Intelligence and National Security
2018, 33(6): 904-917

Positivism and Its Limitations for Strategic Intelligence: A Non-Constructivist Info-Gap Critique°

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Outline:

Abstract

Knowledge underlies rational choice between options. Predictive optimization is the prioritization of options according to their predicted outcomes based on available knowledge. The epistemological justification of predictive optimization is based on positivism, which asserts that facts and laws about the world exist and are discoverable. However, knowledge of human affairs in strategic adversarial interactions is often severely limited and erroneous: residual uncertainty is often vast. This results especially from deception and innovation by the adversary which introduce deep Knightian uncertainty. Consequently, predictive optimization is unreliable: outcomes may differ substantially from predictions. An alternative strategy for prioritization of options is info-gap robust satisficing: achieve critical goals (that are adequate but perhaps suboptimal) over a wide range of deviation of reality from current knowledge. The epistemological justification of robust satisficing is based on extending positivism to acknowledge and manage the unknown. Prioritization of options by robust satisficing manages both the limitations of knowledge and the need for achieving critical goals. This critique of positivism is not constructivist. Rather, we extend positivism to account for highly deficient knowledge. We present several examples and conclude by discussing the relation between inductive, abductive and deductive inference.

Methodological Issues in Strategic Intelligence Analysis

Intelligence analysis in support of strategic decision making raises acute methodological issues and disputes. In this section we briefly review some recent methodological debates, as background for developing the methodological contribution of this paper. Specifically, we will see that much current methodological dispute focuses on the divergence between positivism and constructivism (or related ideas with different names). This paper is a non-constructivist critique of positivism, extending positivism to acknowledge that some elements of the world of human affairs are in principle unknowable.

Numerous methodological schools are discussed in intelligence literature. We look at three: positivism, realism and constructivism, which each have diverse interpretations. Very briefly, *positivism* asserts that

° \papers\positivism-mil-intel\pmi005.docx 26.2.2018.

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facts and laws about the world exist, are discoverable by the scientific method of observation, hypothesis and falsification, and that all other supposed forces, mechanisms or materials are imaginary and irrelevant.[1] *Realism* asserts the existence of material objects independent of human thought, as opposed to idealism that denies material existence apart from human thought and consciousness.[2] Realism partially overlaps with positivism. Realism emphasizes the ontological assertion of physical existence independent of human thought, while positivism emphasizes human discovery of knowledge about the independently existing reality.

Constructivism is the most elusive methodology of those we are considering, with the greatest range of conceptualizations. As Lillbacka writes,

> "Constructivism emerged as a postmodernist critique of realist epistemology. ... [I]t denies the existence of any objective truth. Constructivism is essentially an idealistic and relativistic skepticism, claiming that even if a mind-independent reality existed, the human mind would not be able to access it. 'Truth' and 'knowledge' are always subjective, created by a conscious subject, and not discovery of a pre-existing 'mind-independent' world outside of the mind of the observer."[3]

While realism is closely related to positivism, constructivism in all of its diverse manifestations is strongly opposed to both realism and positivism.

Lillbacka criticizes constructivism primarily on epistemological grounds, writing that

> "Because constructivism denies the existence of objective facts, it cannot provide any criteria for 'good science,' or for distinguishing knowledge from theory, fantasy, or even psychotic states. Constructivist 'knowledge' is largely equated with beliefs shared within a community. … Constructivism basically implies that knowledge in the sense commonly understood is impossible."[4]

For the present paper the importance of Lillbacka's critique is the fact that, in addition to the epistemological focus, it also emphasizes the importance of topical knowledge: "The primary concern and challenge of intelligence analysis is how to use insufficient data to understand real-world phenomena, rendering it inherently realist."[5] The understanding referred to here is in the topical domains of social and humane sciences. Intelligence analysis uses data to understand history, economics, psychological, ideology, etc., and their specific realizations such as intentions, capabilities, plans, strategies, and so on. While these elements are essential in intelligence analysis, we will subsequently demonstrate the need to augment this topical expertise with decision theoretic expertise, and discuss a method to do so. This underlies our non-constructivist critique and extension of positivism to manage the unknown and unknowable aspects of the subject of analysis. We don't reject the basic positivist contention that realistic knowledge about the world can be obtained. However, we modify positivism to acknowledge and manage important aspects of the world of human affairs that are in principle unknowable.

In contrast to Lillbacka, Manjikian criticizes positivism, writing that

> "Even the words used to ask a question can affect the answer received. Thus, in recent years, in place of positivism, many social science communities have embraced new methodologies and methodological tools, including discourse analysis, constructivism, and critical theory. And, in each case, the move away from positivism rests on an acknowledgement that positivism has failed in its goal of producing neutral,

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[1] Paul Edwards, editor in chief, 1996, *The Encyclopedia of Philosophy,* Simon and Schuster Macmillan, New York, Vols. 1-8 in 4 volumes. Entry on positivism.

[2] *Ibid,* entry on realism.

[3] Ralf G. V. Lillbacka, 2013, Realism, constructivism, and intelligence analysis, *Intl J of Intelligence and Counter-Intelligence,* 26(2): 304-331, p.308.

[4] *Ibid,* p.311.

[5] *Ibid,* p.315.

clean, value-free analysis about the social world – since the social scientist is ultimately unable to theorize in isolation, being unaffected by personal values and perceptions as well as those of the environment."[6]

She illustrates this by noting that the designation of "a country as a 'failed state,' ... can be applied only if the analyst has in mind an idea of what a functioning state looks like".[7] Our aim here is not to adjudicate this dispute over the relative merits of positivism and constructivism. Rather, we point out that Manjikian's critique emphasizes the importance of topical knowledge in the social sciences. Without disputing this importance, we will show that decision theoretic expertise is also an essential element in strategic intelligence analysis because some aspects of human affairs cannot be known. This critique of positivism is not constructivist.

