe, and limited amounts for Navy procurement directly related to replenishing ammunition stocks reduced by the war in Ukraine, considerably less than what the Army and Air Force were given to procure rockets, missiles, and air defense related equipment to support Ukraine (Additional Ukraine Supplemental Appropriations Act, 2022).

The ground war in Ukraine is not the Defense Department's only area of concern. The Department's priorities are: “Defending the homeland, paced to the growing multi-domain threat posed by the People's Republic of China; deterring strategic attacks against the United States, Allies, and partners; deterring aggression, while being prepared to prevail in contact when necessary – prioritizing the PRC challenge in the Indo-Pacific region, then the Russia challenge in Europe; and building a resilient Joint Force and defense ecosystem” (Department of Defense, 2022, p. 7). The priorities mention China

twice and Russia once, and the 2022 *National Defense Strategy* (NDS) identifies China as the pacing threat and Russia as an acute threat.

The 2022 *National Defense Strategy* states that “The Department will advance our priorities through integrated deterrence, campaigning, and actions that build enduring advantages” (Department of Defense, 2022, p. 1). Integrated deterrence is using all means of national power to deter adversaries including maintaining a high state of readiness of conventional and nuclear forces. Campaigning is “the conduct and sequencing of logically-linked military initiatives aimed at advancing well-defined, strategy-aligned priorities over time” and includes operational deployments and training events with partner nations (Department of Defense, 2022, p. 1). Finally, building enduring advantages relates to a host of activities including support for military modernization, research, development, test, and evaluation (RDT&E). The NDS guidance for force planning is for a “lethal, sustainable, resilient, survivable, agile, and responsive” array of forces ready to support the national strategy and combatant commanders (Department of Defense, 2022, p. 18). Finally, the NDS states that “we must not over-exert, reallocate, or redesign our forces for regional crises that cross the threshold of risk for our highest strategic priorities” (Department of Defense, 2022, p. 22).

The Navy must provide Combatant Commands with forces ready to respond to crisis, maintain freedom of the seas, and deter adversaries. This is of course no small task. The 2022 Nuclear Posture Review (NPR) cancels the nuclear-armed Sea Launched Cruise Missile (SLCM-N) program and states that nuclear weapons have the following roles: “Deter strategic attacks, assure allies and partners, and achieve U.S. objectives if deterrence fails” (Department of Defense, 2022, p. 7). Further, the 2022 NPR states that “We will rely in part on nuclear weapons to help” mitigate the risk of “conflict with two nuclear-armed states” (p. 12). The Navy maintains one portion of the nuclear triad and the submarine force is in theory the only portion of the triad that guarantees second strike capability. The 2022 NPR gives the Navy specific guidance to “fully fund the COLUMBIA-Class SSBN program to deliver a minimum of 12 boats to replace the OHIO-Class fleet beginning in 2030” and other guidance specific to sustaining the OHIO-class and sustaining existing nuclear weapons (p. 21).

The 2022 *National Defense Strategy* gives the Department of the Navy competing demands for resources as The Department of the Navy funds the Navy and the Marine Corps. This strategic guidance restricts the decision space available for Navy programming as the guidance gives specific funding thresholds for programs. In addition, the Department of the Navy maintains its own strategic guidance, the Marine Corps has the Commandant's Force Design 2030, and the Navy has the Chief of Naval Operation's Navigation Plan. These strategic documents act as additional supporting strategic guidance that communities within the naval services use for long-range planning and programming during the POM build. The Department of the Navy's portion of the FY23 President's Budget requested \$230.8B, with 78% to the Navy and 22% to the Marine Corps (Assistant Secretary of the Navy (Comptroller), 2022).

