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# Cognitive Biases and Decision Making: A Literature Review and Discussion of Implications for the US Army

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## White Paper

Human Dimension Capabilities Development Task Force  
Capabilities Development Integration Directorate  
Mission Command Center of Excellence (MC CoE)

## Executive Summary

As the US Army's strategic and operating environment becomes more diffuse and unpredictable, military professionals will increasingly be expected to make critical decisions under conditions of uncertainty. Research suggests that under such circumstances people are more susceptible to make predictable errors in judgment caused by cognitive biases. In order for the US Army to retain overmatch and remain adaptive and effective amid the complex and ambiguous environment of the future it will be critical to more fully understand cognitive biases and to train, educate and develop US Army personnel and institutions to cope with them appropriately.

This paper discusses research on cognitive biases and draws conclusions and recommendations relevant to reducing these biases and improving decision making in the Army. The purposes of the research are to 1) describe key concepts that form the foundation of the heuristics and biases literature, 2) identify attempts to develop theories and models to mitigate biases, 3) identify initiatives implemented by the US Army to address cognitive biases or, more generally, to improve decision making, 4) provide a platform to begin linking research on cognitive biases to the success of the US Army for Force 2025 and Beyond, and 5) suggest avenues for the US Army to pursue to address this issue, including courses of action and topics of future research.

Descriptive theories of decision making acknowledge that there are finite bounds to human cognition that frequently result in irrational decisions. Among these theories is the heuristics and biases approach, which argues that people rely on cognitive shortcuts (heuristics) to make decisions under conditions of uncertainty. Because these heuristics generalize situations and allow people to make quick decisions despite time constraints or imperfect information, they often result in predictable errors in judgment (cognitive biases). The lens provided by heuristics and biases helps to better articulate and understand the wide array of variables that influence decision making. This is critical for the US Army's interest in improving the decision making expertise of its members amid conditions of uncertainty and ambiguity. A more robust understanding of the factors that influence decision making can be used as a fulcrum by the US Army to develop tools to improve individual and organizational decision making and help identify, develop and promote personnel who are able to make good decisions. Despite the vast body of research that has developed the heuristics and biases paradigm, there is relatively little consensus on effective methods to mitigate biases and improve decisions.

The Army has addressed decision making in a number of different ways. One is by describing and defining good decision making in US Army manuals, directives and publications. Among these documents, however, there remains little clarity or consistency in the definitions. Without a clear definition of "good" decision making, the success (or failure) of any tools, methods, concepts, or theories that the US Army may attempt to implement to improve decision making will be impossible to measure. The Army has also integrated decision making into many of its education and training initiatives; however, with a few exceptions, there is little specific mention of the influence of cognitive biases in these tools. Finally, the US Army, specifically the US Army Research Institute for the Behavioral and Social Sciences (ARI), has a

rich history of research on decision making and cognitive biases. Despite this robust research, however, it remains unclear to what degree these efforts been institutionalized throughout the Army to mitigate biases and improve decision making among military personnel.

To address cognitive biases and improve decision making in the US Army, the Human Dimension Capabilities Development Task Force (HDCDTF) recommends:

- 1) Convening a decision making workshop to
  - a. Develop a standardized and scalable definition of good decision making that can be incorporated throughout the Army,
  - b. Develop potential methods and tools for effectively assessing decision making among Army professionals, and
  - c. Distinguish the decision making skills, including cognitive biases and heuristics, that are innate (nature) to some people and those that are developed or learned (nurture) over time. This will facilitate better screening and assessment of Army personnel and guide how to develop those decision making skills that might be considered a kind of learned expertise.

The HDCDTF recommends that interested, relevant and expert personnel from CAL, ARI, ARL, ARIC, MCTP, and MCBL should be invited to the workshop. The HD community should also consider reaching out to external experts from academia, private industry institutions, government agencies and institutions (RAND, for instance), and other military branches to include in the workshop in order to get the broadest perspective possible on the subject.

- 2) Incorporating UFMCS decision making, cognitive bias and heuristics curriculum into School for Command Preparation education.

The Army should take advantage of the expertise and curriculum concerning intuitive decision making, cognitive biases and heuristics that UFMCS has already established. One possible solution is to add an additional module for students at the School for Command Preparation (SCP) that allows them to take advantage of the curriculum provided by UFMCS, which is co-located with SCP at Fort Leavenworth, KS. A second option would be for the SCP to work with UFMCS in order to incorporate their training expertise on decision making, cognitive biases and heuristics to develop a module or course specifically designed for students at SCP.

- 3) Considering implementing the ShadowBox method throughout US Army training and education institutions to increase expertise in decision making.

The ShadowBox method develops students' expertise (in any number of cognitive skills, including decision making) by allowing them to "shadow" the techniques of experts. Similar to the UFMCS recommendation above, this technique relies on developing decision making

expertise (including, for instance, becoming aware of cognitive biases) by learning from experts. The advantage of the ShadowBox model is that it does not rely on experts to be present to facilitate the training. Also, once the training module is developed and the responses provided by the experts are collected, it would be easy to expand at a number of institutions throughout the Army. While the approach may have some limitations, it would be relatively easy to implement on a large scale throughout the Army.

- 4) Considering moving forward with the research study proposed by Analysis First LLC titled "Increased Working Memory Capacity to Decrease Cognitive Load"

This study aims to 1) identify the degree to which an individual's working memory capacity can be enhanced through computer-based training, and 2) identify the degree to which an increase in computer-based working memory capacity will result in enhanced cognitive performance in "real-life" military tasks. The study design suggests that it may be possible to improve decision making through specialized training to increase working memory capacity. Once approved, the initiative could be operational within 2-3 months.

- 5) Conducting additional research to more thoroughly canvass the available decision making and cognitive bias literature. This includes identifying additional institutions and scholars that are conducting relevant research on cognitive biases and decision making that may be applicable to the US Army. The field is rich with real world anecdotes and ever-evolving theoretical insight. The scope of the current study necessitated a rather cursory overview of the field's highlights. A more nuanced study and understanding is necessary to fully consider the impact of cognitive biases and good decision making on large institutions such as the US Army. This is particularly true when considering how to develop practical tools to improve decision making (through debiasing or other methods) and allowing practitioners to effectively assess decision making. Furthermore, the HDCDTF recommends that the HD community continue to reach out to relevant elements throughout the US Army to catalogue important on-going initiatives that deal, either directly or indirectly, with cognitive biases and decision making that may be appropriate to expand upon or at least inform other initiatives.

## Introduction

Decision making at all levels is critical to the success of the US Army. As the strategic and operational environment is increasingly characterized by ambiguity and complexity, military professionals are faced with an increasing variety of responsibilities.<sup>1,2</sup> This emerging situation presents new challenges to decision makers at all levels within the US Army. As the quantity and variety of available information becomes more abundant, military professionals will be expected to make critical decisions under conditions of uncertainty.<sup>3</sup> Research from the fields of cognitive psychology and behavioral economics tells us that under constrained conditions—time limitations, over-abundance of information, unfamiliar dynamics—people are more prone to make errors in judgment caused by cognitive biases.<sup>4,5</sup> As such, it will be critical for the Army to train, educate and develop its personnel to understand and cope with these cognitive biases appropriately. The consequences of not doing anything—that is, of making poor decisions—in the current and future operating environment are amplified due to expanding media and communication networks and increasingly sophisticated use by more and more people.<sup>6,7</sup> In order for the military to retain overmatch and remain adaptive amid the unpredictable conditions of the future, its leaders will need to be able to negotiate complex circumstances and make effective and meaningful decisions.<sup>8</sup> Just as the military commits substantial resources to develop appropriate new technologies to counteract emerging threats, it will be critical over the coming years for the US Army to invest time, money and talent to more clearly understand how individuals make decisions, what factors and dynamics influence these decisions, and how the military can foster better and more agile decision making among its Soldiers and leaders so that they are able to operate effectively in this new environment.<sup>9</sup>

## Purpose and Organization of Paper

This paper discusses research conducted on heuristics and cognitive biases. It draws conclusions and recommendations relevant to reducing these biases and improving decision making in the Army. The Human Dimension Capabilities Development Task Force (HDCDTF) reviews relevant academic, private-sector and government literature focusing on cognitive biases and their influence on decision making, specifically in ambiguous and complex situations.

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<sup>1</sup> Department of the Army, *The U.S. Army Human Dimension Concept*, TRADOC Pam 525-3-7, May 21, 2014, 7.

<sup>2</sup> United States Army Combined Arms Center, “The Human Dimension White Paper: A Framework for Optimizing Human Performance,” October 9, 2014, 7

<sup>3</sup> Army Capabilities Integration Center (ARCIC), “Army Vision – Force 2025 White Paper,” January 23, 2014, 6.

<sup>4</sup> Amos Tversky and Daniel Kahneman, “Judgment Under Uncertainty: Heuristics and Biases,” *Science* 185, no. 4157 (1974): 1124.

<sup>5</sup> David Arnott, “Cognitive Biases and Decision Support Systems Development: A Design Science Approach,” *Information Systems Journal* 16 (2006): 59.

<sup>6</sup> Department of the Army, *The U.S. Army Human Dimension Concept*, 7.

<sup>7</sup> United States Army Combined Arms Center, “The Human Dimension White Paper,” 9.

<sup>8</sup> Department of the Army, *The U.S. Army Operating Concept: Win In a Complex World*, TRADOC Pamphlet 525-3-1. October 31, 2014, 39.

<sup>9</sup> United States Army Combined Arms Center, “The Human Dimension White Paper,” 7.

The purpose of the research is to 1) describe key concepts that form the foundation of the heuristics and biases literature, 2) identify attempts to develop theories and models to mitigate biases, 3) identify initiatives implemented by the US Army to address cognitive biases or, more generally, to improve decision making, 4) provide a platform to begin linking research on cognitive biases to the success of the US Army for Force 2025 and Beyond, and 5) suggest topics for further research and discussion to assist the US Army in addressing this issue.

This research addresses specific learning demands articulated by the Force 2025 HDCDTF and culled from Army Warfighting Challenge #9. The first asks, “How can the Army best accelerate the learning, experience, training, and education of Soldiers, leaders and teams to develop the technical, tactical, social, and cultural skills and knowledge necessary to support unified land operations.”<sup>10</sup> The relevant elements of analysis for studying cognitive biases for this learning demand include identifying and elucidating the technical, tactical, social, and cultural skills and knowledge that are necessary to conduct unified land operations. The next learning demand asks, “How can the Army best build ethical, creative and critical thinking leaders at all echelons with refined problem solving skills and the knowledge to understand political, military, economic, social, information, infrastructure, physical environment, and time (PMESII-PT) variables and who effectively lead, train and mentor their subordinates.”<sup>11</sup> Here, the specific elements of analysis relevant to cognitive biases includes identifying 1) the methods effective for the refinement of problem solving, 2) what the Army requires to develop strategic thinkers with highly refined problem solving skills that are intellectually agile enough to adapt to conditions, tactics, and methods of conflict that may be impossible to accurately predict, and 3) how the Army can develop agile, adaptive, and innovative leaders who thrive in conditions of uncertainty and chaos, are skilled in applying the principles of mission command, can expertly employ operational art and the operations process and are capable of visualizing, describing, directing, leading, and assessing operations in complex environment and against adaptive enemies.