Zohar, in discussing 'grounded theory' for qualitative intelligence analysis, writes: "Intelligence analysis … combines evidence and reasoning in order to produce judgments, insights, and forecasts intended to enhance the understanding and reduce the uncertainty of national security policymakers in relation to an enemy." He continues that "the intelligence analyst must maintain a focus on learning the meaning that the participants have assigned to a problem or issue. Most important, intelligence analysis … aims to develop a complex picture of a security problem or security issue under study."[8] The understanding and uncertainty-reduction depend on topical understanding of politics, organizations, economic factors, ideological motivations, and so on. We will explain that decision theoretic expertise needs to supplement this topical expertise, unlike both positivism and constructivism, in order to manage vast uncertainty that is in principle unresolvable.

Kuhns clearly identifies the role of social and humane sciences, asserting that "intelligence estimating seems closer to science than pseudo-science." Furthermore, "social scientists and historians" study human affairs and discern "patterns of behavior, similarities that exist in events that are widely separated by time and distance, [that] do make it possible for us to generalize about important human endeavors. Warfare is an example."[9]

Marrin introduces a special issue of *Intelligence and National Security* devoted to "inter-disciplinary connections" between social science and intelligence, "to improve the rigor of intelligence analysis".[10]

Walsh, in that special issue, emphasizes qualitative methodologies for strategic intelligence analysis. He elaborates a distinction between positivist or empirical analyses that "explain" the "social world", and interpretivism or constructivism that provide "understanding" of it.[11] Most importantly for our discussion, Walsh argues "that intelligence analysis and by extension strategic/estimative analysis can be viewed as an inter-disciplinary social science."[12] We will augment Walsh's argument by adding decision theoretic expertise to topical social science expertise, for example to "enhance current collection and analytical

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[6] Mary Manjikian, 2013, Positivism, post-positivism and intelligence, *Intl J of Intelligence and Counter-Intelligence,* 26: 563-582, p.565.

[7] *ibid,* p. 571.

[8] Eran Zohar, 2013, Intelligence analysis as a manifestation of a grounded theory, *Intl J of Intelligence and Counter-Intelligence,* 26: 130-160, pp.130, 134.

[9] Woodrow J. Kuhns, 2003, Intelligence failures: Forecasting and the lessons of epistemology, pp.80-100 in Richard K. Betts and Thomas Mahnken, eds., 2003, *Paradoxes of Strategic Intelligence: Essays in Honor of Michael I. Handel,* Routledge, London, pp.86, 87.

[10] Stephen Marrin, 2017, Understanding and improving intelligence analysis by learning from other disciplines, *Intelligence and National Security,* 32(5): 539-547, pp.539, 541.

[11] Patrick F. Walsh, 2017, Improving strategic intelligence analytical practice through qualitative social research, *Intelligence and National Security,* 32(5): 548-562, p.552.

[12] *Ibid,* p.549.

procedures"[13] by managing the impact of the extensive uncertainty that inevitably remains after topical expertise has reduced as much uncertainty as possible.

The relevance of social and humane sciences to strategic intelligence analysis is widely accepted. Nonetheless, Phythian, in the same special issue, points out several important distinctions. First, the social scientist typically has abundant data, while "For professional intelligence analysts ... limited data is enough. In fact, it is the norm." Second, "social science is an inescapably retrospective science", attempting to "explain the driving forces behind events – that is, to provide causal mechanisms … after the fact", while intelligence must often provide warning or foreknowledge.[14] Third, deception is prevalent in intelligence work, but much less so in social science.[15] Nonetheless, despite these important differences, Phythian's "essential point" is that intelligence analysis is "based on mental models of individual and group motivation and behaviour that are themselves based on social science theories, however implicitly."[16]

The central contribution of social science and humanities is undisputed. We now proceed to demonstrate the essential contribution of decision theoretic expertise in extending the positivist paradigm.

The next section contains a preliminary discussion of reducing the impact of uncertainty, with implications for positivism. This is followed by discussing an irrevocable indeterminism, due to Shackle and Popper, that limits the ability to predict outcomes in human affairs. We will contrast this with positivism that characterizes prediction in the physical sciences. In the subsequent section we succinctly summarize the info-gap robust-satisficing approach to strategic foresight and policy selection under severe uncertainty. We illustrate the method and its implications with three examples. We conclude by discussing inductive, abductive and deductive inference.

Reducing the Impact of Uncertainty: Preliminary Discussion

Gill offers the following cautious support for positivism:

> "The search for 'truth' in intelligence is praiseworthy and accounts for the dominance of positivism within intelligence but it may be highly misleading – the more so the greater the complexity and uncertainty of the threat being assessed."[17]

This is an apt introduction to our critique and extension of positivism to acknowledge and manage the vast unavoidable unknowns in human affairs.

For semantic conciseness we will refer to issues related to topics in social science and humanities as "topical". Topical issues will be distinguished from methodological decision-theoretic issues. Methodological issues will focus on assessing and enhancing the immunity to residual uncertainty that accompanies topical knowledge. This immunity to residual uncertainty will be referred to as "robustness" to uncertainty, and is based on decision-theoretic rather than topical expertise.