The Navy requested \$180.5B with 34% for Operations & Maintenance (O&M), 30% for Procurement (PROC), 23% for Military Personnel (MILPERS), 11% for Research & Development (R&D), and 2% for Military Construction (MILCON) (Assistant Secretary of the Navy [Comptroller], 2022). The Marine Corps requested \$50.3B, with 34% for MILPERS, 33% for O&M, 24% for PROC, 6% for R&D, and 3% for MILCON. To compare the two services, the Navy spends more on PROC and R&D and less on MILPERS compared to the Marine Corps. This follows logic as the Navy is more defined by expensive weapons platforms, including those that are nuclear capable, than the Marine Corps. The most expensive weapons system in Marine Corps procurement is the F-35, followed by the CH-53K, and then other systems needed to implement Force Design 2030. The Navy is buying the F-35 and other aircraft, submarines, and surface ships needed to follow the CNO Navigation Plan and other strategic documents (Assistant Secretary of the Navy [Comptroller], 2022).

The strategic documents outline a way ahead for the naval services. The Navy is in the process of divesting legacy equipment, testing its new Ford class aircraft carrier, and preparing for a nuclear submarine transition in the next decade. The Navy campaigns with the Marine Corps and other services as part of the joint force, supports the nuclear triad, and is making strategic investments in modernization that will allow the service to compete with China in the Indo-Pacific and others around the globe. With so many

competing demands, the Navy must prioritize, assess risk, and make the best resource-informed decisions possible to meet the moment and the challenges posed by adversaries in the next decade. Literature on decision-making and behavioral economics can inform Navy leaders to make sound decisions.

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### III. LITERATURE REVIEW

#### A. CLASSIC ECONOMICS CONCEPTS CHALLENGED

In 1955, Herbert Simon noted that economic theory stated that “economic man” is “rational” and is “assumed to have a well-organized and stable system of preferences” that allow him to make the most informed and rational decisions possible (Simon, 1955, p. 99). Simon disputed this theory and began an academic discussion with others on ways that economic theory could improve based on psychology and further research. Simon worked with other concerned academics to develop the field of decision-making science as he operated within the fields of political science, operations research, and economics; and was awarded the Nobel Prize in Economics in 1978 (Simon, 1979, p. 493). Behavioral economics as a discipline began to form between several academics and institutions in the 1950s and advanced again in the proceeding decades with work from Daniel Kahneman, Amos Tversky, Richard Thaler, and other academics.

Economics comes from two Greek words: “oikos, meaning house, and nomos, meaning manager,” which put together in Greek is “oikonomikos,” meaning house management skills (Maital, 1982, p. 8). Economics informs the choice to get something now, later, or not at all, how much should it cost, and what one will give up to get it (Maital, 1982, pp. 9–10). The opportunity cost of an activity is what one gives up to do the chosen activity (Thaler, 2015, p. 17). For example, if the Navy has \$1 billion set aside for shipbuilding, it could choose to spend it all on one ship or choose to spend \$1 billion on two different ships. In this scenario, the opportunity cost of buying the \$1 billion ship is not buying two ships costing \$500 million each.

The decisions made to keep a house or organization well managed are ripe for study, as well as the process by which one comes to make an economic decision; and many academics have researched these topics to try to better understand judgment and decision-making (JDM). The normal path to becoming an effective organizational manager is by observing others manage, and this has positive and negative impacts, as one learns from positive and negative economic decisions. Hirshleifer writes that

“learning by observing others can explain the conformity, idiosyncrasy, and fragility of social behavior” (Tommasi & Ierulli, 1995, pp. 188–189). A house manager that observed others managing their house well may be able to successfully manage a house, but there is no independent metric on this. The social behavior that Hirshleifer writes about leads to localized conformity in which people imitate the same mistakes of their peers and predecessors. Localized conformity in organizations is quite different from the theoretical behavior humans practice in economic models, where they always make perfectly rational decisions.

Traditional economists have used a model of humans that is problematic when tested against human behavior. In economic models, normal human beings or homo sapiens were replaced with homo economicus, otherwise called economic man or what economist Richard Thaler calls an “Econ” (Thaler, 2015, p. 4). These “Econs” in economics are built upon flawed assumptions, including that they can make unemotional decisions using all information available, that they always act in their self-interest, and as rational actors are not swayed by their past behavior or decisions.

