Simple Culture-Informed Models of the Adversary

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Preface

This Working Paper was prepared to be a chapter in a forthcoming book, tentatively entitled *Culture Awareness in Human Reasoning and Behavior and in Intelligent Systems*, edited by Colette Faucher, Toyooki Nishida, and Lakhmi C. Jain. Informal comments on the Working Paper are welcome during the book's preparation and review and should be addressed to me at pdavis@rand.org. The book will be published by Springer in its Intelligent Systems Reference Library series.

This research was conducted within the International Security and Defense Policy Center of the RAND National Security Research Division (NSRD). NSRD conducts research and analysis on defense and national security topics for the U.S. and allied defense, foreign policy, homeland security, and intelligence communities and foundations and other non-governmental organizations that support defense and national security analysis. For more information on the International Security and Defense Policy Center, see <http://www.rand.org/nsrd/ndri/centers>.

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Simple Culture-Informed Cognitive Models of the Adversary

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Abstract

Simple cognitive models of the adversary are useful in a variety of domains, including national security analysis. Having alternative models can temper the tendency to base strategy on the best-estimate understanding of the adversary, and can encourage building a strategy that is better hedged and more adaptive. Best estimates of adversary thinking have *often* been wrong historically. Good cognitive models must avoid mirror-imaging, which implies recognizing ways in which the adversary's reasoning may be affected by history, culture, personalities, and imperfect information, as well as by objective circumstances. This paper describes a series of research efforts over three decades to build such cognitive models, some as complex computer programs and some exceptionally simple. These have been used to represent Cold-War Soviet leaders, Saddam Hussein, Kim Jong Il, and modern-day leaders of al Qaeda. Building such models has been a mixture of art and science, but has yielded useful insights, including insights about the sometimes-subtle influence of leaders' decision-making culture.

1 Introduction

1.1 Intent of Paper

This paper describes episodic research over several decades to build models representing an adversary so as to better understand him and his possible reasoning (the generic "him," whether an individual or a group, and whether male or female). This can aid in developing strategies to influence his actions—e.g., deterring him from aggression. When building such

models it is necessary to consider the influence of culture, but doing so has often been difficult and contentious. Leaders may be part of several cultures, each of which is only poorly understood by outsiders. Further, objective circumstances matter, even though viewed through culture-influenced lenses. The paper's examples involve leaders in such diverse cultures as Cold-War Soviet Communist leaders, a Muslim Baathist Iraqi despot, members of the North Korean Kim Dynasty, and Middle Eastern Islamist terrorist leaders. The dominant considerations in reasoning have sometimes been objective, sometimes cultural, and sometimes idiosyncratic. More often, all of these have contributed.

Before proceeding it is useful to draw a contrast. A common modern-day approach for research on systems that have thinking adversaries is agent-based modeling. Agent-based simulations can represent large numbers of interacting entities that make decisions about next actions. These can be used, for example, in describing "artificial societies (Epstein and Axtell, 1996);" business interactions in an information economy (Carley, 2002); complex societies with military, social, and economic turmoil (Chatuverdi and Dolk, 2011); and complex business challenges (North and Macal, 2007). This paper is instead about "simple models" that can be largely explained with a half-dozen viewgraphs or with small computer programs written in high-level visual-programming languages. Such models are intended to inform policy analysis. A historical example of "simple" is game theory's depiction of the prisoner's dilemma. This paper, however, goes well beyond the domain of economic rational actors. Further, it is less about rigorously posing and solving a problem than about understanding and perhaps influencing adversaries. Even more important, because of myriad uncertainties, the models I describe are not reliably predictive. Instead their function is to help us understand and act, but with humility and caution because of uncertainties.

1.2 Structure of Paper

The structure of the paper is as follows. Section 2 makes the case for why cognitive models are needed. Section 3 describes long-ago complex versions based on 1980's artificial-intelligence concepts and technology. Sections 4 and 5 describe early efforts to "skim the cream" of such work in the study of Saddam Hussein (1990-1991) and Kim Jong Il (1994). Section 6 describes an application integrating qualitative social-science information about terrorism. Section 7 discusses how such work can be extended to uncertainty-sensitive computational models. Section 8 offers principles for work of this general nature, which is a mix of art and science. Consistent with the intent of the larger volume, throughout the paper, I discuss how cultural considerations play a role—sometimes dominant, sometimes only contributory.

2 The Need for Cognitive Models

A core assumption in analytic work of the 20th century was that competitors behave in ways consistent with economic rationality: comparing the costs and benefits of options and choosing the course of action that maximizes subjective expected utility. The related theory is associated with such figures as John von Neuman, Oskar Morgenstern, and Leonard Savage. From the beginning, it was recognized that real people do not necessarily make decisions in that way. Thus, the distinction was drawn between normative (i.e., prescriptive) models and descriptive models: what people *should* decide is..., but what they *actually* decide is often different. Mainstream economics has been driven by the rational-actor model for the better part of a century. An immense body of psychological research exists on the descriptive side, usually associated with Nobel Prize winner Daniel Kahneman and his early collaborator Amos Tversky (Kahneman et al., 1982; Kahneman, 2002). The work is often referred to as about heuristics and cognitive biases. As has been decisively demonstrated, people aren't actually so rational. Even some economists have grudgingly accepted this, as reflected by the new sub-field of behavioral economics (Thaler and Mullainathan, 2005; Krugman, 2009).