Topical and methodological issues focus on different categories of questions. Topical questions culminate in asking: What do we know and how does this knowledge help to prioritize the available options or assessments? The methodological question of robustness is: How much can our topical knowledge err without changing the prioritization of options or assessments? The robustness question is

[13] *Ibid,* p.548.
[14] Mark Phythian, 2017, Intelligence analysis and social science methods: exploring the potential for and possible limits of mutual learning, *Intelligence and National Security,* 32(5): 600-612, pp.602, 603.
[15] *Ibid,* p.608.
[16] *Ibid,* p.604.
[17] Peter Gill, 2012, Intelligence, threat, risk and the challenge of oversight, *Intelligence and National Security,* 27(2): 206-222, p.212.

motivated by the inevitable challenges facing the topical expert: deficient or inaccurate data, deception or innovation by the adversary, the need for foresight rather than retrospective explanation, limitations of time and other resources. These questions – topical or methodological – can lead to different prioritization of options or assessments, as we illustrate briefly now with two simplified and stylized preliminary examples, and subsequently in greater detail in three examples.

Preliminary example: Intelligence collection. Central collection questions include: What information to collect? Should we collect (look for) this type (or piece) of information or that type? What sources should we use, and how to rank their value or credibility? Does conflicting or paradoxical evidence warrant further collection, or does it justify abandoning that line of inquiry? What is the marginal value of information?

The answers to these collection questions provided by a topical expert may differ from those provided by a decision-theoretic expert. When viewed as topical questions, the topical expert responds by assessing the degree to which the collection enhances understanding and reduces uncertainty. For instance, evidential conflicts and paradoxes are important signposts for the topical expert. The topical expert – whether positivist or constructivist – will tend to explore paradoxes and conflicts in order to discover hidden mechanisms or undetected ideologies or analytical preconceptions. In contrast, the robustness question introduces a different perspective. The analysis of robustness assesses the degree to which the collection reduces the impact of residual uncertainty by enhancing immunity to surprise. Paradoxes or evidential conflicts are important only to the extent that their resolution would alter prioritization of options or assessments. The robustness question is not concerned with truth as an ultimate goal, only with immunity to ignorance. If our cup of knowledge is half full, the topical expert seeks to extend the truths, while the robustness expert seeks to reduce the impact of ignorance and error. The topical expert tries to manage surprise by reducing uncertainty, and the decision theoretic expert tries to manage surprise by reducing its impact. This topical expert is a positivist, while the decision-theoretical expert extends positivism to manage inevitable surprise.

Preliminary example: Binary foresight. We consider the adoption or rejection of binary decisions. In particular, we are interested in accepting or rejecting warning or foresight assertions such as: "Country V will invade country W within the next 48 hours." "Country X has a secret program to produce chemical weapons." "Sub-state organization Y has a major contingent of informal fighters in country Z." While the best topical knowledge may indicate 'yes' (or 'no'), the most robust decision may be 'no' (or 'yes'). By definition, the best available topical knowledge leads to the best available assessment. However, the best available knowledge is likely to err or be deficient in important but unknown ways, especially about the future which may harbor major surprises not knowable at all (often unknowable even by those responsible for the surprise).

For instance, consider the 1968 Tet offensive against American forces in Vietnam. Historians were aware of what is sometimes called The First Tet Offensive in 1789 when the Vietnamese drove the Chinese from Vietnam. Nonetheless, extensive additional topical knowledge indicated that the Tet holiday is sacred to the Vietnamese and that therefore the North Vietnamese Army (NVA) and the Viet Cong (VC) would not initiate hostilities during the Tet holiday. Extensive unusual military preparations and actions by the NVA and VC in the months leading up to Tet were interpreted by American intelligence in various ways without altering the understanding that Tet is inviolable.[18] The Americans were greatly surprised when communist forces initiated a major multi-pronged offensive on 31 January 1968 during Tet.

[18] James J. Wirtz, 1991, *The Tet Offensive: Intelligence Failure in War,* Cornell University Press, pp.139, 142, 268.

Hindsight is, of course, a great aid here. However, the keystone role of the inviolability of Tet was not challenged in the way that a robustness analysis might have done. The robustness question is: how much could our knowledge and understanding change, without altering the final assessment of the unusual military activities of the NVA and VC?

The U.S. intelligence analysts had extensive information about North Vietnamese planning, supply activities, agreements with China and the Soviet Union, defections, force movements and attacks, cultural attitudes, and more. An overall picture was developed of North Vietnamese military weakness and political exhaustion. In addition, however, was extensive evidence of widespread military preparations.

However, if Tet is not inviolable, then the evidence can be interpreted differently. The unusual attacks by NVA and VC forces in border areas were, it turned out, attempts to draw U.S. forces away from major cities, the slight softening of the condition for opening negotiations was a ruse, the reduced defections resulted from heightened morale, etc. If Tet is not inviolable then the offensive on 31 January 1968 can identified as possible, perhaps even plausible, rather than excluded almost apodictically.

In this example, the answer to the robustness question is that a single small change in the topical knowledge – Tet is not inviolable – enables a major change in assessment of existing evidence. In other words, the immunity to ignorance was small and the assessment was highly vulnerable to error and uncertainty. The best – most likely and most plausible – estimate (preparation for sporadic and diffuse attacks) had low robustness to surprise and thus low credibility when viewed from the methodological decision-theoretic perspective in this simplified example. A robust assessment would reject this most plausible assessment. A robust assessment could be 'broad coordinated offensive during Tet possibly indicated' or even perhaps even stronger, depending on how the available evidence is re-interpreted. The robust assessment is based on positivism that is extended to acknowledge and control the vast unknowns of enemy capabilities and intentions.