The imperfection in economic models is accounted for in traditional economics and behavioral economics in distinct ways. An example of an economic model is the one that determines the price for an object and includes the upward-sloping supply curve and downward-sloping demand curve (Schlefer, 2012, p. 25). In theory, this model will perfectly predict what the price for an object will be given specified values for supply and demand. The challenge, though, is that this model assumes a perfect world that only exists in textbooks. Traditional economists respond to this difference in perfection by improving their models to account for outside market forces (Schlefer, 2012, p. 93). A rational choice is an informed choice made by comparing one or more options, and then deciding based on how close to complete satisfaction one will be with their choice. Rational actors must be seen in a society full of irrational actors, as irrationality is our “distance from perfection” (Ariely, 2008, p. xix). Behavioral economists assume that humans are not perfectly rational and have conducted controlled and naturally occurring experiments to determine how humans systematically and predictably make irrational economic decisions in order to improve economic models (Thaler, 2015, pp. 7–9).

## **B. ECONOMICS AND STRATEGIC PLANNING IN THE DEFENSE DEPARTMENT**

In 1956, Congress passed legislation that required budget justifications be supported by “information on performance and program costs by organizational units” (McGarry, 2022, p. 14). The Department of Defense (DOD) met this legislative requirement in 1961 with Secretary of Defense McNamara’s Planning, Programming, and Budgeting System (PPBS). The military services then had to submit their annual budget requests through the Office of the Secretary of Defense (OSD), where the requests were scrutinized for program cost, schedule, and performance. The process was meant to improve economic decision-making and allow multiple reviews of the Army, Navy, and Air Forces budget requests prior to their inclusion in the President’s Budget Request to Congress. A modified version of PPBS exists today, where it is known as the Planning, Programming, Budgeting, and Execution (PPBE) process (p. 14). One intent of the process was to reduce duplication of effort, so that the Services complemented each other rather than competing for similar capabilities. An example of this is nuclear deterrence during the Cold War as the Army, Navy, and Air Force all provided distinct delivery capabilities such as artillery, missiles, submarines, and bombers (p. 14).

The Cold War and Vietnam War heightened everyday American awareness of military spending, the role of government, public spending and taxation, and ways to make decisions. Gordon Tullock in 1970 observed that “the conventional wisdom holds that the market is made up of private persons trying to benefit themselves, but that the government is concerned with the public interest” (p. v). The conventional wisdom in 1970 held some truth and still does, although the market has more government regulation today. However, Tullock wrote that the government uses a decision-making process, and that even if it was well intentioned, it was still going to disadvantage someone, whether that be the taxpayer in general or a specific group or people in a set geographic area. Members of Congress are as concerned today as they were in the past about military spending in their districts and states as it impacts the livelihoods of their constituents, the defense contractors that provide goods and services to the military, and national security.

Tullock (1970) noted that there are two sectors in the economy, the private sector and the public sector, and that “the private market is where selfish individuals seek to maximize their preferences. The public interest of government then is at odds with the selfish viewpoint” (p. 32). The Department Defense has the largest part of federal discretionary spending authority, and the two sectors of the economy naturally overlap to an extent because of that. The Navy provides public goods in that it campaigns forward and ensures freedom of navigation and the free flow of goods across the oceans. This is a positive externality from the public sector Navy that impacts the private sector. The Navy also purchases airplanes, ships, boats, and other weapons systems from the private market of the defense and maritime industries, which is another positive externality to the private sector.

The Navy has a limited budget based upon the appropriation it receives from Congress, which means that it cannot purchase a ship from the market in the same way that a private organization could purchase a ship. There are winners and losers to an extent in the system, and based on economics, “the government does not provide exactly what each voter wants because it would be too expensive to do so” (Tullock, 1970, p. 33). Thus, public decision-makers cannot make everyone happy because they do not have the budget to do that, and even if they had an unlimited budget, there would be a portion of the taxpaying public that would see excess spending as what it is – waste.

### **C. BEHAVIORAL ECONOMICS: DECISIONS EXPLORED THROUGH ECONOMICS AND PSYCHOLOGY**

Behavioral economics assumes that people are not perfectly rational and then identifies specific and systematic behaviors that show people acting against their self-interest. For example, people purchase brand name medication instead of generic medication because they feel better about the decision even though they are paying more for the same active ingredients. Behavioral economists have studied judgment through experiments to assess how well people make decisions under uncertain conditions, and the heuristics they employ when they do so.