The prescriptive versus descriptive distinction, then, has been important. Equally significant but less well recognized, however, is that the prescriptions of rational-actor theory have grievous shortcomings. The practical shortcomings were highlighted in the 1950s by Herbert Simon, who introduced the terminology of "bounded rationality," noting that decisionmakers did not have and could not obtain the information necessary for the idealized rational-actor calculations, that they could not make the complicated calculations anyway, and that in reality they *necessarily* used shortcuts—seeking "satisficing" solutions that were good enough (Simon, 1978). His observations crossed the boundary between prescription and description. Nonetheless, the rational-actor model continued to be seen as the normative ideal and a description of behaviors, which can be "as if" decided rationally even if the actual process is more complex (Friedman, 1953). Late in the 20th century, this assumption was fundamentally challenged by Gary Klein and Gerd Gigerenzer (Klein, 1998; Klein, 2001; Gigerenzer and Selten, 2002). Their research described humans as often using more intuitive decision processes. They *celebrated* this because, often, quick, intuitive decisionmaking is precisely what is needed. It may also be amazingly perceptive as discussed in a popular book (Gladwell, 2005). Although disputes were strong between the heuristics-and-biases school and the intuitive/naturalistic school, synthesis was clearly possible (Davis et al., 2005). Kahneman's most recent book partly synthesizes the two schools' themes by noting distinctions between thinking fast and slow, depending on circumstances (Kahneman, 2011).

An additional consideration of interest to policy makers, managers, and those who advise them is that the effort to do "rational" decision making and to have "rational" decision processes often devolves, in practice, to stultifying processes that lack imagination, creativity, and effectiveness. The options considered may be mundane and the result of log-rolling within the organization; the costs and benefits may be calculated with simplistic metrics; and the calculations may ignore uncertainties. Such processes may purport to be rational, but are not—if "rational" relates to wisdom (see also (Mintzberg, 1994)). Another problem is particularly relevant to this paper: when developing strategy to deal with an adversary, seemingly rational processes may miss the mark entirely because of mirror-imaging: assuming that the adversary reasons in the same way as the analysts, despite the adversary having a different vantage point, being in a different culture, and having his own history and idiosyncrasies. Consider the following:

1. *Cross-corporate negotiations* in which the underlying issues are not just profitability but the separate corporations' cultures and self-concepts (think of the failed mergers of Daimler-Benz and Chrysler, or of AOL and Time Warner). The issues are discussed with fictional companies in a thoughtful paper by Nigel Howard (Howard, 2001).
2. *Competitive military actions* by national rivals relating to arms, territory, navigation rights, and support of third countries (think of the U.S. and China).
3. *Crisis actions* by military antagonists who are concerned about avoiding catastrophe, but who are also concerned about, e.g., preserving power and saving face (think of the U.S. and Soviet Union during the 1962 Cuban Missile Crisis).
4. *A family-level battle of the spouses* over something objectively unimportant, but in the context of emotional past events (we can all think of many examples).

Outcomes for such clashes will be better if the sides understand each other in terms that go well beyond assuming narrow economic rationality. As researchers, we may therefore see value in constructing "cognitive models" of adversaries, competitors—or even spouses. What follows draws on my national-security research, but the ideas are more general.

3 Background: Large A.I. Models in Analytic War Gaming

3.1 Structure of the Approach

In the early 1980s, the U.S. Department of Defense sponsored an activity that generated what was called the RAND Strategy Assessment System (RSAS) (Davis and Winnefeld, 1983). This was a global analytic war game covering conventional war through general nuclear war. It was a large and automated computer simulation, but it was also game-structured with "objects" for what would be Red, Blue, and Green teams in human war games. It permitted substitution of

humans for agents, or vice versa. For example, a simulation might have agent-driven decisions by Red and third countries (Green), but decisions of a human team for Blue (Figure 1).

Figure 1 Architecture of the RAND Strategy Assessment System (1980s)

The RSAS allowed independent decisions (whether by humans or agents) by NATO, the Warsaw Pact, and individual nations. Rather than trying to “optimize,” the agents used heuristic artificial intelligence methods. We drew a sharp distinction between strategic-level decisions and operational-level decisions (Davis et al., 1986; Davis, 1989a). We saw the strategic decisions as requiring “national command level models” (NCL models) that would ordinarily just monitor developments, but that could choose to escalate the level or scope of conflict, or to otherwise change strategy. Although the models were rule-based, they were very different from the production-rule or expert-system models of the era because they were structured from a top-down strategic perspective. This structuring was in preference to having an inference engine trying to make sense of disorganized rules¹.

The operational-level models were more like commanders following a war plan, which might have contingent branches and be otherwise complicated because of the need to direct many different force operations. The agent commanders were more or less “following a slotted script” (Schank and Abelson, 1977; Steeb and Gillogly, 1983). They would adapt to developments, but the adaptations would be relatively straightforward. For example, during the simula-

¹ Some of this discussion draws on material in Chapter 3 of a recent National Academy report ((National Research Council, 2014).

tion the commander would each day allocate ground-force reserves to sectors where they were most needed and would apportion air forces across missions such as bombing air bases or attacking ground forces depending on the phase of the plan and event-driven needs.

The NCL models had to have a strategic construct (i.e., a "cognitive model"). Ours were based on escalation-ladder structures and the current and projected status of combat and conflict levels. Thus, a model might characterize its situation as "We are still conducting conventional conflict, but we're losing." This might lead to escalation if it seemed likely that the escalation would improve outcome, taking into account the other side's response.

Given this structure, how could it be "filled in" with content? In particular, what should the Red NCL model, the model of the Soviet Union's leadership, look like? How should it reflect differences in personality, history, and culture?

3.2 Uncertain Effects of Culture and Individual Characteristics

During the 1970s a fierce debate existed within the United States national-security community with one segment insisting that the Soviet Union was preparing to fight and win a nuclear war (Pipes, 1977). Strong evidence for this existed at the military level in the form of doctrine, practice, and general-officer admonitions. It was argued that Soviet political leadership grew up in the same culture as the military leadership, was subject to the planning realities of the Soviet military culture, and remembered having successfully survived World War II, despite thirty million losses. The last point, it was suggested, meant that the leadership was culturally aware of the ability to survive even after catastrophes (Wohlstetter, 1987). Another segment of the community, however, argued that Soviet leadership had no such illusions and understood well the realities of mutual assured destruction (Garthoff, 1978). They argued that the horrific memory of World War II made the Soviets more risk-averse, not less.