It is important to note that the literature review, the examination of Army initiatives addressing cognitive biases and decision making, and the recommendations for next steps are not comprehensive due to time constraints, the wealth of relevant academic literature, and the extensive work the US Army has conducted to improve decision making. This paper provides a review of the key concepts of heuristics and biases, discusses how these are relevant to decision making in the US Army, and identifies examples of how the US Army is addressing them. Most importantly, it is intended to stimulate discussion of the issue and nurture a more sustained exploration of how the US Army can enhance operational effectiveness through improving decision making among its Soldiers and leaders.

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<sup>10</sup> Human Dimension Capabilities Development Task Force, *Army Warfighting Challenges, Gaps, and Learning Demands*, 2014.

<sup>11</sup> Ibid.

## Situation/Environment

Military operations are inherently steeped in uncertainty. This is perhaps best and most famously captured by the Prussian military analyst Carl von Clausewitz's phrase "the fog of war," used to describe the natural ambiguity of the operational environment in the early 19<sup>th</sup> Century.<sup>12</sup> The complexity and ambiguity of the contemporary operational environment is not remarkably different in nature but rather only in intensity and variety from the one Clausewitz described nearly two hundred years ago. As noted above, it is an environment increasingly characterized by a multiplicity of threats that are unpredictable, diffuse and uncertain.<sup>13,14,15</sup> While they vary in detail, forecasts of the future agree in general terms that threats over the coming years will continue to increase in complexity and resemble less the familiar dualism of past conflicts and more the protracted, multi-polar and networked conflicts that have occupied the US more recently.<sup>16,17</sup> Population growth, particularly in urban areas, competition for diminishing natural resources, the effects of climate change, deepening economic divides between and within states, rapid development and distribution of communication and transportation technologies, and distinct ideological cleavages between cultures all contribute to this unpredictable environment.<sup>18,19,20</sup> Furthermore, the US now faces a broad range of threat actors. This includes (re)emerging states that have interests, typically ideological and/or economic in nature, that conflict with those of the US, as well as a wide array of amorphous non-state actors, such as violent extremist organizations and transnational criminal networks.<sup>21,22</sup>

In order to effectively anticipate and engage these new threats, the military will need to adapt accordingly. While much of the focus of this transformation will necessarily be on materiel and technological solutions to specific new threats and vulnerabilities, the US Army remains an organization comprised of and administered by people. Like every organization of people, it is one that depends entirely on the decisions that its members make. As such, in order to more comprehensively address the changes in the operational environment that the US Army anticipates, it will be necessary for military leaders to develop increased mental agility and

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<sup>12</sup> Alan Beyerchen, "Clausewitz, Nonlinearity, and the Unpredictability of War," *International Security* 17, no. 3 (Winter 1992-1993): 77.

<sup>13</sup> Department of the Army, *The U.S. Army Operating Concept: Win In a Complex World*, 10.

<sup>14</sup> United States Army Combined Arms Center, "The Human Dimension White Paper," 6-7.

<sup>15</sup> Secretary of the US Army and the United States Army Chief of Staff, "Army Strategic Planning Guidance, 2014," 2014, 1.

<sup>16</sup> National Intelligence Council, "Global Trends 2030: Alternative Worlds," Office of the Director of National Intelligence, December 2012, accessed December 4, 2014,

<http://globaltrends2030.files.wordpress.com/2012/11/global-trends-2030-november2012.pdf>

<sup>17</sup> Department of the Army, *The U.S. Army Operating Concept: Win In a Complex World*, 10-15.

<sup>18</sup> Ibid.

<sup>19</sup> Ibid., 12

<sup>20</sup> United States Army Combined Arms Center, "The Human Dimension White Paper," 7-10.

<sup>21</sup> Ibid., 6-7.

<sup>22</sup> Department of the Army, *The U.S. Army Operating Concept: Win In a Complex World*, 10.

embrace a refined variety of decision making.<sup>23,24,25,26</sup> This new environment will require that people process large amounts of information quickly, think critically about their options, and make good decisions accordingly.<sup>27</sup>

A major consideration to understanding what influences decision making in uncertain conditions relies heavily on research conducted over the past forty years in the fields of cognitive psychology and behavioral economics. This research unpacks the idea that people often rely on “heuristics” (typically paraphrased as a kind of “rule of thumb”) that help us cope with unfamiliar situations by reducing their complexity in order to negotiate their circumstances or make decisions more efficiently.<sup>28</sup> These heuristics, because they simplify circumstances in order to facilitate decision making, can lead to cognitive biases that unconsciously influence our decisions.<sup>29</sup> Cognitive biases can be thought of as deviations in judgment that lead to a subjective reality that may result in what an objective observer may consider illogical decision making. Research suggests that the consequences of intuitive decision making, and therefore of relying on heuristics and succumbing to cognitive biases, becomes more prevalent in situations of greater complexity or uncertainty.<sup>30</sup> Considering the future environment that the US Army anticipates as explained above—one characterized by an abundance of information, complexity and ambiguity—this insight into the nature of human decision making has important implications for the US Army, its mission and the decisions military professionals make. This study provides insight into the existing research on decision making in general and, more specifically, cognitive biases, that may inform US Army efforts to prepare its Soldiers and leaders for the environment of the future.

### **Implications of Heuristics and Biases for the US Army**

The nature of human decision making is intensely complex. There is a vigorous, on-going debate among scholars about the fundamental character of the cognitive processes that influence and determine our intuitive judgment.<sup>31,32,33</sup> More importantly, there is a distinct lack of consensus

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<sup>23</sup> Department of the Army, *The U.S. Army Operating Concept: Win In a Complex World*, 18.

<sup>24</sup> Department of the Army, *The U.S. Army Human Dimension Concept*, 11-13.

<sup>25</sup> Volker Franke, “Decision-Making under Uncertainty: Using Case Studies for Teaching Strategy in Complex Environments,” *Journal of Military and Strategic Studies* 13, no. 2 (Winter 2011): 2.

<sup>26</sup> Lieutenant Colonel Kelly A. Wolgast, “Command Decision-Making: Experience Counts,” US Army War College Research Project, March 2005, 1.

<sup>27</sup> Department of the Army, *The U.S. Army Operating Concept: Win In a Complex World*, 18.

<sup>28</sup> Tversky and Kahneman, “Judgment Under Uncertainty,” 1124.

<sup>29</sup> Gerd Gigerenzer, “How to Make Cognitive Illusions Disappear: Beyond ‘Heuristics and Biases,’” *European Review of Social Psychology* 2 (1991): 2.

<sup>30</sup> University of Foreign Military and Cultural Studies, *Red Teaming Handbook, 7.0 (Draft)*, October 2015, 79.

<sup>31</sup> Ibid.

<sup>32</sup> Gerd Gigerenzer, “Fast and Frugal Heuristics: The Tools of Bounded Rationality,” in *Blackwell Handbook of Judgment and Decision Making*, ed. Derek J. Koehler and Nigel Harvey (Oxford, UK: Blackwell Publishing Ltd, 2007): 64.

<sup>33</sup> Committee on Improving the Decision Making Abilities of Small Unit Leaders, Naval Studies Board, Division of Engineering and Physical Sciences, National Research Council, *Improving the Decision Making Abilities of Small Unit*



about how best to approach and frame relevant investigations into these processes. These debates indicate that the vast majority of decisions made by people are intuitive in nature. Indeed, it is a rule of thumb among cognitive psychologists that people spend about 95 percent of our time in the intuitive mode.<sup>34</sup> While an all-encompassing theory of human decision making remains impractical, the lens provided by heuristics and biases contributes significantly towards better understanding the wide array of variables that influence decision making and lead to potential errors in judgment.<sup>35</sup> This is critical for any organization interested in improving the decision making of its members. Certainly the US Army is no different, with similar interests in optimizing decision making amid conditions of uncertainty, ambiguity and more austere budget requirements.

A more robust understanding of the factors that influence sound decision making can be used as a fulcrum by the US Army to develop tools to improve individual and organizational decision making and help identify, develop and promote personnel who are able to make good decisions. This will be particularly important as the operating environment increases in complexity. In this environment, effective execution of mission command will become more critical as leaders are expected to increasingly rely on intuitive decisions.<sup>36,37</sup> Finally, the consequences of those decisions become more profound and open to public debate and criticism due to ever-more sophisticated and available modes of communication.<sup>38</sup> With this in mind, it is clear that a better understanding of heuristics and biases, and decision making more generally, has important implications for the US Army of the future. As a recent publication by the National Research Council suggests, a better understanding of heuristics and biases could be leveraged to improve personnel performance in the Army and, ultimately, the effectiveness of the Army itself.<sup>39</sup> For instance, institutionalizing heuristics and biases as a consideration throughout the Army could assist in modifying job design and descriptions to account for these cognitive processes. Alternatively, a more robust and extensive understanding of heuristics and biases could be used to help better assess Soldiers and leaders in order to find more optimal matches between tasks and personnel. In each of these cases, institutional and individual decision making can be improved through an appreciation of heuristics and biases.

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*Leaders* (Washington DC: The National Academies Press, 2012), 50-51, accessed December 4, 2014, [http://www.mccdc.marines.mil/Portals/172/Docs/SWCIWID/COIN/Small%20Unit%20Leadership/Improving%20Decisionmaking%20in%20Small%20Unit%20Leader's%20Nat'l%20Academy%20of%20Science%20\(2012\).pdf](http://www.mccdc.marines.mil/Portals/172/Docs/SWCIWID/COIN/Small%20Unit%20Leadership/Improving%20Decisionmaking%20in%20Small%20Unit%20Leader's%20Nat'l%20Academy%20of%20Science%20(2012).pdf)

<sup>34</sup> Pat Croskerry, Geeta Singhal, and Silvia Mamede, "Cognitive Debiasing 1: Origins of Bias and Theory of Debiasing," *BMJ Quality and Safety* 22 (2013): ii58.

<sup>35</sup> Committee on Improving the Decision Making Abilities of Small Unit Leaders, *Improving the Decision Making Abilities of Small Unit Leaders*, 50.

<sup>36</sup> Army Capabilities Integration Center (ARCIC), "Army Vision – Force 2025 White Paper," 4.