In 1974, Amos Tversky and Daniel Kahneman wrote about three heuristics associated with judgment: representativeness, availability, and adjustment from an anchor, referred to today as the anchoring effect (Tversky & Kahneman, 1974). Heuristics are problem solving methods or mental shortcuts that people use to make decisions quickly or intuitively and may not lead to optimal decisions (Hjeij et al., 2023). Cognitive biases “stem from the reliance on judgmental heuristics,” and are associated with intuition and suboptimal decision-making (Tversky & Kahneman, 1974, p. 1130). General awareness of heuristics and their impact on decision-making increased after Daniel Kahneman published his bestselling book *Thinking, Fast and Slow* in 2011. The book introduced his work with Amos Tversky to mainstream American society.

The representativeness heuristic can be compared to abductive reasoning and the “duck test”: “If it looks like a duck, and quacks like a duck, it must be a duck.” The representativeness heuristic has to do with the belief in the probability of a future uncertain event and relies upon stereotypes and the similarity of one event to another (Tversky & Kahneman, 1974, p.1124). People guess the probability of an event by how much it reminds them of a similar event and this is accepted as normal human behavior. This behavior is also seen in studies involving small sample sizes, in which researchers and scientists may overestimate the replicability of an event and overinterpret the findings (Tversky & Kahneman, 1974, p.1126).

The availability heuristic assesses frequency or probability and impacts judgment. An example is “one may evaluate the probability that a given business venture will fail by imagining various difficulties it could encounter” (Tversky & Kahneman, 1974, p.1127). The rate at which someone recalls ideas or events related or unrelated to the necessary judgment impacts their decision-making.

The last heuristic observed in the 1974 paper was the anchoring effect, which demonstrated that decisions are biased by a given initial value or a value determined by an incomplete calculation. Tversky and Kahneman observed that “people make estimates by starting from an initial value that is adjusted to yield the final answer” and the initial value used and the subsequent adjustments from that value may be suboptimal (Tversky & Kahneman, 1974, p.1128). The authors also reviewed the anchors that lead to over-

estimation and under-estimation and found that the cause for “unwarranted optimism” that a project would succeed or be completed on time was based on over-estimation of the probability of conjunctive events (Tversky & Kahneman, 1974, p.1128).

The anchoring effect also explains how irrelevant or intentionally placed anchors weigh on the decisions people make. An example of this is the manufacturer’s suggested retail price (MSRP) on a vehicle, which a car salesperson uses to negotiate the price of a new car sale. The MSRP is introduced by the salesperson to the customer to anchor the customer on the salesperson’s preferred price. Negotiations then normally take place around that anchor, which is inflated to ensure that the salesperson and car dealership earn a profit over the price that was paid to the vehicle manufacturer.

In 1979, Tversky and Kahneman proposed prospect theory as an alternative to expected utility theory and explained systematic decision-making under risk (p. 263). The authors essentially argued that the certainty of the status quo was the reference point used when people decide whether to categorize an outcome as positive (gain) or negative (loss) (pp. 263–265). A person is considered risk averse if they prefer a certain prospect over a risky prospect, and the authors demonstrated that the framing of a choice impacted their decision (pp. 264–265). The authors then demonstrated that people overweight positive outcomes they believe to be certain relative to uncertain outcomes and describe this as the certainty effect (p. 265).

Negative outcomes are then introduced. The preference between negative outcomes is the same as the preference between positive outcomes, a pattern called the reflection effect (Kahneman & Tversky, 1979, p. 268). The important implication here is that risk averse behavior dominates in the positive domain, while risk seeking behavior dominates in the negative domain (p. 268). The next important concept is the value function, and the idea that “value should be treated as a function in two arguments: the asset position that serves as reference point, and the magnitude of the change (positive or negative) from that reference point” and that value is centered on changes in wealth, rather than a final state of wealth (p. 268). An example is someone holding \$100 in their wallet, and that amount of money being considered positively if it was an increase

from nothing, and negatively if it was a decrease from a higher amount, such as \$200 or \$1,000.