Knightian Uncertainty and Shackle-Popper Indeterminism

We now introduce an argument that provides an epistemological basis for our extension of positivism.

By 'uncertainty' we mean: ignorance or ambiguity or the potential for surprise. The concept of Knightian uncertainty is fundamental to our understanding of uncertainty in human affairs. Frank Knight's concept of 'true uncertainty' arises from innovation and initiative of entrepreneurs. In this connection, Knight asserts that "there is no objective measure of the probability" because there is little or no experience with new innovations or initiatives from which frequencies or likelihoods can be learned.[19] Knightian uncertainty arises from the unbounded potential for future innovation, or simply from ignorance of the vastly complex world. Uncertainty may also arise from deception or denial by an adversary.

G.L.S. Shackle[20] and, independently, Karl Popper,[21] explained a concept of indeterminism that is related to Knightian uncertainty.[22] Human behavior depends on what people (or groups) know: if you know it will

[19] Frank H. Knight, *Risk, Uncertainty and Profit,* (Hart, Schaffner and Marx, 1921, Re-issued by Harper Torchbooks, New York, 1965) pp.46, 120, 231-232. See also Frank H. Knight, *The Economic Organization,* (New York: Harper Torchbooks, 1933, 1951) p.120.

[20] G.L.S. Shackle, Epistemics and Economics: *A Critique of Economic Doctrines* (London: Transaction Publishers, 1992, originally published by Cambridge University Press, 1972) pp.3-4, 156, 239, 401-402.

21 Karl Popper, 1982, The Open Universe: An Argument for Indeterminism. From the Postscript to *The Logic of Scientific Discovery* (London: Routledge 1982) pp.80-81, 109.

22 Yakov Ben-Haim, Peirce, Haack and info-gaps, pp.150-164 in *Susan Haack, A Lady of Distinctions: The Philosopher Responds to Her Critics,* edited by Cornelis de Waal, (New York: Prometheus Books 2007).

rain then you'll take an umbrella; if you know the enemy has chemical weapons then you'll take a gas mask. However, what will be invented or discovered tomorrow cannot, by definition, be known today. Hence tomorrow's behavior will have an element of irreducible indeterminism today. Knightian uncertainty and Shackle-Popper indeterminism (SPI) imply a fundamental and irrevocable limitation in the ability to predict outcomes in human affairs.

We can understand SPI more thoroughly by contrasting it with positivism. The physical sciences are grounded on the assumption that laws of nature exist, are stable in time, universal and discoverable. As our mastery of these laws improves, our ability to predict the trajectory of physical systems in space and time also improves. The methodology of science-based engineering, as it emerged in the 19th century, proceeds in two steps: first learn the laws that govern a system, and then use those laws to design or control the system. For instance, first learn Newton's equations of motion of physical objects, and then use that scientific understanding to control the motion of missiles, airplanes, and so on. This methodology is the essence of positivism.

Positivism is employed in social sciences. For example, Ross and Makovsky write that "[w]hether trying to foster peace or liberalization in the Middle East or alter regime behaviors, we have to see the world as it is. … [O]ne cannot change an unacceptable reality before one understands it – and then it becomes possible to shape a strategy that produces change in stages."[23]

In contrast to positivism, Shackle-Popper indeterminism implies that human affairs entail an element of behavior that does not follow stable universal discoverable laws. SPI implies an element of non-nomological behavior in human history that is fundamentally different from the realm of physics. The predictive power of the physical scientist depends on the ability to learn – at least approximately – the stable and universal laws that govern the dynamics of the system of interest. Such laws exist only partially for human systems, so prediction in human affairs is likewise limited. SPI does not refute positivism, but it does imply that some aspects of the human situation are inherently unknowable, especially in strategic adversarial situations. The epistemological extension of positivism – necessary for human affairs – asserts that some elements of the real world are in fact unknowable. This extension is motivated by Shackle-Popper indeterminism, and is unlike positivism as it refers to the natural or physical world.

Info-Gap Robust Satisficing

The decision methodology that could be called "predictive optimization" begins by identifying the best available information, understanding, theoretical and contextual insight, including perhaps assessments of uncertainty. We will call this information our "knowledge". This knowledge entails information and understanding about friendly and adversarial capabilities, geopolitical constraints and opportunities, domestic politics, terrain, logistics, and whatever else is deemed relevant. Predictive optimization chooses the option whose knowledge-based predicted outcome is best.

Predictive optimization is usually *unsatisfactory* when facing strategic uncertainty because our knowledge is likely wrong in important respects, as explained by Knightian uncertainty and by Shackle-

[23] Dennis Ross and David Makovsky, (2010), *Myths, Illusions, and Peace: Finding a New Direction for America in the Middle East,* Penguin Books, New York, p.315.

Popper indeterminism. Instead, we advocate the decision methodology of robustly satisficing[24] outcome requirements.[25]

The basic idea of info-gap robust satisficing is to first identify outcomes that are essential – goals that must be achieved – and then to choose the option that will achieve those critical outcomes over the greatest range of future surprise. We use our knowledge in two ways. First, to assess the putative desirability of the alternative options, and second, to evaluate the vulnerability of those options to surprising future developments. The first use of our knowledge is positivist: objective reality exists and can be approximated by our knowledge. The second use of our knowledge recognizes the limitations of positivism: knowledge in human affairs is often deficient or wrong.