Given such disagreements among foreign-policy experts, how could the Soviet leadership be modeled? We did so by constructing *alternative* models (alternative "Ivans and Sams") reflecting the different postulated mindsets (Davis et al., 1986). Before expressing these in computer code, we constructed essays, temperament check lists, and illustrative decision trees to strengthen our sense of how the alternatives reasoned. The models' rules would need to reflect implicit assumptions and such devices helped us achieve a degree of coherence. We also avoided simple stereotyping. A "warfighting" Ivan presumably didn't *want* war, much less nuclear war, and a more deterrence-accepting Ivan presumably would fight strongly and use whatever means proved necessary. That is, circumstance and, e.g., perceptions of the adversary (the US and NATO) would interact with predilections. The simulation reflected this complexity. Depending on details of scenario, the "warfighting" Ivan might end up terminating conflict and the less-

warfighting Ivan might end up escalating to general nuclear war. Such model behavior frustrated some observers, especially those steeped in the fight-and-win Soviet military literature, but the context and path dependence of decisions seemed appropriate and consistent with history.

Overall, we concluded that Soviet leaders were far better understood as intelligent human beings with more or less universal characteristics of reasoning (and cognitive biases) than as cultural stereotypes, much less stereotypes drawn by U.S. analysts of Soviet military culture. Khrushchev's memoirs, for example, reveals thinking that reflected the Soviet view of the world (encirclement by enemies, constant pressures from the malevolent western powers, aggressiveness by the U.S., and a willingness to cope with whatever adversity arose, even war)(Khrushchev and Talbot, 1970). This was consistent with Soviet history and culture, as well as his own experiences. However, Khrushchev's reasoning was ultimately similar to Kennedy's: it was essential to find a way to avoid war, while allowing everyone to save face adequately. Remarkable discussions between former U.S. and Soviet leaders after the Cold War reinforce this imagery. The primary differences were rooted in history and psychology (e.g., the tendency to impute malevolent motives). Both sides were afraid of the other and could much more readily "see" the threatening behavior of the other side than that of themselves (Musgrave Plantation, 1994).

But what if the Soviet leadership had been different? After all, leaders change over time. In 2003, the Soviet leader, Yuri Andropov—previously, director of the KGB— was seriously concerned about the potential of a U.S. first strike. He worried that the U.S., rather than the Soviet Union, believed that it could fight and win. Since other officials did not share his fears, it is difficult to claim that he was captive to Soviet culture. Nonetheless, the fact that he had a distinctly different perspective reinforces the need to consider alternative models of adversary leadership when developing strategy. During the Andropov period, the U.S. and Soviet Union went through a serious crisis in 2003 without the United States even recognizing that a crisis existed. U.S. and NATO forces were exercising in ways that included nuclear escalation and the Soviet leadership feared that the exercises were cover preparations for an actual attack (Bracken, 2012). Only later did the U.S. come to understand all this. President Reagan in his later memoirs wrote:

Three years had taught me something...Many people at the top of the Soviet hierarchy were genuinely afraid of America and Americans.... many of us in the administration took it for granted that the Russians, like ourselves, considered it unthinkable that the United States would launch a first strike against them. But ...I began to realize that many Soviet officials feared us not only as adversaries but as potential aggressors who might hurl nuclear weapons at them in a first strike...(Reagan, 1990, pp. 588-89).

As an example of work with the RSAS and their Red agents, we conducted experiments with limited nuclear options. In addition to having alternative Red and Blue models, each Blue

had alternative models of Red, each of which had a simpler model of Blue, which had an even simpler model of Red. Similarly for Blue. In some cases, Blue would use a limited nuclear option to “re-establish deterrence,” as in NATO doctrine. Red, however, would perceive the act as Blue having initiated nuclear war and would initiate all-out general nuclear war. In other runs, depending on details and model, Red would de-escalate or simply proceed. Playing through mainstream scenarios, however, cast doubts on NATO’s concepts and plans for nuclear use shortly before collapse of its conventional defenses (Davis, 1989a; Davis, 1989b), suggesting that such late use might be ill-advised for reasons discussed below. We now know that similar conclusions emerged from sensitive high-level U.S. human war games conducted in the 1980s , games that ended in general nuclear war (Bracken, 2012).

3.3 Skimming the Cream with Simpler Adversary Models

Although we saw the RSAS as a technical success and greatly enjoyed building it because of the many substantive and technical challenges, I suspected (correctly, as it turned out) that it was too big and complex for use in government, rather than a Ph.D.-loaded think tank with people willing and eager to consider unconventional views (such as Soviet leadership understanding deterrence rather than reflecting Soviet doctrinal writings), and also too expensive to maintain.

A primary cause of complexity was that the NCL models had to be able to wake up at each time step, assess the situation, and consider options under arbitrary circumstances so that the simulation could proceed uninterrupted. Programming to achieve that would not have been so difficult if we had trivialized the substance, but to be realistic (even at low resolution), an agent had to look at the worldwide situation (developments in one theater might be favorable in one and unfavorable in another), to communicate and "negotiate" with allies, to consider options ranging from changes of military strategy at a given level of conflict to one involving, say, nuclear escalation, and so on. Further, in evaluating options, the model had to consider the other side's response as well as the likely decisions of numerous other countries. Even in a simplified approach, it was necessary to pay attention to alliances, permission rights, and the independent nuclear-use decisions of the UK and France. Further, judgements about the likely outcome of one or another option's military outcome were based on "look-ahead calculations" (simulations within the simulation) or subtle heuristics. On top of this, the RSAS contained a complex multi-theater model of combat, which became the Joint Integrated Combat Model (JIICM) that has now been used for more than twenty years by the U.S. Department of Defense and U.S. Allies.