The abstract value of wealth then depends on a reference point, which is seen through a positive or negative frame depending on the change from the reference point. Figure 1 shows that the value function in prospect theory is “concave for gains and convex for losses,” and “steeper for losses than for gains” (Kahneman & Tversky, 1979, p. 279). This value function helps explain why people prefer the status quo as opposed to taking a risk. Kahneman and Tversky further evaluated decision-making under risk and riskless conditions and in 1984 labeled the effect loss aversion, illustrating why people would rather bet on a possible loss than take a sure loss, and why the pleasure of gaining \$10 is felt less than the pain of losing \$10 (Kahneman & Tversky, 1984, p. 342).

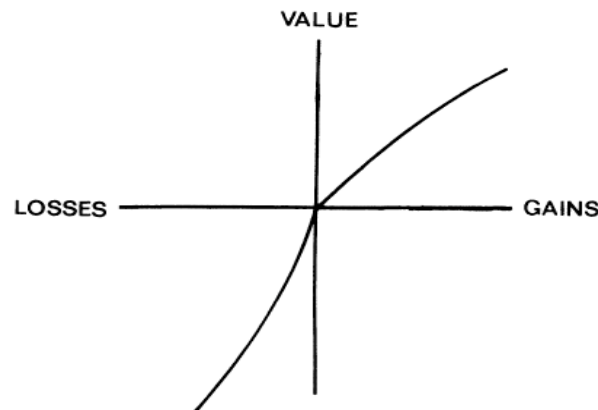


Figure 1. Prospect theory’s hypothetical value function. Source: Kahneman and Tversky (1979).

Prospect theory suggests that people are risk averse when they are comfortable or happy with the status quo, and when they fear a large loss; they are risk seeking when they are uncomfortable with the status quo and want to recoup a loss or there is a high probability of a significant loss. How well decision-makers understand their current situation, or the reference point they are using to measure gains and losses, also matters, as well as how a choice is framed, as framing the choice through the lens of a gain or a loss impacts decision-making (Kahneman & Tversky, 1984, p. 343). People can

manipulate the frame that a decision-maker uses when viewing a problem, and manipulation can take place subconsciously or as a conscious effort to bias the outcome. The person framing the decision might be in a marketing department, a newsroom, political advocacy firm, or part of a warfighting community acting as a resource sponsor within the Pentagon. Thus, the theory's application ranges from everyday consumer behavior to resource decisions within the Department of the Navy.

People can fail to see the similarities between two options and have inconsistent choices when the same choice is presented in different forms, something called the isolation effect (Kahneman & Tversky, 1979, p. 271). The wording of choices could be "lives saved" or "lives lost" for a public health decision, something called the formulation effect, whereby people then view the choice as a gain or loss (Kahneman & Tversky, 1984, p. 346). Replace the word "lives" with "jobs" and one may see the impact of framing on economic policy in addition to public health policy.

While Kahneman and Tversky had a background in psychology, another prominent thinker in behavioral economics is economist Richard Thaler. Thaler collaborated with psychologists and developed another important concept. Thaler noted that all expenses or costs are opportunity costs, as the decision to purchase one thing with \$10 represents the inability to spend that same \$10 on something else. Thaler's argument was that "opportunity costs should be treated as equivalent to out-of-pocket costs" and that "if out-of-pocket costs are viewed as losses and opportunity costs are viewed as foregone gains, the former will be more heavily weighted" (Thaler, 1980, p.44). Thaler referred to the undervaluing of opportunity costs as the endowment effect because removing a good from an endowment "creates a loss while adding the same good (to an endowment without it) generates a gain" (Thaler, 1980, p.44).