The robust-satisficing strategy is the one with maximal robustness against strategic uncertainty while satisfying the critical requirements. In other words, what is optimized is not the predicted quality of the outcome, but rather the immunity to error and surprise. The outcome will be satisfactory, though not necessarily optimal, over the greatest range of future deviations from our current understanding. What constitutes a satisfactory outcome can be as modest or as ambitious as one wants, though the robustness trades off accordingly. Robust-satisficing is positivist in that it acknowledges that objective knowledge about the world can be obtained. Nonetheless, robust-satisficing also acknowledges that vast domains of reality are unknowable and must be managed decision-theoretically in a way that differs from predictive optimization.

For instance, the positivist would prefer the option that is predicted to have the best outcome, based on current knowledge. Choice of an option with putatively less desirable outcome would be viewed as perverse or unjustified in light of the best current knowledge. In contrast, the robust satisficer would prefer the option that would achieve an outcome that is acceptable or good enough (though perhaps suboptimal) under predicted conditions and throughout the widest range of surprise or deviation of reality from current knowledge.

Knowledge often includes assessments of likelihood. In this case, the positivist may prefer the option that has the greatest predicted likelihood to succeed. Choosing an option with lower predicted likelihood of success would again be viewed as perverse or unjustified. In contrast, the robust satisficer would prefer the option that has acceptable or good enough (though perhaps suboptimal) likelihood to succeed according to current knowledge and throughout the widest range of surprise or deviation of reality from current knowledge.

We now consider three examples in more detail.

Example: Robust Satisficing and Uncertainty About Alternative Theories

We will illustrate the robust satisficing method with a simple hypothetical example that focuses on the use of alternative theories for foresight and policy analysis.

Consider US coordination with a friendly state (e.g. India), in competition with a neighboring state that can project both land and marine power (e.g. China). A 'competitive strategies'[26] model argues that land

[24] To satisfice means "To decide on and pursue a course of action that will satisfy the minimum requirements necessary to achieve a particular goal." *Oxford English Dictionary,* online version accessed 7.4.2016.

[25] Further discussion of these ideas are found in Yakov Ben-Haim (2014) Strategy selection: An info-gap methodology, *Defense & Security Analysis,* 30(2): 106-119, and Yakov Ben-Haim (2015), Dealing with uncertainty in strategic decision-making, *Parameters,* the US Army War College Quarterly, 45(3) Autumn 2015. Robust-satisficing is central in info-gap decision theory. See Yakov Ben-Haim, *Info-Gap Decision Theory: Decisions Under Severe Uncertainty*, 2nd edition (London: Academic Press, 2006). References to work of many scholars can be found at info-gap.com.

power buildup by the friendly state (India) could threaten the competitor's border and draw the competitor (China) away from maritime competition with the US. In contrast, a 'strategic partnership' model argues that maritime buildup by the friendly state could assist US efforts to protect the maritime commons against the competitor.

Let us suppose that the US has a fixed budget for assisting military buildup by the friendly state. It might reasonably be argued that US support for Indian maritime buildup is more cost effective than US support for Indian land power buildup. The reason is that drawing Chinese attention to its land border with India only indirectly influences Chinese maritime policy. In other words, it might reasonably be argued that our knowledge indicates a US preference for Indian maritime buildup over Indian land power buildup. The US outcome-optimizer would tend to prefer Indian maritime buildup because our best understanding (in this simplified hypothetical example) is that it achieves greater US control of the maritime commons.

However, there is considerable uncertainty in the relative validity of these two models: competitive strategies and strategic partnership. Friendly land power buildup could, unlike the competitive strategies prediction, drive the competitor to maritime buildup as a path of least resistance for power projection. Or, friendly maritime growth could, unlike the strategic partnership anticipation, lead to re-doubled maritime competition in response to augmented maritime challenges. Strategic uncertainty dominates this foresight problem, and weighs against choosing the strategy with the best predicted outcome. The robust-satisficing approach chooses the strategy that can tolerate the greatest error without jeopardizing specified outcome requirements.

To illustrate the reasoning, let us suppose that analysis indicates that the competitive state places great emphasis on its maritime power, and that it is less concerned about the land-border threat from the US-friendly state. (Not implausible in the US-India-China context where India is not likely to attack China, and China has systematically strengthened its maritime power over the years.[27]) In this situation, substantially greater uncertainty accompanies the Indian maritime buildup to which the magnitude of China's response may be great but is highly uncertain. While Indian maritime buildup is predicted to yield better US maritime control, it could possibly lead to far worse maritime power balance if China responds with redoubled maritime buildup. In other words, Indian land power buildup is predicted to draw modest Chinese resources to land power capability, and is not predicted to be as useful as Indian maritime buildup, but the outcome of land power buildup is less uncertain. The robust-satisficing analyst might judge that Indian land power buildup more reliably provides adequate US maritime control. If so, the robust-satisfier rejects the outcome-optimizer's foresight assessment. This simplified hypothetical example illustrates a reversal of preference from the putative predicted outcome-optimum (Indian maritime buildup) in favor of the putatively less attractive option (Indian land power buildup). This reversal of preference results from the severe uncertainty in foreseeing the Chinese response.