<sup>37</sup> General Martin E. Dempsey, "Mission Command White Paper," April 3, 2012, 3-4.

<sup>38</sup> United States Army Combined Arms Center, "The Human Dimension White Paper," 9.

<sup>39</sup> Committee on Improving the Decision Making Abilities of Small Unit Leaders, *Improving the Decision Making Abilities of Small Unit Leaders*, 63.

## Mission Command & Decision Making

The key institutional touch-point for evaluating any new consideration to improve decision making within the Army begins with mission command. Mission command is defined as “the exercise of authority and direction by the commander using mission orders to enable disciplined initiative with the commander’s intent to empower agile and adaptive leaders in the conduct of unified land operations.”<sup>40</sup> In short, a commander’s intent is communicated to their subordinate(s), who are empowered and entrusted to achieve those ends by means that they best see fit. Commanders are expected to blend intuitive and analytic decision making approaches to make “timely and effective decisions”.<sup>41</sup> Mission command is not a method of control; instead, it is a cultural philosophy that is based on trust among and between ranks in the US Army.<sup>42</sup> The relationship of trust that forms the foundation of mission command is perhaps most clearly manifest in the decisions that Soldiers and leaders are empowered and, indeed, demanded, to make. The framework of decentralization codified in mission command provides the US army and its military professionals with the latitude to remain flexible and adaptive in the face of complex emerging threats. Through mission command the Army empowers leaders at all levels to make quick decisions, often without the luxury of time to deliberate or seek approval from higher elements.

As the enemy has evolved since the end of the Cold War—as it has become more diffuse, decentralized, and complex—it has become increasingly apparent that to effectively combat these threats the capabilities and influence of US Soldiers and leaders must also become more decentralized.<sup>43</sup> The trend towards adaptive decentralization must necessarily include modifying our decision making to address emerging exigencies. Crucially, this evolution to improve decision making amid rapidly changing circumstances does not require developing a new philosophy of command. Rather, it requires appropriating the existing framework provided by mission command. Indeed, it is the flexibility and adaptability of mission command that anticipates these kinds of changes in the operational environment and provides the flexibility among Army leadership to adjust accordingly.

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<sup>40</sup> Department of the Army, *ADP 6-0: Mission Command*, 2012, 1-1.

<sup>41</sup> Ibid.

<sup>42</sup> Donald E. Vandergriff, “What Are the Basics? Developing for Mission Command,” *Law Enforcement and Security Consulting Blog*, May 21, 2014, accessed December 5, 2014, <http://www.lesc.net/blog/what-are-basics-developing-mission-command-donald-e-vandergriff>

<sup>43</sup> General Martin E. Dempsey, “Mission Command White Paper,” 3.

## Review of Decision Making

### Theories of Decision Making

In order to contextualize decision making in the US Army and discuss methods to improve it by addressing heuristics and cognitive biases, it is first necessary to review how decision making more generally is understood and theorized. Cognitive psychologists, behavioral economists, business analysts, and others have long tried to formulate and apply a variety of theories to model human decision making. The models and theories can generally be placed into two categories: 1) prescriptive (sometimes also called normative) and 2) descriptive.<sup>44, 45</sup> Each is discussed below.

### Prescriptive Theory

Prescriptive theories explore how people ought to make decisions. These theories typically assume ideal circumstances (availability of information, awareness of options, abundance of time to deliberate, and so forth) in order to model the best and most rational path a person can take in order to come to the most suitable decision. Prescriptive models are useful in highlighting how real-world decision making processes might be improved. However, they largely remain theoretical in nature, because people rarely, if ever, operate under the circumstances that such theories propose.<sup>46</sup> As such, prescriptive models are limited in their direct application to help improve real-world decision making.

Prescriptive Theory	Identifying features of each prescriptive theory <sup>47</sup>
<b>Subjective Expected Utility</b>	<ul style="list-style-type: none"><li>• Assumes that decision maker has a “utility function”</li><li>• Decision maker orders possible outcomes by subjective preference</li><li>• All choice alternatives are known to the decision maker</li><li>• Makes it possible to assign probabilities subjectively</li></ul>
<b>Economic Model</b>	<ul style="list-style-type: none"><li>• Equates human rational behavior with “instrumentalist” rationality</li><li>• Maximize utility from a stable set of preferences</li><li>• Accumulate an optimal amount of information and inputs before making a decision</li></ul>
<b>Rational Actor</b>	<ul style="list-style-type: none"><li>• Assumes that people desire more of a good rather than less of it</li><li>• Individuals choose the best action according to unchanging and stable preference functions and constraints</li><li>• These assumptions are often violated under real-world conditions</li></ul>
<b>Behavioral Decision Theory</b>	<ul style="list-style-type: none"><li>• Choices are described in terms of 1) options, 2) outcomes, 3) values, and 4) uncertainties</li></ul>

<sup>44</sup> Daniel Reisberg, *Cognition: Exploring the Science of the Mind* (Third Edition) (New York, NY: W.W. Norton & Company, Inc.): 469-471.

<sup>45</sup> Committee on Improving the Decision Making Abilities of Small Unit Leaders, *Improving the Decision Making Abilities of Small Unit Leaders*, 52.

<sup>46</sup> Peter M. Todd and Gerd Gigerenzer, “Précis of Simple Heuristics That Make Us Smart,” *Behavioral and Brain Sciences* 23 (2000): 728.

<sup>47</sup> Committee on Improving the Decision Making Abilities of Small Unit Leaders, *Improving the Decision Making Abilities of Small Unit Leaders*, 52-62.

	<ul style="list-style-type: none"> <li>• These elements are synthesized in decision rules that enable choice among options</li> <li>• Decision Theory helps clarify the structure of complex choices by identifying the best COAs in light of the values that a decision maker holds.</li> </ul>
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Table 1. Prescriptive theories of decision making.

## Descriptive Theory

In contrast to prescriptive theories, descriptive models of decision making are designed to *describe* how people actually make decisions under real-world circumstances, regardless of their rationality, elegance or efficacy. Rather than idealizing the conditions of the human decision making process, descriptive theories allow scholars to study and better understand the internal schema people use when making decisions, highlighting successes and challenges of the process along the way.

Descriptive Theory	Identifying features of each descriptive theory <sup>48</sup>
<b>Heuristics and Biases</b>	<ul style="list-style-type: none"> <li>• Heuristics are rules of thumb used to make decisions under conditions of uncertainty</li> <li>• Highly economical and usually effective</li> <li>• However, heuristics can lead to biases and predictable errors</li> </ul>
<b>Naturalistic Decision Making</b>	<ul style="list-style-type: none"> <li>• Seeks to understand human cognitive performance by studying how people and teams make decisions in the real world</li> <li>• Three major criteria: 1) focuses on expertise, 2) takes place in the field, and 3) reflects the conditions such as complexity and uncertainty that complicate our lives</li> <li>• Focused on the importance of intuition</li> </ul>
<b>Intuition</b>	<ul style="list-style-type: none"> <li>• Tacit knowledge or expertise that comes from experience</li> <li>• Relies on experience to recognize key patterns that indicate the dynamics of a situation</li> </ul>
<b>Recognition-Primed Decision Making</b>	<ul style="list-style-type: none"> <li>• Used by USMC in past</li> <li>• People use their experience in the form of a repertoire of patterns</li> <li>• Blends pattern-matching (intuition) and analysis</li> <li>• RPD used 80-90 percent of the time by fire ground commanders</li> </ul>
<b>Data-Frame Theory of Sensemaking</b>	<ul style="list-style-type: none"> <li>• Exploitation of information in order to support awareness, planning, and decision making</li> <li>• Frame provides cues, goals, and expectancies and guides attention toward data that are of interest to the frame</li> <li>• Frame is dynamic</li> <li>• Similar to action learning</li> </ul>
<b>Team Cognition</b>	<ul style="list-style-type: none"> <li>• Shared knowledge among team members</li> <li>• Developed over time as members perform together</li> <li>• Improving team cognition usually involves exposing them to realistic scenarios that represent types of problems that they will encounter in the OE</li> </ul>

Table 2. Descriptive theories of decision making.

<sup>48</sup> Committee on Improving the Decision Making Abilities of Small Unit Leaders, *Improving the Decision Making Abilities of Small Unit Leaders*, 52-62.

## Intuitive vs Analytical Thinking

As these theories have been developed, refined and tested over the years, scholars of decision making and cognition have identified two main modes of thinking among humans: intuitive and analytical.<sup>49</sup> This typology of cognition has helped researchers and practitioners better understand how people approach problems and make decisions in real world circumstances. These modes are labeled, System 1 (intuitive) and System 2 (analytical) thinking.<sup>50</sup> Although the notion that intuitive and analytic thinking form a binary foundation of human decision making and thinking had been around for some time in the field of cognitive psychology, the broad terminology of System 1 and System 2 is now widely known as Dual Process Theory (DPT).<sup>51,52</sup>

### Intuitive (System 1)

Intuitive thinking (also called System 1) is fast and automatic thinking.<sup>53</sup> In this mode, thinking, impressions, associations, feelings, intentions, and preparations for action converge, complement each other and move forward effortlessly.<sup>54</sup> It is variously labeled “automatic, natural, non-verbal, narrative, and experimental” thinking.<sup>55</sup> This kind of thinking provides people with no sense of voluntary control. That is, the method is totally unconscious. Intuitive thinking allows people to multitask in a complex and often dangerous and threatening world. It allows people to do things like drive, avoid oncoming traffic, and carry on a conversation all at the same time. Intuitive thinking does not require consciously focusing on any of these tasks; instead, people simply do them.

The crucial benefits of intuitive thinking are that it is time efficient and requires relatively little allocation of mental resources. By generalizing circumstances, intuitive thinking allows us to reduce the complexity of a situation, recognize patterns (real or perceived) and make decisions quickly according to past experiences or the logic of those recognized patterns.

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<sup>49</sup> Daniel Kahneman, Dan Lovallo and Olivier Sibony, “Before You Make That Big Decision...” *Harvard Business Review*, June 2011, 52.

<sup>50</sup> Keith E. Stanovich and Richard F. West, “Individual Differences in Reasoning: Implications for the Rationality Debate?” *Behavioral and Brain Sciences* 23 (2000): 658.

<sup>51</sup> Stanovich and West, “Individual Differences in Reasoning,” 658-659.

<sup>52</sup> Croskerry, Singhal, and Mamede, “Cognitive Debiasing 1,” ii58.

<sup>53</sup> Reisberg, *Cognition*, 427.

<sup>54</sup> Kahneman, Lovallo and Sibony, “Before You Make That Big Decision...” 52.