I suspected that the "big" insights from the decision models could be obtained more simply. Using the earlier example where we learned that NATO's late use of nuclear weapons was problematic, the reason was ultimately simple: if Blue used one or a very few nuclear weapons in

an effort to reestablish deterrence by raising stakes, but did so only when it was about to lose badly in the conventional conflict, then Red could see the same reality—that NATO was about to collapse. It might therefore conclude that its way to major victory within a few days was by merely plunging ahead—perhaps responding only minimally if at all to NATO's demonstrative nuclear use. In contrast, a somewhat earlier NATO first use would have created a much bigger dilemma for Red. Indeed, in some of the simulations, Red did indeed terminate conflict: the risks that Red perceived were too great to do otherwise. Couldn't we understand that without all the complex apparatus and simulation? An opportunity soon arose to address the question.

4 Saddam Hussein

4.1 An Approach to Building Simple Models

By the late 1980s the U.S. was considering different possible adversaries, particularly Iraq's Saddam Hussein. Colleague John Arquilla and I constructed models of Saddam that could be reduced to a few viewgraphs (National Research Council and Naval Studies Board, 1996). We structured them around considerations that we believed would be on Saddam's mind as he contemplated alternatives. For example, we constructed Figure 2 to indicate with a cognitive map based on taking seriously Saddam's statements and taking a strategic view of what was in fact going on. The convention in such diagrams is that more of a variable at the start of an arrow tends to cause more of the variable at the end of an arrow, unless a minus sign exists, in which case more leads to less. The map describes a bad situation that is weakening Iraq and undercutting Saddam's ambitions—one seen as due significantly to a U.S.-Gulf-State *conspiracy*.

Figure 2 A Model of Saddam Hussein Assessing the Situation in 1990

Source: Adapted from Figure G.2.1 of National Research Council and Naval Studies Board, 1996

As in the earlier RSAS work we constructed alternative models because there were fundamental disagreements about how Saddam actually reasoned. Table 1 shows a 1990 depiction of the two models we used. This table was to summarize our mental models. Internalizing its content then led to specific decisions in structuring the analytic models. Model 1 was similar to the then-prevailing intelligence-community best estimate. Model 2 was our own construction. Model 2 proved to be more accurate when, in August 1990, Saddam invaded Kuwait.

A core concept of the approach was that we did not claim that one or the other model of Saddam was "right," but rather than strategy development should take seriously that Saddam's reasoning might be like either, or a combination. Appreciating that would encourage building a strategy that laid the basis for adapting to new information. As in a great deal of RAND work, the admonition is to seek a strategy that is flexible, adaptive, and robust (FARness), rather than a strategy tuned to some dubious best estimate . That is the key to planning under uncertainty (Davis, 2012).

Table 1 Alternative Models of Saddam Hussein (1990)

Attribute	Model 1	Model 2
Ruthless, power focused; emphasizes <i>Realpolitik</i>	••	••
Ambitious	••	••
"Responsive;" seeks easy opportunist gains	••	•
Impatiently goal-seeking; likely to seek initiative	•	••
Strategically aggressive with non incremental attitudes		••
Contemptuous of other Arab leaders	•	••
Contemptuous of U.S. will and staying power		••
Financially strapped and frustrated	••	••
Capable of reversing himself strategically; flexible (not suicidal)	••	••
Clever and calculating (not a hip shooter)	••	•
Pragmatic and once burned, now cautious	••	•
Still risk taking in some situations	•	••
Grandiosely ambitious	•	••
Paranoid tendencies with some basis	•	••

Concerned about reputation and legitimacy in Arab and Islamic worlds	•	
Concerned only about being respected for his power		••
Sensitive to <i>potential</i> U.S. power not immediately present	••	•

Note: Number of bullets indicated degree to which model reflects the row's attribut. The table is reconstructed from Table G.2.2 of National Research Council and Naval Studies Board, 1996 and earlier RAND work (Davis and Arquilla, 1991a).

Moving forward, we concluded that even a leader attempting to be rational is doing well if merely he considers upside, downside, and best-estimate outcome possibilities for several options.² That is, we saw Saddam as perhaps having a de facto cognitive structure such as in Table 2. A given model of Saddam would give different weights to the most-likely, best-case, and worst-case outcomes estimated for an option when making his net assessment. Later work generalized this scheme to allow the combining rule to be more complex than mere linear-weighted sums.

Table 2 Generic Decision Table

	Estimated Outcome						Net Assessment of Option	
	Most Likely Case		Best Case		Worst Case		Model 1	Model 2
Option	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2		
1								
2								
3								
4								

Note: This is a more general version of a table used in the original work (National Research Council and Naval Studies Board, 1996).

We asked in 1990, before and during the crisis that led to Saddam's invasion of Kuwait, how Saddam might assess the likely outcome of different options, such as do nothing, mount a smallish invasion, or mount a full-scale invasion of Kuwait and Saudi Arabia? Although it would be possible to use a combat model to estimate such things, we thought it better to draw on more general knowledge to make the estimates subjectively, thereby including all-important "soft" variables ignored by combat models.

² This sense was confirmed in a 2004 unpublished review by me, Brian Jenkins, John Arquilla, Michael Egner, and Jonathan Kulick of high-level decisionmaking that drew on the memoirs of top officials, noting frequent shortcomings in the ability to look at both upside and downside potential as well as the alleged best estimate.