Example: Robust Satisficing and Anticipatory Identification of Failures

Ross and Makovsky discuss President Obama's attempt to achieve peace between Israel and the Palestinians in 2009, with the mediation of George Mitchell. The US strategy was based in part on the public statement by the US of the need for a settlement freeze by Israel. Ross and Makovsky point out that "[t]he Obama administration wanted to set the bar high for what it asked from Israel; but did not think

[26] Thomas G. Mahnken, ed., (2012), *Competitive Strategies for the 21st Century,* Stanford University Press, Stanford.
[27] Brad Roberts, (2016), *The Case for U.S. Nuclear Weapons in the 21st Century,* Stanford University Press, Palo Alto, CA, pp.147, 162, 199, 212.

through the impact and implications of the move should the strategy fail after expectations had been raised."[28] What they are suggesting here is to explore the vulnerability to error and uncertainty of the Obama/Mitchell understanding of the parties involved. Anticipatory identification of failures and their implications is very different from the positivist paradigm of choosing policy based on predicted outcomes. Thinking through the possible avenues of policy failure due to erroneous understanding is different from using the best understanding to predict the outcome of a policy. Prioritizing policies in terms of their relative robustness against error and surprise is different from prioritizing policies according to the relative quality of the predicted outcome.

There is no doubt that one must understand the context of one's policy choices (e.g. the Middle East as a case in point) as thoroughly as possible. However, Shackle-Popper indeterminism provides a strong argument against the idea that one can construct a predictive model upon which to base policy choices. The primary role of one's knowledge (by which I mean one's understanding in the broadest sense) is to identify one's vulnerabilities to error, not to predict the outcome of one's actions, as illustrated by Ross and Makovky's example. This use of knowledge extends the positivist paradigm upon which engineering practice is largely based. Positivism is predicated on the existence of stable, universal and discoverable laws of nature. Positivism advocates that one first discover the laws governing the system of interest, and then exploit those laws to design or control the system. The positivist paradigm often (though not always) works well in engineering, but is much less suitable to strategic issues in human affairs, where important knowledge and understanding is often – and in principle – lacking. In human affairs one must extend positivism by using one's knowledge while also managing one's ignorance and uncertainty. In human affairs one can use knowledge to analyze scenarios for the vulnerability to failure, as we now illustrate.[29]

Example: Robust Satisficing and Assessing War

Gibbons-Neff reported in the *Washington Post* on 26 April 2016 that "The flow of foreign fighters into Iraq and Syria has dropped from roughly 2,000 a month down to 200 within the past year, according to the Pentagon, which says the waning numbers are further proof of the Islamic State's declining stature."[30] This dramatic assessment has important strategic implications because "The declining number of fighters is a direct result of strikes that have targeted the terror group's infrastructure, [according to] Air Force Maj. Gen. Peter E. Gersten". In times of armed conflict, political and military leaders need to know if they are winning or losing, in order to maintain or modify current strategy or tactics.

Two difficult questions confound these assessments: what do the numbers mean, and is the assessment (the numbers and their meanings) robust against myriad uncertainties.

Does the 90% reduction reported by Gibbons-Neff really reflect diminished stature, or does it reflect the rapid spread of the Islamic State to Libya, Tunisia, Sinai, Yemen and other regions, and diminished need (by the Islamic State) for fighters in Iraq and Syria? Has the 90% reduction actually reduced the Islamic State's military effectiveness, or does it reflect a diversion of non-military supporters whose service is more effective elsewhere?

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[28] Ross and Makovsky, *op. cit.,* p.324.

[29] The limitation of the positivist paradigm, and the value of scenario analysis, is discussed in: Steven Bernstein, Richard Ned Lebow, Janice Gross Stein and Steven Weber, 2000, God gave physics the easy problems: Adapting social science to an unpredictable world, *European Journal of International Relations,* Vol. 6(1): 43-76.

[30] https://www.washingtonpost.com/news/checkpoint/wp/2016/04/26/number-of-foreign-fighters-entering-iraq-and-syria-drops-by-90-percent-pentagon-says, accessed 4.5.2016.

Blanken and Lepore characterize the difficulty of such assessments by referring to the "cacophony of confounding variables introduced by the social context in which the operations take place."[31] A decline in *foreign* fighters does not rule out a rise in domestic support in the Arab region. Gibbons-Neff reports that "80 percent of Arab teens and young adults [aged 18 to 24] rule out any support for the Islamic State, a number that is up from 60 percent in 2015." However, the remaining 20% still represents millions of individuals whose support is significant. Furthermore, tacit or de facto support (perhaps due to fear) by the populations under Islamic State control is also important for the viability of that control. In other words, both the numbers, and their meanings, could change substantially due to alternative interpretations or counting procedures. Without disputing the importance of a 90% reduction, both the number and its significance are vulnerable to substantial alteration given a different constellation of data and knowledge.

This points to the importance of multi-dimensional assessment that may be quantitative but that is strongly grounded in qualitative contextual understanding. For instance, Hix and Sepp discuss a 5-dimensional assessment of counterinsurgency in Iraq during 2004-2005, addressing the following issues.[32] (1) Is the level of violence rising, and what is the nature of violent acts (e.g. coordinated or sporadic)? (2) Is the population freely giving information about insurgents to the police and armed forces? (3) Does insurgent propaganda substantially influence popular behavior? (4) Are the insurgents in control of their own casualties, that is, do the insurgents incur casualties in operations of their choice (e.g. ambushes or suicide bombings), or are their casualties primarily the result in US-coalition and Iraqi-government action? (5) Is there widespread popular support for the Iraqi government?

These five questions are all relevant to the assessment problem facing strategic planners. They are all grounded in historical or ethnological considerations as they bear on the viability of the insurgency. They relate both to the insurgents' efforts to rebel, and to coalition and government efforts to suppress the insurgency. The answers to those questions provide contextual understanding that is necessary in assessing the state of the conflict.