<sup>55</sup> Lawrence Woocher, “The Effects of Cognitive Biases on Early Warning and Response.” Paper presented at the annual meeting of the ISA's 49th Annual Convention, Bridging Multiple Divides, Hilton San Francisco, San Francisco, CA, March 26, 2008, accessed December 9, 2014, [http://eeas.europa.eu/ifs/publications/articles/book3/book\\_vol3\\_chapter5\\_the\\_effects\\_of\\_cognitive\\_biases\\_on\\_early\\_warning\\_and\\_response\\_lw\\_en.pdf](http://eeas.europa.eu/ifs/publications/articles/book3/book_vol3_chapter5_the_effects_of_cognitive_biases_on_early_warning_and_response_lw_en.pdf)

## Analytical (System 2)

Analytical thinking (also called System 2), on the other hand, requires conscious mental effort. The analytical and reflective nature of this mode is “slow, effortful and deliberate.”<sup>56</sup> The operations of analytical thinking are linked to individual agency, choice and concentration.<sup>57</sup> Both modes of thinking are continuously active in people’s minds, but analytical thinking is typically relegated to simply monitoring on-going cognitive activities and can be called upon when necessary. It is activated when “stakes are high, when we detect an obvious error or when rule-based reasoning is required.”<sup>58</sup>

Analytical thinking allows us to process information deliberately, consciously consider multiple options, debate with others, contemplate alternative perspectives, and come to logical and, ideally, thorough and effective conclusions. The military decision making process (MDMP) is a prime example of analytical thinking and decision making. Because it is rule-based and can follow a pre-described template (such as the MDMP), the benefits of analytical thinking are that it reduces errors in judgment by allowing more information to be processed more thoroughly. Along these same lines, the major drawback of analytical thinking is that it is time and labor intensive.

Because of the significant cognitive load required by analytical thinking and common limitations imposed by time, intuitive (System 1) thinking dictates our cognitive processes, informs our decisions and drives our action the vast majority of the time. While this mode of thinking is exceptionally efficient and very often accurate, it does make us more vulnerable to errors. A discussion follows of how cognitive psychologists theorize the ways in which these errors come about and how they can best be understood.

## Heuristics and Biases

### Bounded Rationality

One of the most important contributions from the last century that has led to better understanding decision making is the idea of bounded rationality.<sup>59</sup> Instead of operating under perfect circumstances that prescriptive theories of decision making assume, bounded rationality proposes that decision makers in the real world have to function under three critical constraints that effectively limit people’s rationality (hence, “bounded rationality”): 1) limited access to information, 2) cognitive limitations inherent to the human mind, and 3) finite availability of time with which to make a decision.<sup>60,61</sup> This research overturns the notion that

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<sup>56</sup> Kahneman, Lovallo and Sibony, “Before You Make That Big Decision...” 52.

<sup>57</sup> Daniel Kahneman, *Thinking, Fast and Slow* (New York: Farrar, Straus and Giroux): 21.

<sup>58</sup> Kahneman, Lovallo and Sibony, “Before You Make That Big Decision...” 52.

<sup>59</sup> Bounded rationality was developed in the 1950s by the Nobel Prize-winning economist Herbert Simon.

<sup>60</sup> Herbert Simon, “A Behavioral Model of Rational Choice,” *Quarterly Journal of Economics* 69 (1955): 99-118.

<sup>61</sup> Paul K. Davis, Jonathan Kulick, and Michael Egner, *Implications of Modern Decision Science for*

humans process information and make decisions in a purely rational fashion, particularly in situations that involve risk and uncertainty. The idea of human irrationality in cognitive processes, including decision making, has since become widely accepted.

Since the notion of bounded rationality proposed in the 1950s that people make decisions irrationally, much effort in the field has been dedicated to “a search for the bounds of human rationality.”<sup>62,63</sup> Some of the most important work in this vein has been conducted by Amos Tversky, Daniel Kahneman and a number of their colleagues in the field of behavioral economics. The foundation of this early work was established in the 1970s when they developed the heuristics and biases paradigm.<sup>64</sup> This research built off the concept of bounded rationality in order to more substantively demonstrate that people do not follow the algorithmic (clearly defined, step-by-step) principles of prescriptive probability theory when making decisions and judging how likely it is that future events will occur.<sup>65,66,67</sup> Instead, the heuristics and biases approach argues that people rely on cognitive shortcuts and rules of thumb to make decisions under conditions of uncertainty.<sup>68,69,70</sup> That is, due to the inherent bounded rationality of human cognition, the heuristics and biases paradigm proposes that people simplify complex and uncertain situations by employing cognitive shortcuts. They termed these mental shortcuts “heuristics” and the predictable errors in judgment that they cause “cognitive biases”.<sup>71,72</sup>

### Heuristics and Cognitive Biases

Heuristics allow people to make quick and reasonably accurate decisions despite time constraints or limited information. These mental processes have developed over the course of human evolution as a means of ensuring survival, activating when decisions need to be made quickly.<sup>73,74</sup> Tversky and Kahneman initially identified three main classes of heuristics: 1) availability, 2) representativeness, and 3) anchoring). Others have since developed a number of

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*Military Decision-Support Systems* (Santa Monica, CA: RAND Corporation), 10, accessed December 5, 2014, [http://www.rand.org/pubs/issue\\_papers/IP155/](http://www.rand.org/pubs/issue_papers/IP155/)

<sup>62</sup> Simon, “A behavioral model of rational choice,” *Quarterly Journal of Economics*, 69, 1955, 99-118.

<sup>63</sup> Kahneman, “Judgment and Decision Making: A Personal View,” *Psychological Science* 2, no. 3 (1991): 142.

<sup>64</sup> Gary Klein, “Naturalistic Decision Making,” *Human Factors* 50, no. 3 (June 2008): 456.

<sup>65</sup> Committee on Improving the Decision Making Abilities of Small Unit Leaders, *Improving the Decision Making Abilities of Small Unit Leaders*, 56.

<sup>66</sup> Klein, “Naturalistic Decision Making,” 456.

<sup>67</sup> Gerd Gigerenzer, “How to Make Cognitive Illusions Disappear,” 2.

<sup>68</sup> Committee on Improving the Decision Making Abilities of Small Unit Leaders, *Improving the Decision Making Abilities of Small Unit Leaders*, 56.

<sup>69</sup> Davis, Kulick and Egner, *Implications of Modern Decision Science for Military Decision-Support Systems*, 10.

<sup>70</sup> Tversky and Kahneman, “Judgment Under Uncertainty,” 1124.

<sup>71</sup> Arnott, “Cognitive Biases and Decision Support Systems Development,” 59.

<sup>72</sup> Martin Hilbert, “Toward a Synthesis of Cognitive Biases: How Noisy Information Processing Can Bias Human Decision Making,” *Psychological Bulletin* 138, no. 2 (March 2012): 212.

<sup>73</sup> Ibid.

<sup>74</sup> Gigerenzer, “Fast and Frugal Heuristics,” 63-64.

others. The three heuristics developed by Tversky and Kahneman are discussed in more detail below. Each one of these heuristics—while very often effective and efficient—may in turn lead to systematic and predictable errors in judgment known as cognitive biases.<sup>75</sup> These errors can have significant implications for decision making. The heuristics and biases approach to studying the nature of human information processing (cognition) that leads to decision making provides us with a more realistic (descriptive) understanding of that process when knowledge is scarce (or over-abundant), deadlines are rapidly approaching, and future is hard to predict.<sup>76</sup> Cognitive biases are mental errors caused by our simplified information processing strategies.<sup>77</sup> Cognitive biases are consistent and predictable. It is important to note that not every judgment by every person will be biased.<sup>78</sup>

Discussed below in more detail are the three original classes of heuristics. Linked to each of these heuristics is a brief mention of a number of each heuristic's associated biases.<sup>79</sup>

## Description of Heuristics

### Availability

The availability heuristic is the perceived likelihood that an event will occur based upon how easy it is for an individual to recollect instances of that phenomena happening in their mind.<sup>80</sup> Tversky and Kahneman first explained it as a simplifying cognitive tool that allows people to “assess the frequency of a class or the probability of an event by the ease with which instances of occurrences can be brought to mind.”<sup>81</sup> More simply, it is the notion that the more examples one can recall of a particular outcome to a situation or event (i.e. how “available” those memories are), the more likely one will judge that outcome happening again in a similar situation or event in the future.<sup>82,83</sup> As more frequent events are usually more easily recalled than less frequent events, the availability heuristic serves a reasonable simplifying function for the human mind in uncertain circumstances and often leads to accurate predictions.<sup>84</sup>

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<sup>75</sup> Arnott, “Cognitive Biases and Decision Support Systems Development,” 59.

<sup>76</sup> Gerd Gigerenzer and Reinhard Selten, *Bounded Rationality: The Adaptive Toolbox* (Cambridge: MA: 2001), 7.

<sup>77</sup> Richards J. Heur, *Psychology of Intelligence Analysis* (Center for the Study of Intelligence, Central Intelligence Agency, 1999), 111.

<sup>78</sup> *Ibid.*, 112.

<sup>79</sup> For a more comprehensive discussion of the details of cognitive biases as they relate to the US Military please see: Major Blair S. Williams, “Heuristics and Biases in Military Decision Making,” *Military Review* (September-October 2010): 40-52.

<sup>80</sup> Norbert Schwarz, Herbert Bless, Fritz Strack, Gisela Klumpp, Helga Rittenauer-Schatka, and Annette Simons, “Ease of Retrieval as Information: Another Look at the Availability Heuristic,” *Journal of Personality and Social Psychology* 61, no. 2 (1991): 195.

<sup>81</sup> Tversky and Kahneman, “Judgment Under Uncertainty,” 1127.

<sup>82</sup> Lieutenant Colonel Michael J. Janser, “Cognitive Biases in Military Decision Making,” Senior Service College Fellowship Project, US Army War College, June 14, 2007, 1.

<sup>83</sup> Tversky and Kahneman, “Judgment Under Uncertainty,” 1127.

<sup>84</sup> Brian H. Borstein and Christine Emler, “Rationality in Medical Decision Making: A Review of The Literature on Doctors' Decision-Making Biases,” *Journal of Evaluation in Clinical Practice* 7, no. 2 (2001): 100.