As the crisis unfolded, we structured Saddam's estimate of the Worst Case (calling it Risks) as in Figure 3. In doing so we were calling upon then-current real-world factors visible at the time. During the 1990 buildup before Saddam actually invaded, we used this structure and concluded with some alarm that deterrence was quite weak (Davis and Arquilla, 1991a). Saddam might reason (as did most U.S. experts at the time) that even if the U.S. was willing to defend Kuwait (unlikely), Saudi Arabia would not cooperate. Further, Saddam would see no warning signs to indicate actual U.S. resolve. The only political warning was minimal and ambiguous and the only military warning was a very weak military exercise, as noted later by other authors (Stein, 1992; Walt, 2011; Marla, 2015; Mearsheimer and Walt, 2002). Saddam did in fact invade. The U.S. government was surprised because its "mental model" of Saddam was akin to that of Model 1 in Table 1, with no hedging against error. A primary value of cognitive modeling of the adversary is to highlight the need to hedge against misunderstanding the adversary.

Figure 3 Structure of Possible Saddam Reasoning About Downside Risks of Invading Kuwait

Source: Redrawn from Figure G.2.2 of National Research Council and Naval Studies Board, 1996, taken from (Davis and Arquilla, 1991a).

4.2 The Roles of Personality and Culture?

When studying and modeling Saddam Hussein, we had to contend with different views on the issues of personality and culture. Some analysts at the time saw Saddam as reckless and risk-taking; others did not. Some regional experts insisted that Saddam would never do this or that because, in their view, that would be inconsistent with his culture. Hmm. *Which* culture?

Saddam was a Baathist leader in an Arab Muslim country. Which culture would influence him, and how? What seemed to us most relevant was that Saddam had gained power with a combination of violence and wile that would make the worst Mafia leaders proud. Yes, Iraq was a Arab Muslim country, but—on the scale of things—rather secular. Would he never retreat or surrender because of culture? Really? Should we imagine irrationality? Although we attempted to fold in some cultural considerations in our modeling, we concluded—in large part from his speeches and history—that the most dominant considerations were rational, but through the lens of a particular type of personality recognizable among cultures. In this we were supported by the work of Jerrold Post (previously head of a profiling unit at CIA), who developed a detailed psychiatric profile of Saddam and concluded that Saddam was best understood as a malevolent narcissist (Post, 2008), a diagnosis with numerous implications. Today, we know a great deal about Saddam due to extensive interviewing and document recovery after the Gulf War in 2003. My personal reading of the evidence is that the broad cultural lens (Arab Muslim, etc.) was the wrong way to see Saddam. The rational but malignant narcissist label seems apt, when coupled with misperceptions. The second of our two Saddam models was close in many respects.

Taken together, the wars in Iraq in 1991, 2003, and subsequently, provide evidence for the role of culture. The aftermath of the 2003 invasion by the U.S. and allies saw Iraq break into a Sunni-Shia conflict that persists to this day and will probably lead eventually to a dissolution of Iraq. That history reflects many decades of tension that experts on Iraq warned about before the 2003 invasion. Even so, we should avoid the error of assuming that the dark side of cultural clashes will inevitably dominate events. There is good reason to believe that the Balkan wars of the 1990s were not inevitable due to the much discussed ancient ethnic hatreds. Rather, the vestiges of those hatreds were exploited by Slobodan Milosevic for his personal agenda (Zimmerman, 1995). Similarly, the tragedy that has befallen Iraq in the last half-dozen years was not inevitable because of Shia-Sunni history, but rather was the consequence of leaders, such as the past President of Iraq, Nouri al-Maliki, failing to rise above that history. That said, anyone who ignores the dark sides of history and culture is likely to make poor bets.

5 Modeling North Korean Leaders in the Context of Nonproliferation Negotiations

5.1 Cognitive Modeling When One Lacks Personal Detail

Another application of the simple-modeling approach was an attempt to understand what the then-new leader of North Korea, Kim Jong-Il, might do in negotiations about nuclear weapons. At the time, the United States was putting the vast weight of its negotiating capital into an attempt to get North Korea to cease and desist from nuclear development, and to reveal and

dismantle prior developments. Could cognitive modeling help? Unfortunately, we were unable to obtain significant information about Kim Jong-Il personally, although much more information came out over the next decade (Oh and Hassig, 2000; Lankov, 2013). Thus, our "cognitive model" had to be based more on a combination of political science and a broad strategic understanding of the Korean-peninsula issues, than on something more personal.

We attempted to be dispassionate and to understand how the situation would be viewed by Kim Jong Il. That is, we could not understand his ideosyncracies at that point, but we could—with effort—view the strategic situation from his vantage point. We concluded that to the North Korean leader the issue was not "proliferation" but rather considerations such as suggested by the cognitive map in Figure 4 (Arquilla and Davis, 1994).

Figure 4 Cognitive Map of Kim Jong Il

Source: Redrawn from Figure 2 of Arquilla and Davis, 1994.

After considering alternative versions of such cognitive maps, we constructed more nearly hierarchical cognitive models such as that in Figure 5, which framed the thinking in terms of natural objectives for the despotic leadership of North Korea. This structure had much in common with later work described in an excellent study of proliferation issues by Stanford University's Scott Sagan (Sagan, 1996). The primary observation to make is that "proliferation" or "non-proliferation" is not the point when framed in this cognitive model. Instead, the model identifies objectives such as security, national power and prestige, and the Kim rulers' power and aspirations.

Figure 5 Issues Affecting Decisions about Nuclear Proliferation

Source: Redrawn from Figure 1 of Arquilla and Davis, 1994.