Thaler also explored consumer behavior and found that while economic theory suggested that historical costs should not matter in current decisions, they in fact do matter (Thaler, 1980, p.47). While "only incremental costs and benefits should affect decisions," "paying for a good or service will increase the rate at which the good will be utilized" (Thaler, 1980, p.47). The sunk cost effect then explains why people who purchased nonrefundable tickets to an event would travel through dangerous weather to

attend the event, or why someone who paid a yearly membership fee to a gym would continue to go even if injured. In both cases the people were trying to recoup a sunk cost. Is it rational to risk your health by driving through dangerous weather to attend an event? Thaler would say that the obvious answer is no, although others might justify the decision to attend by rationalizing that the weather was not dangerous, or that even if it was, that their experience driving in hazardous conditions validates their decision to drive in a storm.

The academic literature on behavioral economics significantly contributes to the economic decision debate as it helps organizations understand their current situation and frame problems. Economic models are useful predictors of future activity and useful in explaining current market forces. The rational behavior assumed in past economic models continues to be challenged through scientific studies by social scientists including psychologists and economists. Understanding the predictability of human nature allows economists to improve their models and provides tools to organizations for critiquing past decisions and improve the quality of future decisions.

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## IV. FINDINGS AND ANALYSIS

If we assume then that imperfect men and women make the best decisions based on the information available to them, then it is important to identify the major decision-making flaws related to littoral combat ship acquisition. Naval Officers grow up observing and adjusting to the cultural norms that exist within the fleet, and further adjust to military acquisition norms and senior leader guidance that shape their decision-making. Navy senior civilian decision-makers have a diverse background by contrast, as they may have served in the past in the military or as a government civilian, have experience in the defense industry, or may be a political appointee.

One cognitive bias exhibited between the U.S. Congress and Department of Defense (DOD) in naval acquisition is the anchoring effect. Congress has required the DOD to submit a 30-year shipbuilding plan when they submit their annual budget request for the past twenty years (Future Force Structure, 2020). The number of ships the Navy publicly plans to procure acts as cognitive anchor that influences behavior during annual Congressional budget discussions (Seligman et al., 2022). This reporting requirement is important because it is Congress that appropriates the money for the Navy's shipbuilding program, and changing ship acquisition goals may go against the model of stable jobs both within the DIB and congressional districts. The Navy's current goal of 373 ships is part of the Chief of Naval Operations Navigation Plan 2022 that includes unclassified numbers from Force Design 2045 (Congressional Budget Office, 2022).

Aspirational shipbuilding goals act as a cognitive anchor that may negatively impact decision-making. The battle force fleet ship count is the total number of warships capable of combat operations or that directly contribute to Navy warfighting and support missions (NAVSEA Shipbuilding Support Office, n.d.). The battle force fleet comprised over 520 ships in 1991 and has remained under 310 ships since 2003 (Naval History and Heritage Command, 2017). The Navy's battle force fleet goals shifted from 308 ships in 2014 to 355 ships in 2016 (Tangredi, p.149, 2019). The battle force fleet anchor drives behavior to acquire ships that can be counted as part of the battle force and contributed to the decision to buy cheaper littoral combat ships instead of more expensive cruisers,

destroyers, and frigates. The annual discussions between the Navy, OSD, and Congressional committees are anchored on the battle force fleet number whether or not that is the Navy's preferred or more importantly optimal metric.

The Navy has been incentivized to procure against the battle force fleet goal of 355 manned ships rather than a combination of manned and unmanned platforms. The Navy is incentivized to do this because of the anchor in place, as it is hard to argue for funding for unmanned platforms without programming funding towards the battle force fleet that until recently did not include unmanned systems. The shipbuilding plan does not have a requirement to include unmanned vessels. Another challenge is that while the 30-year shipbuilding plan is submitted annually, navy ship programming cannot reflect achieving the goal during an annual POM cycle as the POM only goes out five years. This is a small limitation but becomes an issue when one hears about a 355-ship goal, yet for example only sees funds programmed to achieve 310 ships in the POM.