Assessment questions must be substantively relevant. However, while contextual understanding is a necessary attribute of assessment questions, it is not sufficient. In addition, resulting decisions by political or military leaders must be robust against uncertainty in the answers. If small errors in the answers could alter the leader's decision, then the robustness is low and the assessment questions are (at least in part) unsuitable, regardless of their substantive relevance. Stated differently, the robustness question is: how wrong can our assessment be, and the leader's decision is still the same? Low robustness implies sensitivity (of the choice of action) to error in the assessment. Good use of assessment questions must lead to decisions that are insensitive to errors in the assessment. Equivalently, good use of assessment questions must generate robustness (of the decision) against uncertainty in the assessment. This is different from the substantive criteria for choosing the assessment questions. One should definitely use substantively relevant assessment questions, but that is not a sufficient criterion for selecting and using assessment questions; the way the answers are used should also generate decisions that are robust against error in the assessment.

[31] Leo J. Blanken and Jason J. Lepore, Introduction: The challenge of wartime assessment, in Leo J. Blanken, Hy Rothstein and Jason J. Lepore, eds., 2015, *Assessing War: The Challenge of Measuring Success and Failure,* Georgetown University Press, pp.3-15.

[32] William C. Hix and Kalev I. Sepp, Assessing Counterinsurgency: The Iraq War, 2004-5, in Blanken, Rothstein and Lepore, 2015, *op. cit.,* pp.197-213.

For example, the 5 questions posed by Hix and Sepp can all by answered in part either 'yes' or 'no'. Hence a voting mechanism can be used, at least initially, to determine whether the counterinsurgency (COIN) strategy needs to be changed.

In one voting mechanism, the policy decision (to maintain or to alter the current strategy) is determined by consensus.[33] The status quo is maintained unless there is a consensus (of the 5 questions) indicating the need for change. This decision rule is highly conservative, constraining the decision to change. That, however, is not our point here. Suppose that the truth of the matter is that the COIN strategy needs to change (the positivist agrees that there is a "truth of the matter"). This algorithm is highly vulnerable to uncertainty in the answers to the Hix-Sepp questions. A small error in assessment (a change from consensus of any one 'vote' for change among the 5 questions) would reverse the decision. Conservatism is not the issue; the point is the low robustness to error in assessment. The consensus rule is vulnerable to uncertainty in the 5 answers, if the COIN strategy should in fact be changed. In contrast, a 4-out-of-5 rule would be less vulnerable to uncertainty in the answers.

Brams describes many political and social considerations in designing voting rules in democracies.[34] Our discussion of this example suggests an additional consideration: robustness of the voting outcome to uncertainty in the election results.

Conclusion: Inductive, Abductive and Deductive Inference

We have described the method of info-gap robust satisficing, discussed its conceptual foundations and illustrated some of its implications for decision making. We have stressed the extension of positivism to acknowledge and manage unavoidable unknowns. We conclude our discussion by suggesting that robust satisficing fits into a taxonomy of inferential methods. We will consider three categories of foresight or forecasting methods: early warning, scenario analysis, and robust satisficing. We will explain that these three methods can be understood as different types of inference: inductive, abductive, and deductive, respectively. There is important overlap between these categories, and the taxonomy does not comprehensively characterize these methods. Nonetheless it reveals some fundamental distinctions, demonstrating how robust satisficing differs from and extends positivism.

Inductive inference: "early warning" methods. The category of inferential methods that we are calling "early warning" includes all quantitative predictive methods (even when they are not intended to warn against anything) whereby data are used to infer something about the future. Trend analysis is in this category, as well as, for example, statistical prediction of state failure.[35] The early warning category also includes less quantitative "weak signal scanning,"[36] including qualitative and heuristic methods, that attempt to detect early signs of impending momentous change by parsing evidence of any sort.

One can characterize the early warning methods of prediction and forecast as inductive inference. As Peirce explained long ago, "Induction is where we generalize from a number of cases of which something is

[33] Like in the U.N. Security Council.

[34] Brams, Steven J., 2008, *Mathematics and Democracy: Designing Better Voting and Fair-Division Procedures*, Princeton University Press.

[35] G. King and L. Zeng, 2001, Improving forecasts of state failure, *World Politics,* Vol. 53, Issue 4, pp.623-658.

[36] Sandro Mendonça, Miguel Pina e Cunha, Frank Ruff and Jari Kaivo-oja, 2009, Venturing into the Wilderness: Preparing for Wild Cards in the Civil Aircraft and Asset-Management Industries, *Long Range Planning,* 42: 23-41.

true, and infer that the same thing is true of a whole class."[37] In early warning methods, data or other perceptual evidence are used to infer that what is true of past and present observations will be true of a broader class including the future.

Abductive inference: scenario analysis. An example of abductive inference is: we observe that the lawn is wet, so we conclude that it rained last night. The conclusion is a simple explanation of the observation. The conclusion is not an induction because it is not a generalization based on evidence. The conclusion is neither necessarily true (the neighbor's sprinkler could have wetted the lawn) nor is it sufficient as an explanation (the lawn could have absorbed last night's rain and hence be dry now).[38] As Peirce wrote, an abductive inference is "the operation of adopting an explanatory hypothesis",[39] and "[t]he abductive suggestion comes to us like a flash. It is an act of *insight*, although of extremely fallible insight."[40] Peirce believed that abductive inference is a creative process that generates a new idea, a provisional hypothesized explanation. Halas demonstrates that abductive inference is not uncommon in the study of international relations, most notably in the study of agent-based models.[41]

Scenario analysis is not strictly an abductive inference from observation to hypothesized cause. Nonetheless, scenario analysis is the creative invention of hypothesized futures based on speculative contemplation of uncertain possible occurrences. The scenario is the hypothesized cause of an event that has not yet occurred but could perhaps occur. Scenario analysis is abductive inference in the future tense, contingent on uncertain possibilities. Scenario analysis is a learning experience through which analysts extend their understanding. For example, consider a scenario of global sea level rise. Within this scenario we can envision flooding, crop devastation, disease and poverty. The futuristic abductive inference is: observing (in our mind's eye) these consequences, we hypothesize the scenario of global sea level rise. Of course, scenario analysis goes further by exploring other possible implications of the scenario. What we have described as abductive inference is the process of inventing scenarios.