However, the availability heuristic can lead to a number of cognitive biases when the incidents that are recalled and perceived to be significant or pertinent are instead statistically or materially irrelevant.<sup>85</sup> For example, a RAND study cites how the USSR over-estimated West Germany's military threat during the Cold War in large part due to its vivid memory of German aggression during WWII.<sup>86</sup> A published review of medical literature found similar evidence of the availability heuristic in the medical field.<sup>87</sup> The review cited a study that found that doctors ordering blood cultures would consistently overestimate the probability that the cultures would be positive for bacteremia based on the extent to which they could recall bacteremic patients in the past.<sup>88,89</sup> Cognitive biases associated with the availability heuristic include retrievability bias, hindsight bias, search set bias, imaginability bias, illusory correlation, confirmation bias, and groupthink.<sup>90,91</sup>

## Representativeness

The representativeness heuristic is evident when the mind places a situation, event or phenomenon into a class or type according to how well, at first glance or consideration, it resembles that class or type. Again, we refer to Tversky and Kahneman who first proposed the notion of the representativeness heuristic by stating that people rely on it in situations "in which probabilities are evaluated by the degree to which A is representative of B."<sup>92</sup> This tool serves us well in terms of survival in that we are able to quickly recognize patterns or similarities and react according to past experiences. Much of the time if one encounters a situation with identical or similar variables as one experienced in the past, it would serve that person well, in the absence of time to deliberate or analyze the situation more fully, and to respond based on the outcome of that previous experience. For instance, a child may have been taught by their parents to avoid rattlesnakes because they are dangerous and happen to be common in the area where they live. Even with no knowledge at all about the existence of other snakes, that same child would likely avoid, for example, a cobra if they ever encountered one because it closely (in relative terms) resembles a rattlesnake.

This cognitive mechanism serves an extremely useful purpose in many circumstances because representativeness often correlates with likelihood; however, this is not always the case and the mental short cut can lead to serious errors in judgment. The main shortcoming of representativeness is that people tend to overestimate representative evidence and

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<sup>85</sup> Davis, Kulick and Egner, *Implications of Modern Decision Science for Military Decision-Support Systems*, 10.

<sup>86</sup> Ibid.

<sup>87</sup> Borstein and Emler, "Rationality in Medical Decision Making," 101.

<sup>88</sup> Poses and Anthony, "Availability, Wishful Thinking, and Physicians' Diagnostic Judgments for Patients with Suspected Bacteremia," *Medical Decision Making* 11 (July-September 1991): 72-76.

<sup>89</sup> Borstein and Emler, "Rationality in Medical Decision Making," 101.

<sup>90</sup> Major Blair S. Williams, "Heuristics and Biases in Military Decision Making," *Military Review* (September-October 2010): 42-46.

<sup>91</sup> Arnott, "Cognitive Biases and Decision Support Systems Development," 60-61.

<sup>92</sup> Tversky and Kahneman, "Judgment Under Uncertainty," 1127.

underestimate other influencing factors, such as relevant prior probabilities.<sup>93</sup> In short, highly similar features can distract people from considering or properly evaluating other elements that affect probability. A RAND study acknowledges that this heuristic can be particularly risky in making decisions and judgment via historical analogy.<sup>94,95</sup> Cognitive biases resulting from the representativeness heuristics include base rate neglect and base rate fallacy, insensitivity to sample size, misconception of change, and insensitivity to prior probability of outcomes.<sup>96,97</sup>

### **Anchoring (and Adjustment) Heuristic**

Anchoring is identified when people use an initial estimate to assess a situation and then adjust that original judgment over time. Problems occur, however, because people tend to make adjustments to the initial estimate/value (the anchor) that are too small.<sup>98</sup> That is, people tend to be moored to their first estimate of a phenomenon and typically do not take other considerations into proper account when modifying their judgment over time. The anchoring heuristic is typically related to how people estimate value and, again, like many heuristics, it can be useful.<sup>99</sup> For instance, knowing today's temperature is an effective starting point (anchor) for estimating tomorrow's temperature. But it is not infallible. As many of us know, this technique is typically accurate for guessing the weather, but from time to time a front moves through and unexpectedly changes the conditions dramatically.

Tversky and Kahneman identified the anchoring heuristic as one in which people make estimates by starting at an initial value that is adjusted over time to yield the final answer.<sup>100</sup> One source cited American troop levels in Iraq from 2003 to 2007 as an example of the anchoring heuristic.<sup>101</sup> During this time the US had an average of 138,000 troops deployed to the country despite consistently mounting evidence that in order to accomplish their stated goals, the US Military needed significantly more. Williams postulates that decision makers refused to properly adjust this figure because they were anchored to original estimates of what was necessary.<sup>102</sup>

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<sup>93</sup> Borstein and Emler, "Rationality in Medical Decision Making," 99.

<sup>94</sup> Robert Jervis, *Perception and Misperception in International Politics* (Princeton, NJ: Princeton University Press, 1976).

<sup>95</sup> Davis, Kulick and Egner, *Implications of Modern Decision Science for Military Decision-Support Systems*, 10-11.

<sup>96</sup> Williams, "Heuristics and Biases in Military Decision Making," 46-48.

<sup>97</sup> Arnott, "Cognitive Biases and Decision Support Systems Development," 60-61.

<sup>98</sup> Reisberg, *Cognition*, 413.

<sup>99</sup> Ibid.

<sup>100</sup> Tversky and Kahneman, "Judgment Under Uncertainty," 1128.

<sup>101</sup> Williams, "Heuristics and Biases in Military Decision Making," 48

<sup>102</sup> Ibid.

Availability Heuristic
• Retrievability bias
• Search set bias
• Imaginability bias
• Illusory correlation
• Confirmation bias
• Groupthink
Representativeness Heuristic
• Base rate neglect
• Insensitivity to sample size
• Misconceptions of chance
• Insensitivity to predictability
• Illusion of validity
• Insensitivity to prior probability of outcomes
Anchoring and Adjustment Heuristic
• Anchoring bias
• Insufficient adjustment
• Evaluation of conjunctive and disjunctive events
• Assessing subjective probability distributions

Table 3. Three main classes of heuristics and examples of associated biases.

### **Criticism of Heuristics and Biases Approach**

While the discussion and development of heuristics and biases has sparked considerable dialogue and contributed much to better understanding decision making, it has also been met with constructive criticism. A quick—and certainly incomplete—review of some of the most salient and common critiques and assessments of the approach is necessary in order to highlight productive responses to the research and place understanding of the utility and effect of heuristics and biases in a broader and more rigorous context.

A general observation of the heuristics and biases approach submitted by Hilbert and forming a common theme among others is that scholars are hesitant to take findings generated through the heuristics and biases lens as a solid foundation for larger theories of decision making or behavior because the lists of cognitive biases in the literature is a “loose grab bag of empirical regularities that still lacks the foundation of a thorough theory itself”.<sup>103</sup> For instance, there is no consensus typology of biases and heuristics. One peer-reviewed source cites 37 biases,<sup>104</sup> while another references 53.<sup>105</sup> This lack of cohesion, Hilbert argues, contributes to conflicting beliefs about the fundamental aspects of decision making. As a result, productive discussion of the theory stalls and scholars make little headway in more thoroughly understanding the architecture of human decision making. Furthermore, the heuristics and biases approach does

<sup>103</sup> Hilbert, “Toward a Synthesis of Cognitive Biases,” 212.

<sup>104</sup> Arnott, “Cognitive Biases and Decision Support Systems Development,” 55-57

<sup>105</sup> Hilbert, “Toward a Synthesis of Cognitive Biases,” 212.

little to explain the origins of deviations in judgment and how these deviations may be interrelated.

While acknowledging the general utility of concepts formulated with heuristics and biases as a starting point for provoking dialogue about human decision making, Gigerenzer<sup>106</sup> has offered critical analysis of the approach that highlights some of the perceived shortcomings of the approach that prevent it from being a more fully realized explanatory theory.<sup>107</sup> Gigerenzer has been a key voice in the debate about the role of heuristics and cognitive biases in decision making over the last several decades. He has two main criticisms of the approach. First, he argues that the heuristics identified and described in the literature are too vague.<sup>108,109</sup> Instead of providing clarity or understanding to the human decision making process, the malleable and imprecise nature of heuristics divert scholars and practitioners away from investigating more detailed models of cognitive biases.<sup>110</sup> He suggests that explanatory notions like the representative heuristic remain “vague, undefined and unspecified” and do little to actually explain their underlying causes and the cognitive processes that propel them.<sup>111</sup> Secondly, Gigerenzer believes that the evidence that supposedly supports the heuristics and biases theory as an explanatory tool is fundamentally flawed. He argues that the definitions of decision making norms and probabilistic reasoning used by these scholars are too narrow, which conveniently, but erroneously, support their theories. Instead, Gigerenzer argues, if one considers a broader and more realistic understanding of these norms, the errors in judgment teased out by heuristics and biases are in fact not actually violations of probability theory.<sup>112</sup>

Finally, Gary Klein, a research psychologist who contributed greatly to the field of naturalistic decision making, provides a number of examples of the “growing literature on the limitations of heuristics and biases approach.”<sup>113</sup> In short, Klein argues that significant research has repeatedly demonstrated the limitations of heuristics and biases. He points out, for instance, that Gigerenzer and Goldstein (1996) have illustrated that so-called predictable biases dissolve when the circumstances of the decision are offered to the decision maker in a more articulate or meaningful manner.<sup>114,115</sup> Klein cites two examples in the research—one focusing on auditors and another on accountants—which demonstrate that biases in fact do not reduce the quality

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<sup>106</sup> Gerd Gigerenzer is a psychologist at the Max Planck Institute for Human Development and the Harding Center for Risk Literacy.

<sup>107</sup> For instance, see 1) Gerd Gigerenzer, “How to Make Cognitive Illusions Disappear: Beyond ‘Heuristics and Biases,’” *European Review of Social Psychology* 2 (1991): 83-115, or 2) Gerd Gigerenzer, “On Narrow Norms and Vague Heuristics: A Reply to Kahneman and Tversky (1996),” *Psychological Review* 103, no. 3 (1996): 592-596.

<sup>108</sup> Gigerenzer, “On Narrow Norms and Vague Heuristics,” 592.

<sup>109</sup> Gigerenzer, “How to Make Cognitive Illusions Disappear,” 83.

<sup>110</sup> *Ibid.*

<sup>111</sup> Gigerenzer, “On Narrow Norms and Vague Heuristics,” 592.

<sup>112</sup> Gigerenzer, “How to Make Cognitive Illusions Disappear,” 83.

<sup>113</sup> Gary Klein, “Developing Expertise in Decision Making,” *Thinking and Reasoning* 3, no.4 (1997): 339.

<sup>114</sup> *Ibid.*

<sup>115</sup> Gerd Gigerenzer and D.G. Goldstein, “Reasoning the Fast and Frugal Way: Models of Bounded rationality,” *Psychological Review* 103, No. 4 (1996): 650-669.

of decisions in real world circumstances.<sup>116,117,118</sup> In reviewing these examples, Klein argues, like Gigerenzer, that the experiments conducted in support of heuristics and biases as an explanatory theory are flawed. He states that it is difficult to adequately prove the influence of heuristics and biases in field conditions; instead, much of the research in support of heuristics and biases is based on evidence uncovered in controlled laboratory conditions.<sup>119</sup> As a result, Klein argues, researchers pursuing this theoretical and experimental logic are not likely to find out how people actually make decisions and therefore are able to contribute little to improving real world decisions.<sup>120</sup>

The following section discusses tools and methods that have been developed to mitigate biases in order to address inherent shortcomings in human decision making. Many of these approaches focus on developing metacognitive skills.