The logical question from Congress then centers around when will the shipbuilding goal be achieved, or why the Navy cannot build to the goal within the POM cycle. Another limitation is industry's ability to ramp up production even if it was given the full funding to do so (O'Rourke, 2023, p. 33). There are a limited number of yards capable of building these ships, and they require workers with extensive training and knowledge to build billion-dollar destroyers, frigates, submarines, and aircraft carriers. The Navy's four public shipyards maintain nuclear powered submarines and aircraft carriers, while the DIB builds the Navy's ships and maintains the non-nuclear fleet (Naval Sea Systems Command, n.d.). To summarize, the battle fleet ship cognitive anchor oversimplifies the analysis to arrive at that number; minimizes discussions on quality, operational use, threat environment, and survivability; and overemphasizes manned ships over unmanned systems.

The Navy's conversation with Congress seems to always come back to the future ship count, and whether or not the proposed budget demonstrates the ability to achieve that ship count. The Congress itself does not have a unanimous voice on this issue, further complicating matters. The Subcommittee on Oversight and Investigations within the House Armed Services Committee (HASC) held a hearing on the LCS program on

December 8, 2016, during the transition from the Obama to the Trump Administration. In that hearing it was apparent that the Navy was continuing to pursue the full LCS program despite Congressional criticism and the Secretary of Defense directing a cut to the program from 52 ships to 40 ships in December 2015 (*Oversight Review*, 2016).

The anchoring effect is not limited to the battle force fleet number as it exists within program executive officer offices and service internal POM build discussions. The Navy and Air Force buy expensive platforms that they then provide to sailors and airmen to service and operate. The number of platforms anchor is not unique to the LCS program but serves as an illustration for this effect within the services. The number of platforms is not an abstract number, but rather has implications for operational use within the combatant commands, command opportunities within the service, basing implications, operations and maintenance funding, and costs associated with military personnel pay. The LCS is capable of low threat presence missions across the globe and was meant to reduce the burden of presence missions that were increasingly assigned to destroyers and cruisers which were more expensive to maintain and were better used in ballistic missile defense and other missions elsewhere. The Navy's anchor for the program changed over the years from 27–28 of each variant (56–58 ships), Freedom and Independence, down to a total of 52 ships within the class (Freedberg, 2012).

The endowment effect impacts warfighting community behavior as it explains the drive to fight to keep a program alive or maintain a level of the funding. The pain of losing funding elicits a stronger response than the response associated with gaining the same amount of funding. If something is taken away from a warfighting community or otherwise reduce a program's funding, then program sponsors may fight harder to keep it, even if it lacks funding, does not meet expectations, or there is a change in priorities. The LCS program was part of the overall ship count discussion with Congress and served as an internal friction point between the Navy and OSD. The number 52 became the anchor between the Navy and OSD when arguing for the LCS program, with Secretary of Defense Carter stating that only 40 were needed based on the Navy's own warfighting analysis (Freedberg, 2015). This episode highlights other related behavioral economics concepts called prospect theory and loss aversion.

Risk aversion and loss aversion are other cognitive biases reflected in the LCS program. The sure losses associated with decommissioning ships frame the shipbuilding decision as one between a sure loss and a possible loss. This drives risk seeking behavior per Prospect Theory, as people would rather gamble on a possible loss than take a sure loss. In this scenario the sure loss is not replacing the ship, while the possible loss is replacing the ship with a new ship that may or may not meet cost, schedule, and performance requirements. In the case of the LCS, not only the ship but the mission modules concept was risk seeking as opposed to risk averse. Risk aversion helped drive the decision to continue purchasing the LCS as the DDG-1000 proved too costly and the CG(X) did not materialize as envisioned in the 2001 DD-21 *Strategy* (O'Rourke, 2019).

The sunk-cost fallacy influenced the decision to continue to buy the LCS even though it did not meet cost, schedule, or performance requirements at different times during its evolution from a concept to two different ship types. The sunk-cost fallacy influenced Congressional and Navy leaders to not change the procurement strategy for three reasons. The DIB was heavily invested in it, the Congress had already appropriated billions of taxpayer dollars, and the Navy simply needed ships even though program termination clearly should have been a viable option, even as the LCS was the least expensive option compared to frigates, destroyers, and cruisers. The Navy had already invested billions of dollars into the program when it became evident that the mission modules were not meeting performance requirements. While it was a programmatic decision at the outset to buy the ships first and the mission modules later, the Navy had a hard time balancing the Congressional need to keep the shipyards employed building a ship that could not function as designed without the necessary mission modules (O'Rourke, 2019).