Deductive inference: Robust satisficing. A deduction is the use of a general rule and a specific case, to infer something about the specific case. Peirce's example refers to a bag that is known *a priori* to contain only white beans:[42]

"Rule. – All the beans from this bag are white.

" Case. – These beans are from this bag.

"∴ Result. – These beans are white."

Deduction is in a sense the reverse of induction, because induction goes from a collection of cases to the construction of a general rule. A deduction uncovers implications that are inherent in the rule (or principle

[37] Charles Sanders Peirce, Deduction, induction, and hypothesis, *Popular Science Monthly,* August 1878, reprinted in Charles Sanders Peirce, *Chance, Love and Logic: Philosophical Essays,* Edited by Morris R. Cohen, University of Nebraska Press, 1998, pp.131-149. See p.135.

[38] We say that proposition *A* is "necessary" for proposition *B* if *A* must be true if *B* is true. We say that proposition *A* is "sufficient" for proposition *B* if *B* is true whenever *A* is true.

[39] Charles Sanders Peirce, Abduction and induction, in *Philosophical Writings of Peirce,* Justus Buchler, editor, pp.150-156. See p.151. Dover reprint of *The Philosophy of Peirce: Selected Writings,* Routledge and Kegan Paul, 1940. The manuscript of this essay is from c. 1901.

[40] Charles Sanders Peirce, Perceptual judgments, in Buchler, *op. cit.*, pp.302-305. See p.304. The manuscript of this essay is from c. 1903.

[41] Matus Halas, 2015, In error we trust: an apology of abductive inference, *Cambridge Review of International Affairs,* Vol. 28, Issue 4, pp.701-720.

[42] Peirce, Deduction, induction, and hypothesis, *op. cit.* p.134.

or axiom), but does not invent anything new or outside of that axiomatic system.[43] In this way a deduction also differs from an abductive inference which is a creative insight that extends the domain of thought.

We can now understand the deductive nature of an inference that is based on robust satisficing. Consider foresights such as "Situation *S* will arise within 1 year" or, "Policy *P* will achieve our specified goals". Suppose furthermore that these assertions are consistent with our current knowledge and understanding. How much confidence can we have that they will hold true in the future?

We *cannot* know how large a surprise will occur, or how much our current understanding of the future errs. More importantly, we do not confidently know the mechanisms that will govern the future evolution of the system in question. However, we *can* deduce how much surprise or error we can tolerate. Confidence in the assertions about situation *S* or policy *P* is based on answers to the robustness question, which is: how much could we err, or how large a surprise could occur, and the assertion is still true? If the answer is that great error or surprise does not jeopardize the truth of the statement, then it robustly satisfies a requirement regarding time of occurrence (for situation *S*) or goal-achievement (for policy *P*).

The robustness question is not ontological. It does not ask "How wrong are we?" or "What is the largest surprise that could occur?". Robust satisficing accepts the positivist legitimacy of these questions. However, we cannot answer these questions (though inductive early warning methods might help). But we can deduce an answer to the robustness question because it addresses what we do know. Stated differently, the answer to the robustness question does not tell us how much we actually err (which the positivist might try to resolve); it only tells us how much error we can tolerate. Whether or not our actual ignorance exceeds this limit remains unknown to us. The answer to the robustness question is deductive, and tells us nothing beyond what is inherent in our knowledge as it currently stands. Reality can be studied and learned (positivism), but vast surprises will still remain and must be managed (by altering positivist predictive optimization).

In summary, the info-gap method of robust satisficing begins by explicitly recognizing that we do not know how much we err, or how large a surprise might occur, or how bad things can get; there is no known worst case. We then specify how good an outcome is required or, equivalently, how bad an outcome is tolerable. Finally, for any proposed assertion, we determine the greatest horizon of uncertainty up to which that assertion is still valid. In particular, a robust option is one that remains valid despite great error or surprise. When the assertions entail policy options, the robustness analysis prioritizes those options based on confidence in achieving specified goals despite surprise. When the assertions entail foresight assessments, the robustness analysis prioritizes those assessments based on confidence in validity of the foresight despite surprise. Robust satisficing is not a constructivist or post-modern critique of positivism. Rather, robust satisficing entails the positivist assertion of knowable reality, but emphasizes that much cannot be known due to Shackle-Popper indeterminism. Robust satisficing extends positivism to manage uncertainty.

Acknowledgements The author is pleased to acknowledge the valuable comments and criticisms of Lieutenant Colonel Dr. Lior Davidovitch, Prof. Steve Marrin and Prof. Patrick Walsh.

[43] For Henri Poincaré this property of deduction seems, perplexingly, to reduce mathematics to "a gigantic tautology". The resolution, he suggested, was that "a single formula [contains] an infinite number of syllogisms". Henri Poincaré, 1905, *Science and Hypothesis,* English translation, republished by Dover Press in 1952, pp.1, 9.