### Mitigating Biases

Despite the vast body of research that has followed the initial work on heuristics and biases in the 1970s, there remains a distinct lack of published research, let alone consensus, on appropriate and effective methods of cognitive “debiasing”.<sup>121,122</sup> Reinforcing a number of the criticisms noted above, it seems that the field has achieved much more progress towards cataloguing and describing an ever-growing list of cognitive biases than it has towards developing and identifying practices to prevent or remedy them. Following an example from several years ago, a recent academic literature search on EBSCO yielded 4534 published results when using the search terms “cognitive bias” or “cognitive biases” while a search for “debiasing” yielded just 866.<sup>123</sup> This situation represents a significant challenge to practitioners—such as US Army professionals—who seek to implement practical initiatives to address the cognitive shortcomings so richly detailed in the academic literature. This is a significant challenge and one that, if properly addressed, has important implications. Indeed, some argue that robust solutions to help debias individuals against these predictable errors in judgment could be among psychology’s “most enduring legacies to the promotion of human welfare”.<sup>124</sup>

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<sup>116</sup> Gary Klein, “Developing Expertise in Decision Making,” 340.

<sup>117</sup> James Shanteau, “Cognitive heuristics and Biases in Behavioral Auditing: Review, Comments, and Observations,” *Accounting, Organizations and Society*, 14 (1989): 165-177.

<sup>118</sup> James F. Smith and Thomas Kida, “Heuristics and biases: Expertise and Task Realism in Auditing,” *American Psychological Association*, 109 (1991): 472-489.

<sup>119</sup> Gary Klein, “Developing Expertise in Decision Making,” 340.

<sup>120</sup> Gary Klein, “Naturalistic Decision Making,” 456.

<sup>121</sup> Scott O. Lilienfeld, Rachel Ammirati, and Kristin Landfield, “Giving Debiasing Away: Can Psychological Research on Correcting Cognitive Errors Promote Human Welfare?” *Perspectives on Psychological Science* 4, no. 4 (2009): 390.

<sup>122</sup> Katherine L. Milkman, Dolly Chugh, and Max H. Bazerman, “How Can Decision Making Be Improved?” *Perspectives on Psychological Science* 4, no. 4 (2008): 381.

<sup>123</sup> Lilienfeld, Ammirati and Landfield, “Giving Debiasing Away,” 391.

<sup>124</sup> Ibid.

One proposed strategy for overcoming specific biases is to deliberately shift people from intuitive (System 1) thinking to analytical (System 2) thinking. This involves promoting metacognitive skills to help people replace intuition—which we have learned is oftentimes effective and efficient but much more prone to error—with more deliberate analytic processes. One study explains that it may be possible to achieve this cognitive shift through a number of approaches: 1) replace intuition with formal analytic processes, 2) take an outsider’s perspective, 3) consider the opposite of whatever decision the decision-maker is about to make, 4) undermine the cognitive mechanism that is the source of the bias, 5) promote analogical reasoning, and 6) joint-versus-separate decision making.<sup>125</sup>

Strategy	Explanation <sup>126</sup>
Replace intuition with formal analytical processes	<ul style="list-style-type: none"> <li>• When data exists on past input to and outcome from a particular decision-making process, decision makers may be able to construct a linear model to forecast an outcome</li> <li>• Research indicates that linear models produce predictions that are superior to those of experts</li> <li>• This method has only been tested in a small subset of the potentially relevant domains</li> </ul>
Take an outsider’s perspective	<ul style="list-style-type: none"> <li>• Trying to remove oneself mentally from a specific situation</li> <li>• Has been shown to reduce decision makers’ overconfidence about their knowledge</li> <li>• Also may be useful to ask an actual outsider for their input into a decision</li> </ul>
Consider the opposite of whatever decision they are about to make	<ul style="list-style-type: none"> <li>• Reduces errors in judgment due to several particularly robust decision biases: anchoring, hindsight bias, and overconfidence</li> <li>• Also helpful to have groups rather than individuals make decisions</li> </ul>
Undermine the cognitive mechanism that is the source of the bias	<ul style="list-style-type: none"> <li>• Develop targeted cue to rely on System 2 processes</li> <li>• Research suggests that subjects are more resistant to bias if they are provided with evidence contrary to the actual outcome</li> </ul>
Promote analogical reasoning	<ul style="list-style-type: none"> <li>• Used to reduce bounds on people’s awareness</li> <li>• People who are encouraged to see and understand the common principle underlying a set of seemingly unrelated tasks subsequently demonstrated an improved ability to discover solutions in a different task that relied on the same underlying principle</li> </ul>
Joint-versus-separate decision making	<ul style="list-style-type: none"> <li>• Consider and choose multiple options simultaneously rather than accepting or rejecting options separately</li> <li>• People exhibit less willpower when they weigh choices separately rather than jointly</li> </ul>

Table 4. Examples of Strategies for Overcoming Biases.

<sup>125</sup> Milkman, Chugh and Bazerman, “How Can Decision Making Be Improved?” 382.

<sup>126</sup> Ibid.

With further development and experimentation, the approaches listed above may indeed prove to be effective in mitigating cognitive biases and improving decision making for certain situations or professions. However, the fundamental notion behind these approaches is, in some fashion, to subsume intuition with analysis. This comes into direct conflict with the nature of many of the decision making scenarios that military professionals in the future operating environment expect to face. The complexity and uncertainty of these situations may not afford individuals the luxury of time or collaboration that the methods detailed above require, particularly for individuals operating at the tactical level where commanders and soldiers must rely on quick, often inherently intuitive, decisions.<sup>127</sup> Considering the circumstances of the (present and future) operating environment it would seem the US Army would be better served exploring, developing and implementing methods that promote metacognitive skills to enhance intuitive expertise rather than subsume it in favor of deliberate analysis. While there is certainly considerable value in promoting analytic decision making for specific circumstances (exemplified by the MDMP, for instance), the operating environment of the future will increasingly require analytical approaches, such as the MDMP, to be complemented by more refined intuitive competencies.

One such approach to developing intuitive expertise and thereby attenuating or even eliminating the effects of cognitive biases is based on the naturalistic decision making (NDM) approach. The NDM school of thought, largely developed through the empirical work of psychologist Gary Klein, denies the need to mitigate biases at all and instead proposes to appropriate them in order to improve decision making.<sup>128</sup> Klein and his followers argue that heuristics highlight specific human strengths of cognition that are hard-wired into us. More specifically, the framework of heuristics are hard-wired into us, while the associated cognitive biases are developed over time through experiences. Consequently, his research suggests that it is possible to take advantage of cognitive biases in order to improve decision making. One of the key concepts behind NDM is that people rely on past experiences, knowledge and expertise to assess a situation and make, according to these subjective inputs, appropriate decisions.<sup>129</sup> This experience does in fact lead to biases but Klein views these as not necessarily detrimental to the decision making process. Instead, he suggests that it is possible to develop decision making as a kind of expertise, which then informs biases that can be used to make better decisions (based on relevant past experiences, knowledge, and, over time, expertise).<sup>130</sup> In short, his research argues that biases may be able to be leveraged, through expertise, to make good decisions. Much of the empirical evidence used to support his model comes from real world examples in professions where quick, intuitive decisions are necessary and common—

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<sup>127</sup> Gary A. Klein, "Strategies of Decision Making," *Military Review* (May 1989): 56.

<sup>128</sup> Klein, "Developing Expertise in Decision Making," 340-341.

<sup>129</sup> Jennifer K. Phillips, Gary Klein, and Winston R. Sieck, "Expertise in Judgment and Decision Making: A Case for Training Intuitive Decision Skills," in *Blackwell Handbook of Judgment and Decision Making* ed. Derek J. Koehler and Nigel Harvey (Oxford, UK: Blackwell Publishing Ltd, 2007), 299.

<sup>130</sup> Ibid.

such as small unit leaders in the Marine Corps, nurses and firefighters.<sup>131,132</sup> Klein subsequently developed the recognition-primed decision (RPD) model to build off the research uncovered in NDM and improve decision making.<sup>133,134</sup> The RPD model blends pattern matching and analysis.<sup>135,136</sup> The Marine Corps has subscribed in varying degrees to the RPD model for improving decision making among small unit leaders.<sup>137</sup> It should also be noted that Gary Klein has done much work in support of improving decision making within the US Military.<sup>138</sup> One shortcoming of the model seems to be how to scale it appropriately in order to institutionalize it throughout the US Army.

Croskerry *et al.* provide a brief review of debiasing methods with regard to improving clinical diagnoses among physicians.<sup>139,140</sup> While not in the realm of military decision making, their review provides useful insight into approaches that may help mitigate cognitive biases. A common theme running throughout the research that they conducted is the importance of metacognition in the decision making process. For instance, Wilson and Brekke suggest an algorithmic (step-by-step) approach to mitigate biases. Such a process so closely resembling an analytic approach would require a level of awareness on the part of the decision maker to acknowledge his or her bias and have the necessary skills and experience to take appropriate steps to correct them.<sup>141</sup> Bazerman goes several steps further, suggesting that simple awareness of the biases and their causes is not enough. Indeed, awareness of the bias is simply the first step in a more elaborate process.<sup>142</sup> The next involves learning how the cognitive change of overcoming the bias will occur and what strategies to do so need to be learned. Finally, the last step occurs when the new approach is incorporated into the cognitive make-up of the individual and that new skill, experience or perspective becomes part of their regular thinking behavior. Similarly, Stanovich and West suggest that in order to overcome biases decision makers must 1) be aware of the rules, procedures and strategies needed to overcome the bias, 2) have the ability to detect the need for bias override, and 3) be cognitively capable of decoupling from the bias.<sup>143</sup> This final step is the most key — learning how to suppress automatic responses in the intuitive mode by consciously separating from it. In all of these

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<sup>131</sup> Ibid.

<sup>132</sup> Klein, "Developing Expertise in Decision Making," 340-341.

<sup>133</sup> Gary A. Klein, "Strategies of Decision Making," 56.

<sup>134</sup> Karol G. Ross, Gary A. Klein, Peter Thunholm, John F. Schmitt, and Holly C. Baxter, "The Recognition-Primed Decision Model," *Military Review* (July-August 2004): 6-10.

<sup>135</sup> Committee on Improving the Decision Making Abilities of Small Unit Leaders, *Improving the Decision Making Abilities of Small Unit Leaders*, 58.

<sup>136</sup> Klein, "Naturalistic Decision Making," 457.