Despite considering alternative models, we concluded (Table 3) that North Korea would be very unlikely to truly give up nuclear weapons. Having such weapons would be seen as too fundamental to regime survival and deterrence of the United States. North Korea might agree to something and cheat (Option 5), but not truly give in. On many other issues, the alternative models would reach different decisions, but not on this. In this instance, it seemed to us that strategic considerations were dominant. The facts of the matter are still not clear because no authoritative inside history of North Korea has been released or is likely to be released. Some evidence exists to the effect that, for a period at least, Kim Jong Il was interested in negotiations and potentially willing to go a long way on nuclear weapons (Chinoy, 2008). That window, if it existed, closed rather quickly and, as is now well known, North Korea has developed nuclear weapons. It clearly seems them as an important element in deterring South Korea and the United States.

Table 3 Option Comparison with a Cognitive Model of North Korea

Option	Most Likely Outcome	Worst-Case Outcome	Best-Case Outcome	Net Assessment of Option
1. Forego nuclear weapons and WMD	Very Bad	Very Bad	Bad	Very Bad
2. Forego nuclear weapons but develop other WMD	Bad	Very Bad	Marginal	Bad
3. Sign NPT but continue modest nuclear program	Marginal	Very Bad	Good	Marginal

4. Acquire nuclear weapons	Marginal	Very Bad	Good	Marginal
5. Agree to forego nuclear weapons if and only if conditions are met, but cheat (covert acquisition)	Good	Very Bad	Good	Good
6. Agree to forego nuclear weapons if and only if conditions are met	Bad	Very Bad	Good	Marginal

Source: Table 3 of Arquilla and Davis, 1994, for the model that has objectives of long-term survival and reasonable prosperity, place in history, and eventual unification preserving power of North

6 Using Cognitive Models To Understand Terrorism and Public Support for Terrorism

6.1 Background

After the September 11, 2001 attack on New York's Trade Center and the Pentagon, RAND and the Institute for Defense Analyses were asked to run a joint study on whether a "deterrent strategy" should be part of the U.S. effort to combat al Qaeda. My colleagues and I sketched a "system view" of terrorism that allowed us to say that, while deterring Osama bin Laden was not in the cards, deterrence and other influences might be very important with respect to other elements of the terrorist system (e.g., its logisticians, financiers, theologians, and other enablers)(Davis and Jenkins, 2002). It seemed evident that we should experiment with some cognitive modeling, but other priorities caused that to be deferred for some years.

In 2007 the Department of Defense asked RAND to review the social science that should inform counter-terrorism efforts. This was a time when many people were offering half-baked or flatly incorrect claims that terrorists were crazy, the result of poverty, or the special consequence of Islam. Our review was an opportunity to call on the rich body of literature by social scientists who had actually studied terrorism for years in the field, including my co-editor Kim Cragin (Davis and Cragin, 2009). The book began as an edited collection of essays on aspects of the problem (what are the root causes of terrorism, how do the terrorists become radicalized, why does the public support them, etc.). We found, however, that the collected chapters didn't cohere and that the individual chapters had structural problems. We then introduced the factor-tree methodology as described below, akin to building cognitive models, to tighten and organize dis-

cussion. The factor trees became the mechanism for internal debate and, then, for briefing our research to both academic social scientists and senior military and civilian leaders. Sometimes, simple graphics can be powerful for communication even if their information content is no greater than a corresponding essay. Beyond communication I had the ambition of moving social-science discussion away from statistics (e.g., is terrorism statistically correlated with poverty?) and toward causal modeling. The "model" would be qualitative because that is the nature of the more profound knowledge of terrorism, but it would have degrees of other features that we look for in analytic work: structure, logical flow, defined concepts, falsifiability, and reproducibility. In my view, causal models—even if soft and imperfect—are needed to inform policy decisions.

6.2 The Approach of Factor Trees

Figure 6 illustrates a factor tree (Davis et al., 2012) for public support of terrorism. In some ways, this is like a cognitive model of the abstraction that we call "the public." It is merely a graphical depiction of factors and their relationships." However, the factors shown are intended to be comprehensive and based on the research base (experts are very good at identifying factors, but often not in making predictions). Also, the factor tree is a multi-resolution qualitative *causal* model. It is for a snapshot in time.

Figure 6 A Factor Tree for Public Support of Terrorism

NOTES: Applies at a snapshot in time. Current factor values can affect future values of some or all other factors.

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Considerable work is necessary to construct such qualitative models (Davis et al., 2012). Fiery arguments arise about whether to include or exclude individual factors, approximating completeness is challenging without a mathematical theory to guide the process, and the same concepts can be described in different ways. Nonetheless, it was possible to generate diagrams and have them extensively peer-reviewed.

We also found ways to accomplish a limited form of validation (Davis et al., 2012). We conducted four new case studies to see whether, in those new cases, the same factors arose. Had we left some out? Were some of the factors unique to a particular episode in history? We found that the factor tree held up well, although we learned and refined. As expected, the relative importance of factors varied with case but, as theory predicted, the relative importance of factors also varied over time. Why? As my colleague Eric Larson emphasized after drawing on social-movement theory, the insurgent organization and the government are in a competition for the minds of the public: they will look for all the levers they can manipulate. Thus, if a lever has not previously been used, it may be in the future.

To illustrate the difference between generic and context-specific factor trees, Figure 7 shows the factors that we found (in work by Zach Haldeman) to be important, circa 2010, for public support of the Taliban in Afghanistan. Identity, leadership, religion, and culture all played an important role (as indicated by arrow thickness), as well as intimidation and judgments about likely victor. Other actors, such as personal gain, were much less important in the period studied.

Figure 7 A Specialized Factor Tree for Afghani Public Support of the Taliban

6.3 Reflecting Culture

As with the other examples, representing cultural issues proved both difficult and contentious, but also important. Some particular instances come to mind:

- Many American political scientists, even terrorism experts, strongly resisted the notion that religion was playing a big role in Al Qaeda's terrorism. They had been educated to believe that religion was usually just a cloak for motivations that were more broadly political or selfish (as in power-seeking). They correctly pointed to the long history of terrorism in which other, non-religious, factors were actually dominant even when religion was invoked. This view was supported by research indicating that many of those in al-Qaeda had only the most superficial knowledge of Islam or any other religion (Sageman, 2008).
- Some other political scientists, however, characterized what was happening as a Clash of Civilizations deeply rooted in the teachings of a significant strand of Salafi Islam.
- This disagreement about "who is the enemy?" continues today, as is being played out in the 2016 political debates within the United States and Europe.