## V. RECOMMENDATIONS

The Navy can apply the lessons learned from the twenty-year LCS acquisition history to other acquisition programs including the new Constellation-class frigate, Columbia class submarine, and the Next-Generation Guided-Missile Destroyer program. The LCS program provides lessons for the naval surface warfare community, Department of the Navy, DoD acquisition community, and Congress. It is important to remember the program because its story from its inception as a competition of ideas in the 1990s to a seemingly economical program in the early 2000s in a DOD that was encouraged to think differently; to a troubled acquisition program whose twists and turns are better chronicled in numerous newspaper articles, GAO reports, and congressional hearings. Recommendations for leaders are based on the concepts of the anchoring effect, loss aversion, and the sunk-cost fallacy.

The Navy can reassess the shipbuilding count and battle fleet force ship count anchors and either abandon the metrics or utilize two numbers for each: a minimum number and an optimal number. These numbers could be assessed between the Joint Staff, Office of the Secretary of Defense, and the Department of the Navy to ensure consistent messaging with Congress. Arguably no one has benefitted from keeping an aspirational shipbuilding number when the Navy's budget does not demonstrate a way to attain that number. The Navy would have to accept higher risk in readiness or within other warfighting communities to meet the envisioned surface fleet requirement. The minimum number could reflect the current amount needed to meet the unclassified *National Defense Strategy*, while the optimal number could be classified to reflect the total number of ships needed to meet the *National Military Strategy* or Combatant Command Operational Plan requirements. Just as the Navy has modified its goals in recent years to include unmanned surface and subsurface vessels, the Navy can modify how it messages the public.

Another valid question to ask is whether the ship count is the right metric for the Department of Defense or Congress to use when evaluating the Department of the Navy's budget request. Would the Congress allow DOD to use a non-numerical qualitative

capability measurement? It can be argued that Congressional concerns both for the DIB and for national defense would not be met. How would the DOD justify how many ships it needs if it did not use a numerical value? The Navy could justify each purchase based on current operational requirements or base it on end of service life dates for ships slated for retirement.

The Navy should also deal with loss aversion to prevent the same mistakes associated with the decision to purchase the LCS. Imagine ships all tagged with an end of useful life (EUL) year on the side. These EUL dates represent sure losses as they are dates when the Navy can no longer economically operate the vessel. It is important to remember that EUL dates are flexible, as the Navy's service life extension program (SLEP) is a means to extend the EUL for years. Although vessels in SLEP are associated with higher operations and maintenance costs than newer vessels, the costs associated with SLEP are cheaper than refurbishing a ship from the Reserve Fleet that has not been used in years.

The Navy should acknowledge the sunk-cost fallacy by ensuring that a program abandonment option remains on the table throughout the acquisition lifecycle. This can be done by having the program sponsor or warfighting community sponsor brief the abandonment option when they request additional funding for a program. The basic question should be: If we killed this program, what risks would be presented to Combatant Commanders and what risk would be presented to the DIB? The follow-up question would be: What actions can the Navy take to mitigate that risk? This is laborious work, but if done could help inform SECNAV decision-making. It is important to remember that program abandonment represents both loss and opportunity, as the funding can be moved to higher priorities. New leadership should not accept that the sunk costs associated with a program prior to their arrival reflect their agreement or should ensure the program's continuation. Could the decisions of the past N-8, CNO, CJCS, and SECNAV to acquire the LCS and continue to procure the LCS despite its challenges act as sunk costs? Yes. Should they matter? No.

The Navy can incorporate one or more of the behavioral economics theory related recommendations in the upcoming POM cycle. Another way to influence warfighting

community leadership behavior is through education prior to the POM build. Richard Thaler's book *Nudge* gives many anecdotes of means to influence people's choices and is grounded in behavioral economics. One example would be to review troubled and successful acquisition programs prior to the POM build in a group setting with the CNO or SECNAV present.

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