<sup>137</sup> Committee on Improving the Decision Making Abilities of Small Unit Leaders, *Improving the Decision Making Abilities of Small Unit Leaders*, 58.

<sup>138</sup> Klein, "Developing Expertise in Decision Making," 341.

<sup>139</sup> Croskerry, Singhal and Mamede, "Cognitive Debiasing 1," ii58-ii64.

<sup>140</sup> Pat Croskerry, Geeta Singhal and Silvia Mamede, "Cognitive Debiasing 2: Impediments to and Strategies for Change," *BMJ Quality and Safety* 22, (2013): ii65-ii72.

<sup>141</sup> Croskerry, Singhal and Mamede, "Cognitive Debiasing 1," ii62.

<sup>142</sup> Ibid.

<sup>143</sup> Ibid., ii62-ii63.



models, metacognition (awareness) plays a pivotal role. Debiasing involves having the appropriate knowledge of solutions and strategic rules to substitute for a heuristic response as well as the thinking dispositions that are able to supersede intuitive thinking.

The theoretical models described above provide a useful starting point to consider possible approaches to addressing cognitive biases in decision making in the US Army. The challenge, however, comes in elucidating specific methods that the US Army can pursue to begin experimentation and, eventually, institutionalize, that result in behavioral change and improved decisions among its personnel. The US Army has expended considerable energy elaborating on decision making, detailing how and why it is important, and exploring tools, methods and initiatives to improve decision making among its personnel.<sup>144,145</sup> Some of these initiatives are discussed below.

## US Army Initiatives Dealing with Cognitive Biases

### Manuals, Directives, Publications

Decision making features prominently throughout US Army manuals, directives and publications. ADP 6-0, for instance, highlights “decisionmaking” as a key component in the doctrinal definition of the *art of command*.<sup>146,147</sup> This document focuses on the importance of understanding the consequences of any decision and the value of processing information to develop meaning to inform decisions.<sup>148</sup> Critically, the definition of good decision making includes integrating “experience, training and study” and a consideration of “human factors”.<sup>149</sup> This definition alludes, at least vaguely, to the potential impact of cognitive processes and judgments, such as cognitive biases, on decision making and the importance of “experience, training and study” to potentially ameliorate their effects. Its accompanying document, ADRP 6-0, elaborates on this notion by making a clear distinction between analytical and intuitive decision making. Here, the US Army acknowledges that analytical decision making “sometimes poses disadvantages” due to its time- and information- intensive nature.<sup>150</sup> The document closes the discussion by recommending that “commanders blend intuitive and analytic decisionmaking...”<sup>151</sup>

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<sup>144</sup> D. Sefarty, J. MacMillan, E.E. Entin, and E.B. Entin, “The Decision-Making Expertise of Battle Commanders,” in *Naturalistic Decision Making* ed. C. Zsombok and G. Klein (Mahwah, NJ: Lawrence Erlbaum Associates), 233-246.

<sup>145</sup> Stanley M. Halpin, “The Human Dimensions of Battle Command: A Behavioral Science Perspective on the Art of Battle Command,” Research Report 1696, U.S. Army Research Institute for the Behavioral and Social Sciences, June 1996.

<sup>146</sup> Department of the Army, *ADP 6-0: Mission Command*, 5.

<sup>147</sup> “Army doctrine defines the art of command as the creative and skillful exercise of authority through timely decisionmaking and leadership.”

<sup>148</sup> Department of the Army, *ADP 6-0: Mission Command*, 7.

<sup>149</sup> Ibid.

<sup>150</sup> Department of the Army, *ADP 6-0: Mission Command*, 2-8.

<sup>151</sup> Ibid.

AR 600-100 attempts to distinguish the decision making skills that leaders at different levels will need to develop in order to be effective. For instance, direct-level leaders will be required to develop “analytical and intuitive decision-making techniques”, while organization-level and strategic-level leaders will need to be skilled at “complex decision-making”.<sup>152</sup> It is not clear, however, what the precise definition of these skills are or how they are distinguishable between these echelons. Other documents are equally general in their discussions of what consists of good decision making or why it is important.<sup>153</sup> And that is when decision making is mentioned at all. The Army Handbook for Self-Development, for instance, makes no mention of decision making at all.<sup>154</sup>

A brief (and certainly incomplete) review of Army manuals, directives and publications illustrate a number of points. First, the US Army clearly acknowledges the importance of good decision making to its present and future success. The fact that decision making features so prominently in many of these documents demonstrates that the US Army understands it is critical to improve decision making among its Soldiers and leaders. Second, this review reveals that there is little clarity or consistency (or economy of language) among these documents concerning how to define good decision making. Without such a clear definition and shared understanding of what comprises good decision making, it becomes difficult to assess it. As a result, the success (or failure) of any tools, methods, concepts or theories that the US Army may be institutionalizing to attempt to improve decision making will be impossible to measure. This is a crucial consideration to developing a more clear and consistent elucidation of decision making throughout US Army manuals, directives, and publications.

### Education and Training Initiatives

Similar to US Army descriptions and definitions of decision making, a limited review indicates that there is little specific mention of cognitive biases in education and training initiatives that the US Army has implemented, developed or proposed to improve decision making among its military professionals. The one notable exception is the discussion of cognitive biases in the University of Foreign Military and Cultural Studies (UFMCS) Red Team Handbook.<sup>155</sup> Outside of institutional research documents (detailed below) this is the most elaborate articulation of the role of cognitive biases in decision making that the HDCDTF discovered in US Army education and training initiatives.<sup>156</sup> Here, UFMCS clearly outlines the concepts of heuristics and biases and how they influence decision making. The Handbook integrates this understanding into its curriculum in order to “improve a soldier’s ability to think and understand in new and

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<sup>152</sup> Department of the Army, *Army Regulation 600-100, Army Leadership*, March 8, 2007, 3-4.

<sup>153</sup> See, for instance: 1) Department of the Army, *FM 6-22: Army Leadership: Competent, Confident, Agile*, October 2006, and 2) U.S. Army Center for Army Leadership, “US Performance Evaluation Guide: ADRP 6-22: Leadership Requirements Model and Example Behavioral Indicators,” January 2014.

<sup>154</sup> Center for Army Leadership, Combined Army Center, Department of the Army, *Army Handbook for Self-Development*.

<sup>155</sup> University of Foreign Military and Cultural Studies, *Red Teaming Handbook, 7.0 (Draft)*, October 2015, 80.

<sup>156</sup> Ibid.

continually evolving environments.”<sup>157</sup> The focus of their work is to develop meta-cognition (including self-awareness and reflection) and critical thinking skills to support decision making. In short, the UFMCS curriculum is intended to “inculcate behaviors designed to make critical thinking a discipline. The outcome of this process is a student with [a] bundle of cognitive capabilities, at the heart of which is a better ability to apply one’s normal thought processes and their common sense [intuition], to the circumstances of a given situation.”<sup>158</sup>

The Center for Army Leadership (CAL) has developed a number of documents and tools that address decision making in general without getting into the specific details of cognitive biases. In one, CAL relies on the framework provided by the Army’s Design Methodology by recommending that decision makers first seek to fully understand the problem and appreciate its complexities before attempting to solve it.<sup>159</sup> In this training model, observer/trainers work with their counterparts to reframe the situation by asking questions so the student is able to approach it differently.<sup>160</sup> This approach resembles a hybrid of two bias mitigation strategies detailed in the academic literature above on page 16: taking an outsider’s perspective and considering the opposite of whatever decision the decision maker is about to make.<sup>161</sup> CAL also developed a “leadership decision making” module for the US Army’s Virtual Improvement Center, a “web-portal that Army leaders can use to easily access the vast and high quality leader development resources that the Army provides.”<sup>162</sup> The module presents an interactive role-playing and decision making interface in a realistic and relevant Army situation. The module is intended to develop decision making skills in complex and chaotic situations. This approach reflects the emphasis proponents of the naturalistic decision making school put on considering decision making as a skill that can be refined with practice and, eventually, turned into a kind of expertise.

The Maneuver Center of Excellence at Fort Benning is currently developing an “Advanced Situational Awareness” course that has important overlap with many of the same skills that inform good decision making and address judgment errors that arise from cognitive biases. Situational awareness is a form of meta-cognition and self-awareness that may be able to help mitigate biases and improve decision making. The modules for this course are currently in the developmental phase, to be piloted in the Infantry Basic Officer Leader Course (IBOLC), Advanced Leader Courses (ALCs) and Sniper Course in the near future.

Around the turn of the millennium, the US Army Research Institute for Behavioral and Social Sciences (ARI) helped develop the Adaptive Thinking Training Method (ATTM) and the Think Like a Commander (TLAC) program in order to improve commanders’ cognitive skills, including

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<sup>157</sup> Ibid., 9.

<sup>158</sup> Ibid., 11.

<sup>159</sup> Center for Army Leadership, “Developing Leadership During Unit Training Exercises,” 24-25.

<sup>160</sup> Ibid.

<sup>161</sup> Milkman, Chugh and Bazerman, “How Can Decision Making Be Improved?” 382.

<sup>162</sup> Center for Army Leadership, *Virtual Improvement Center (VIC) Catalog: A Guide to Leadership Development Materials*, September 2012, 1.

decision making, for tactical scenarios (specifically kinetic). ATTM emphasizes the importance of “deliberate practice” to develop thinking habits characteristic of experts.<sup>163</sup> ATTM is designed to foster cognitive skills, habits and responses that become automatic (“second-nature”) through practice that enable adaptive thinking in specific circumstances.<sup>164</sup> In turn, the TLAC integrates the ATTM to focus on a pre-defined set of cognitive skills, such as “keeping focus on the mission and commander’s intent, modeling a thinking enemy, considering the effects of terrain, using all assets available, considering timing, seeing the big picture, visualizing the battlefield, and remaining flexible” in order to improve understanding, plans, and decisions.<sup>165</sup> In the training, students are asked to identify critical information relevant to a number of tactical scenarios.<sup>166</sup> As the training progresses, students are required to complete the task in ever-decreasing increments of time.<sup>167</sup> The students are then assessed through performance measures that are collected throughout the training.<sup>168</sup> The TLAC training program has been implemented at a wide-range of institutions within the US Army, including the Armor Captain’s Career Course, the Reserve Component Armor Captain’s Career Course, the International Military Student Officer’s course at Fort Know, and the School for Command Preparation at Fort Leavenworth, Kansas.<sup>169</sup> In an assessment of TLAC, ARI determined that the program elicited “significant performance gains in... [the] rapid analysis of battlefield situations to identify key considerations for decision-making...” among students.<sup>170</sup> Critically, the ATTM and TLAC rely on input from subject matter experts who observe and guide students through the vignettes and make recommendations to develop “expertise” among the students. This approach is supported by the research conducted by Gary Klein that emphasizes developing expertise in decision making (and other cognitive skills) through coaching and mentoring by experts.