My own thinking has been affected by a tendency to think in system terms. Although modeling "al Qaeda," we needed to recognize that al Qaeda's top leaders (bin Laden and al-Zawahiri) were likely quite different than many others in the al Qaeda organization. From their speeches, from al-Zawahiri's writing, and from careful biographies (Wright, 2006), it was clear that they were indeed driven by religious ideas rooted in the Salafist tradition. They were *also* deeply affected by the history and culture of their region, which included what many Muslims have seen as the humiliating decline of the Islamic world in recent centuries (Lewis, 2002), by the colonial period, and what they saw as the clever and insidious continued colonization of the middle east through the West's manipulation of their "masked agents" (the despots of Saudi Arabia, Egypt, and other regional states) (al-Zawahiri, 2001). I found al-Zawahiri's writing on such matters striking enough to assign it to graduate students. With only a modest amount of imagination, they could imagine it being appealing to impressionably young students of the Middle East, as Sayyid Qatb's writing had influenced a college-age bin Laden.

Spiritual Advisors. My colleague Eric Larson studied the writings of Muslim thinkers spiritually influential within al Qaeda, demonstrating the rigor of the discussions and their deep basis in Islamic writings. That basis is unquestionable, even though the beliefs are held by only a small portion of the Islamic community. All major religions have their dark side.

Foot Soldiers. As for spear-carriers and foot soldiers within al Qaeda, motivations vary drastically (as in the motivations for support of terrorism in Figure 7). Many were reasonably

depicted as just a "bunch of guys" (Sageman, 2008), but motivations included a desire for glorious action and violence, enjoyment of the organization's camaraderie, revenge, and various others. A sense of Muslim identity was particularly important.

As of 2016, it is the Islamic State that is most prominently discussed in connection with terrorism. I have made no effort to build models of ISIL leadership, but again there would be conflicting considerations. Many within ISIL's leadership are true believers in a particular version of Salafist theology (Wood, 2015). They are deadly serious about the Caliphate and their desire to adopt the features that they imagine characterized the excellent period of Islamic history in the 7th century. Their behaviors and rhetoric are consistent, even down to the level of their attitudes about beheadings, women, and sex slaves. At the same time, some in ISIL, including military leaders, are left-overs from Saddam's brutal Baathist military, hardly known for its religiosity. These leaders are probably adopting the religious mantle because it suits their purposes as they seek power. To model ISIL leader Abu Bakr al-Baghdadi, then (he even holds a doctorate in Islamic studies), is not the same as modeling other leaders or ISIL as a whole. More broadly, the expressed motivations of various ISIL participants vary widely, from thrill-seeking to religion (Quantum, 2015), as expected from the earlier work (see motivations in Figure 6).

7 A Computational Implementation of Factor Tree Models

When showing our factor trees, we urged the analytic community to see structuring qualitative factors as more important than doing the quantitative analysts beloved by analysts. We argued that it is possible to *understand* the reasoning of an adversary, and to identify ways to influence it, without being able to predict reliably the adversary's conclusions. Our arguments resonated, particularly with leaders having operational experience in complex campaigns.

7.1 Public Support of Terrorism (A Cognitive Model of "the Public")

It was with trepidation, then, that we began building a computational implementation of the factor-tree model (Davis and O'Mahony, 2013). Was this a repudiation of our earlier message? Not really. We chose public support for terrorism as our example. Turning the factor tree into a computational model brought out all the traditional challenges of modeling, and then some. We had to define the variables, indicate how to measure them (using qualitative scales), construct functional forms for their interactions, etc. The latter was especially difficult because no one claims to understand those functional forms reliably. A few "building-block" functional forms, however, went a long way in allowing us to represent the kinds of interactions that we recognized as occurring. For example, if "the public" is disaggregated into disputing factions, is the net result a shift to the view of the stronger factor or is it instead a watered-down mix? These are profound issues in social science, but these bounding cases can be treated with simple func-

tions. It's just that we don't necessarily know which function will be more accurate. Further, we are dealing with complex adaptive systems, so the behavior of which is not predetermined.

We made uncertainty a fundamental, explicit, and difficult-to-avoid feature. We tried to preemptively eradicate the tendency to see models as predictive with some sensitivity analysis as "optional." Figure 8 shows an illustrative output. The items at the top are variable parameters. Thus, the user can do exploratory analysis, varying these simultaneously rather than merely doing sensitivity analysis. For the particular settings shown, and looking at the rightmost bar, public support is 9 (very high) if motivation for the cause is very high (horizontal axis), intimidation by the insurgent group is very high (the "key variable" distinguished by color of bars), and—shifting to the list of variables at the top of the screen, the insurgency's organization effectiveness is very high, etc.³

Figure 8 Public Support as a Function of 14 Variables

Figure 9 illustrates how effects of a great deal of uncertainty-related analysis can be represented (Davis and O'Mahony, 2013). The figure shows the extent of public support (indicated by cell number or color) as a function of five variables. Although briefing such a display must be

³ The model was developed in *Analytica*, sold by *Lumina*. It was originally developed at Carnegie Mellon University and features visual programming and "smart arrays," which are powerful for uncertainty analysis.

done slowly and in layers, audiences can understand the results and appreciate just how many what-if questions are being addressed in one fell swoop.