ARI is also currently developing a technological tool to help enhance leader decision making interpersonal contexts. The tool will be developed with embedded, interactive scenarios reflecting Army Leadership Manual instructional strategies intended to develop leader skills.

### Institutional Research

Beyond the practical projects noted above, ARI has a rich history of conducting research on decision making and cognitive biases.<sup>171</sup> Indeed, Gary Klein, the pioneer of the naturalistic

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<sup>163</sup> S.B. Shadrack and J.W. Lussier, “Assessment of the Think Like a Commander Training Program,” Research Report 1824, U.S. Army Research Institute for the Behavioral and Social Science, July 2004, 1.

<sup>164</sup> Ibid.

<sup>165</sup> G. Klein, N. Hintze and D. Saab, “Thinking Inside the Box: The ShadowBox Method for Cognitive Skill Development,” in *Proceeding of the 11<sup>th</sup> International Conference on Naturalistic Decision Making (NDM 2013), Marseille, France, 21-24 May 2013*, ed. H. Chaudet, L. Pellegrin and N. Bonnardel (Paris, France: Arpege Science Publishing), 121-123.

<sup>166</sup> Shadrack and Lussier, “Assessment of the Think Like a Commander Training Program,” vii.

<sup>167</sup> Ibid.

<sup>168</sup> Ibid., 8.

<sup>169</sup> Ibid., vii.

<sup>170</sup> Ibid.

<sup>171</sup> For instance see Halpin (1996), Klein and McGregor (1988), Michel and Ridel (1988), Pleban *et al.* (2009), Shadrack and Fite (2009), and Thorsden *et al.* (1990). All of these sources are detailed in the bibliography.

decision making school and the recognition-primed decision model did much of his work for ARI in the 1980s and 1990s. His and others' research for ARI provides an important foundation for understanding decision making and cognitive biases within the context of the US Army.

The discussion above is a modest review of examples of initiatives that the US Army is currently pursuing regarding decision making and cognitive biases. A more thorough examination and cataloguing of these initiatives is necessary in order to get a full appraisal of how the US Army approaches decision making and implements efforts to improve it among its personnel. Such an investigation is critical to improving these methods and preparing the US Army, its Soldiers and leaders for the environment that they anticipate to unfold in the near future. The above discussion is not intended to be comprehensive. Rather, it is meant to provide a common point of departure for the Human Dimension community and the US Army at large to discuss and provide a glimpse of the "state of the art" of decision making in the US Army and how to begin thinking about improving existing mechanisms. The following section provides a number of recommendations that builds on this understanding of decision making theory and US Army initiatives with the intent of better preparing the institution and its personnel for better decision making in the future.

## **Recommendations**

### Overall Recommendations

The HDCDTF recommends conducting additional research to more thoroughly canvass the available decision making and cognitive bias literature. This includes identifying additional institutions and scholars that are conducting relevant research on cognitive biases and decision making that may be applicable to the US Army. The field is rich with real world anecdotes and ever-evolving theoretical insight. The scope of this study necessitated a rather cursory overview of the field's highlights. A more nuanced study and understanding is necessary to fully consider the impact of cognitive biases and good decision making on large institutions such as the US Army. This is particularly true when considering how to develop practical tools to improve decision making (through debiasing or other methods) and allowing practitioners to effectively assess decision making. Furthermore, the HDCDTF recommends that the HD community continue to reach out to relevant elements throughout the US Army to catalogue important on-going initiatives that deal, either directly or indirectly, with cognitive biases and decision making that may be appropriate to expand upon or at least inform other initiatives. This is not only to come to a common understanding of the work that is currently underway in the Army that addresses decision making and cognitive biases, but also to ensure that there is a unity of effort among and between these institutions.

### Immediate-Term

- 1) Convene a "decision making workshop".

The workshop would identify the decision-making skills and processes thought to be required by Army leaders in F2025B, identify the critical aspects of the decision making skills that are innate and which are learned, and develop a standardized method for evaluating decision making in the US Army. The HDCDTF recommends that interested, relevant and expert personnel from CAL, ARI, ARL, ARCIC, MCTP, and MCBL should be invited. The community should also consider reaching out to external experts from academia, private industry institutions, government agencies and institutions (RAND, for instance), and other military branches to include in the workshop in order to get the broadest perspective possible on the subject. The outputs of the workshop would include:

- a) A standardized, scalable and meaningful definition of good decision making in the US Army that could be incorporated into relevant directives, manuals, and publications. This may include distinguishing good decision making between echelons and specific job responsibilities within the US Army. It will be important to incorporate and consider as many of the established on-going US Army initiatives as possible (some discussed above) to inform this definition.
- b) Potential methods and tools for effectively assessing decision making among US Army professionals, once the definition of good decision making is established and agreed upon. The HDCDTF identifies this as the most critical component to improving decision making. That is, there is currently no clear understanding of how to accurately evaluate good decision making. It will be important to ensure that any assessment tools considered for implementation would be, at least to some degree, scalable to institutionalize throughout the Army in order to improve Soldier development and optimize placement of personnel. Once this decision making tool is developed it could, for instance, be incorporated into future editions of the CASAL. One approach to developing such a tool may be to assess the focus of exercises in a variety of training and education institutions across the US Army, such as the School of Advanced Military Studies (SAMS), the School for Command Preparation (SCP), the Command and General Staff College (CGSC) and the US Army War College. Here, it would be helpful to understand how many of the exercises that the students at each of these institutions focus on planning and how many focus on execution. Each of these types of exercises require different types of thinking – planning exercises largely develop analytical thinking and decision making, while execution exercises largely develop intuitive thinking and decision making. In order to inform how to improve each of these approaches throughout the US Army (and recognize when each is appropriate), it would be helpful to understand how (and if) these institutions assess these respective modes of thinking and how they attempt to develop them. Analytical thinking can be developed through planning exercises, discussion and collaboration, and formal briefings and presentations. Intuitive thinking, on the other hand, is best developed through practical execution exercises where military professionals are repeatedly forced to make critical decisions. Coinciding with the work of Gary Klein and his naturalistic decision making model discussed

above, this approach develops decision making as expertise through practice, repetition, coaching and mentoring.

- c) A better understanding of the decision making skills and factors, including heuristics and cognitive biases, that are innate to some people (nature) and which ones are developed or learned over time (nurture). In combination with the assessment tool, this distinction is important to understand how the US Army may be able to screen personnel for innate decision making skills and how to develop those decision making skills that might be considered a kind of learned expertise.

The workshop should be held following the HD Cognitive Dominance forum which should provide guidance for the HD community on methods, concepts, tools, and theories that may be appropriate to incorporate or inform any conclusions, recommendations or courses of action that the members of the workshop agree upon.

#### Near-Term

- 2) Incorporate commanders in UFMCS decision making and cognitive biases curriculum.

As noted above, UFMCS (Red Team) thoroughly addresses cognitive biases and heuristics in their curriculum. The vast majority of students who are currently sent to study with UFMCS are support staff officers. While the training the support staff receive from UFMCS concerning cognitive biases and heuristics is helpful in order provide commanders with better analysis, in the end it is the commander who expected to make decisions in the field. As we have learned, in the operational environment of the future, these decisions will increasingly be made amid conditions of uncertainty and rely much more on refined intuitive decision-making skills. As such, it follows that it will be necessary for commanders to better understand the intuitive decision making process, specifically becoming more aware of cognitive biases and heuristics. There are a number of possible ways to simultaneously address this issue and take advantage of the expertise and curriculum concerning intuitive decision making, cognitive biases and heuristics that UFMCS has already established. One is to add an additional module for students at the School for Command Preparation (SCP) that allows them to take advantage of the curriculum provided by UFMCS, which are co-located at Fort Leavenworth, KS. A second option would be for the SCP to work with UFMCS in order to incorporate their training expertise on decision making, cognitive biases and heuristics to develop a module or course specifically designed for students at SCP.

- 3) Consider implementing the ShadowBox method throughout US Army training and education institutions to increase expertise in decision making.

The ShadowBox method was developed by Neil Hintze and Gary Klein of Macrocognition LLC. The method develops students' expertise (in any number of cognitive skills, including decision making) by allowing them to "shadow" the techniques of experts. Students are subjected to

scenarios in which, at critical moments, they are required to provide information and decision priorities in a series of one-inch boxes.<sup>172</sup> At the end of the scenario their responses are compared and calibrated against the responses of experts. Hintze initially used the technique to improve the expertise of firefighters.<sup>173</sup> As of 2013, the ShadowBox technique was also being applied on a DARPA's Strategic Social Interaction Modules (SSIM), which was designed to develop better interpersonal skills for military personnel dealing with civilians (specifically, gaining "voluntary compliance"). Initial findings from the work indicate that the ShadowBox technique was very effective in highlighting to students how their perspective differs from experts.<sup>174</sup> A similar approach may be useful to help accelerate intuitive decision making expertise and awareness of cognitive biases among military personnel. Similar to the UFMCS recommendation above, this technique relies on developing decision making expertise (including becoming aware of cognitive biases) by learning from experts. The advantage of the ShadowBox model is that it does not rely on experts to be present to facilitate the training. Also, once the training module is developed and the responses provided by the experts are collected, it would be easy to expand at a number of institutions throughout the Army. In 2013, for instance, a company (Soar Technology, Inc.) was commissioned to develop a ShadowBox mobile application that would allow the ShadowBox technique to be accessed by anyone with a mobile device.<sup>175</sup> However, the absence of experts in the training environment would likely result in less robust performance gains than if a coach or mentor were present to work directly with students. While the approach may have some limitations, it would be relatively easy to implement on a large-scale throughout the Army. A first step may involve contacting DARPA to gather their input on how they assess the implementation and effectiveness of the method thus far.

- 4) Consider moving forward with the research study proposed by Analysis First LLC titled "Increased Working Memory Capacity to Decrease Cognitive Load"

This study aims to 1) identify the degree to which an individual's working memory capacity can be enhanced through computer-based training, and 2) identify the degree to which an increase in computer-based working memory capacity will result in enhanced cognitive performance in "real-life" military tasks. The study design suggests that it may be possible to improve decision making through specialized training to increase working memory capacity. Once approved, the initiative could be operational within 2-3 months.

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<sup>172</sup> Klein, Hintze and Saab, "Thinking Inside the Box," 121.

<sup>173</sup> Ibid.

<sup>174</sup> Ibid., 122.

<sup>175</sup> Soar Technology, Inc., "MAST: Mobile Application of Shadowbox Technique," 2013, accessed January 6, 2015, <http://www.soartech.com/images/uploads/SoarTech%20-%20ShadowBox.pdf>



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