Figure 9 Public Support as a Function of 5 Variables

Note: the numbers 1, 3, 5, 7, 9 correspond to very low (VL), low (L), medium (M), high (H), and Very High (VH). The ratings are from the perspective of the counterinsurgent side. Thus, 9 (red) is very adverse for it, but very good for the insurgency.

7.2 Extending Uncertainty Analysis in Simple Computational Social-Science Models

Very recently, Walter Perry, John Hollywood, David Manheim and I have studied concepts and methods for heterogeneous information fusion in the context of detecting terrorist threats (and also exonerating those falsely suspected). This has not been about cognitive modeling, but has used some of the same methods. In particular, we used a qualitative model based on the factor-tree work to help fuse fragmentary information. In that study we attempted to confront *all* the uncertainties of the problem, structural, parametric, and procedural. For example, we built in the ability to easily vary the functional forms for how factors combine, the values of related parameters, and even the order of processing reports (Davis et al., 2016). The same methods would apply for cognitive modeling.

7.3 Computational Models of North Korea Informed by Human Gaming

The most recent work with cognitive modeling has been in cooperation with the Korean Institute for Defense Analyses (KIDA) in Seoul. We are using a combination of simple cognitive modeling and human gaming to better understand issues of deterrence and stability in the Korean peninsula. A major objective is to use the modeling to design human exercises, to conduct human exercises to test the model and point out shortcomings, and to then improve the models accordingly (Davis et al., forthcoming). This is by analogy with the model-test-model approach in many domains of research and development.

Personality and culture again matter. With respect to culture, what matters is less "Korean" culture than the "Kim Dynasty culture" in which the ruling Kim despot is treated as God-like and people are barraged throughout life with propaganda about the wonders of the North Korean system and the magnificence of their leaders (Oh, 2013; Bowden, 2015). Even if we accept the fundamental importance of that culture, would Kim Jong Un behave in crisis stereotypically and fatalistically, or would he reason in a way that an economist would regard as rational, although driven by a "bad" utility function prizing the ability to remain in power? The jury is out, but—based on experience with his father Kim Jong Il and Kim Jong Un's behavior to date— it seems that Kim Jong Un is best understood as violent, ruthless, picking up in the footsteps of his father, but also rational.

An interesting question is whether the artificial environment of the Kim Dynasty will degrade his rationality over time. After all, in such a despotic culture, we would hardly expect advisors to tell him things he doesn't want to hear or to question his beliefs. Further, at some point, a person that has been treated like a God might come to believe some of his own propaganda. Would that potentially mean that he would value a "glorious" death to something that would spare his people?

The spectre of an adversary seeking a "glorious" death has some basis. Adolph Hitler went through a period when he seemed strongly to embrace the concept of the glorious death. In discussing the possibility of dying in battle, he expressed the view that his death would be inspirational:

We shall not capitulate...no, never. We may be destroyed, but if we are, we shall drag a world with us...a world in flames...we should drag half the world into destruction with us and leave no one to triumph over Germany. There will not be another 1918 (Langer, 1943)

In the end, Hitler just committed suicide, but what if he had had nuclear weapons?

As a final example to remind us of how important non-rational considerations can be, including those due to culture, consider the Japanese decision to attack Pearl Harbor. This was a

decision made with the *knowledge* that Japan could not plausibly win a long war with the United States. Recent scholarship based on unprecedented access to Japanese primary materials reinforces the conclusion that the Japanese decision was strongly affected by considerations as (1) avoiding shame, (2) a sense of persecution and wounded pride, (3) a belief in the "Yamato spirit" referring to a perceived Japanese trait of being unique, resilient, disciplined and hard-working, (4) a willingness to gamble based in part on Japan's success in its 1904-1905 war with Russia, (5) *hope* that the United States, if badly bruised would quickly tire and sue for peace, and (7) a sense of desperation because the U.S.-British embargos were undercutting their rightful ability to expand their empire (Davis et al., forthcoming; Hotta, 2013). Could similar ideas influence a Kim-Dynasty leader at the time of some future crisis?

8 Conclusions and Suggestions for Research

From this paper's research involving simple cognitive models and related methods, it seems that the most important points for the present volume are these:

- Cognitive modeling should be undertaken with humility. History is replete with examples of failures to understand the adversary. A more fruitful approach is constructing *alternative* models rather than reflecting only the current best estimate, which is often wrong. Even having two well-chosen alternatives can highlight uncertainties and possibilities, improving the ability to construct an appropriately hedged and adaptive strategy. It is necessary, however, for the alternatives to be taken seriously, rather than as the best estimate plus a token variant.
- The models should have a structure *allowing* for a version of rational-actor decision making: multiple objectives, multiple criteria for their evaluation, a range of options, option comparison by the recognized criteria, evaluation of options based on best-estimate, best-case, and worst-case outcomes, and a net-assessment calculation.
- In estimating each of the elements of that model, however, the analyst should consider alternative models, and their *perceptions* of the elements as affected by information, cultural and personal biases, and situationally dependent factors such as desperation and related risk-taking propensity. Also, the net-assessment calculation should be model-dependent, and may need to be nonlinear (heuristics introduce edges amounting to nonlinearities).
- Both perceptions and net-assessment logic may be affected by emotional considerations, to fear, desperation, and culturally fueled hatred.
- Such estimates should be guided first by *qualitative* constructs in tune with actual human psychology rather than such analyst abstractions as narrow cost-effectiveness. Factor trees are especially useful for such purposes.

- Computational models should be avoided *except* when simple and routinely uncertainty-sensitive. Enforcing a shift to uncertainty-sensitive models is difficult because of ingrained habits and limitations of common modeling and programming technology. With more appropriate methods and technology, routine exploratory analysis under uncertainty can be straightforward. Modern methods, such as those in data mining, can be valuable in inferring conclusions that are relatively robust to assumptions (Davis, 2012).

About the Author

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