The Limits of Prediction—or, How I Learned to Stop Worrying About Black Swans and Love Analysis

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Intelligence analysts have it rough. Their plight extends beyond the old adage of being only responsible for intelligence failures while the policymakers they inform collect praise for their supposed unilateral policy successes. This certainly irritates some, but what truly imperils intelligence analysts is something that goes much deeper. The key struggle for intelligence analysts is that what they are able to produce and what their consumers think they can produce are often two different things. In a sense, to borrow from former CIA Deputy Director for Intelligence Douglas MacEachin's oft-repeated analogy, intelligence analysts are best at providing scouting reports on opposing teams, but policymakers are expecting to hear what the score of the game is going to be.[1]

So what do intelligence consumers want from intelligence analysts? When asked this question directly, they often trot out myriad responses that range from "just the facts" to something akin to clairvoyant understanding.[2] While it is a truism that different policymakers have different requirements based on the issues they cover and their own personal backgrounds, any good analyst will admit that a good chunk of taskings from policymakers is centered on a simple theme: tell me what is going to happen. To a certain extent, the primary desire of modern-day intelligence consumers has not advanced far beyond that of the Duke of Wellington who said, "all the business of war, and indeed all the business of life . . . is to . . . guess what was at the other side of the hill."[3]

Drones have mostly solved that problem for warfighters, but the wrinkle here for analysts is that humans struggle to see over the figurative hill into the future.[4] When humans do make the effort to stare over those mounds of dirt and rock to make predictions, they, on average, are not much better than chance or simple actuarial models.[5]

This does not mean that a majority of the Intelligence Community's (IC's) estimates are wrong. On the contrary, when we use sound analytic techniques and reasoning to extrapolate from the present to make linear predictions about the future, we do quite well.[6] Additionally, recent research shows there are things individuals and teams can do to provide better judgments about future events.[7] However, when forecasting a break from the norm, a wholly new development, or the course of change over a longer timeframe, even the most seasoned analyst regresses to throwing darts.

So does this mean that intelligence analysts should take their crystal balls

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and go home? On the contrary, this recognition of fallibility and limits should encourage intelligence analysts to chart proactive ways in which they approach their work. Analysts can also bridge the gap between policymaker expectations and their actual capabilities by doing a simple thing: coming clean. Intelligence analysts need to educate policymakers about the limits to what they can provide in the realm of forecasting and adopt a more modest analytic ethos.

Despite wanting to wow customers with deep expertise or a collation of highly classified reporting, analysts should keep their eyes on the main goal of any engagement with new customers: educating them about the range of ways intelligence analysis can make the customer's jobs easier. And, yes, this will at times include offering probabilistic thoughts on the future, but it will also include things short of that—things that still will help reduce surprise, inform about uncertainties, and feed into the policymaking process. Intelligence analysts would do well to educate their customers on how their analytic approach and perspective can best answer some fundamental questions that are relevant to almost any policy problem. As former CIA analyst and senior manager Dennis Wilder so rightly said, "An educated consumer is our best customer."[8]

The analyst's job does not end there, because despite the difficulties of prediction, there is room for improvement. Intelligence agencies must alter the types of analysis they most value and reform their cultures based on lessons learned for better forecasting. They also need to prepare the next generation of analysts through improved hiring and training and a commitment to harnessing technological advancements that will help analysts and policymakers grapple with the uncertain, contingent, and downright unpredictable world ahead.

Why Forecasts Go Wrong

Postmortems of intelligence failure are chock-a-block with explanations of how the IC made a faulty estimate, either through a failure to predict (9/11) or a failure to understand (Iraq WMD). These intelligence reviews list a litany of issues leading to these failures, including cognitive biases, faulty mindsets, groupthink, stovepiping of information, and outdated analytic frameworks.[9] However, one of the great deceits found within the key findings of these "do better" commissions is that with just a little more information, coordination, connecting of the right dots, disconnecting of the nongermane ones, and so forth, the IC would have gotten it right.[10] In some cases these flaws were fatal, but all IC forecasts come with limitations that no blue-ribbon panel will be able to overcome with new standards or improved oversight.

The best research on human ability to forecast the future shows that a majority of us—even experts—are severely deficient. Renowned Wharton professors Barbara Mellers and Philip Tetlock have shown how human predictions are often overconfident, use the wrong mental models, unknowingly rely on small amounts of data or assumptions, do not test hypotheses sufficiently, and are infrequently updated or adjusted even in the face of new information.[11] Daniel Kahneman said, "We are normally blind about our own blindness. We are generally overconfident in our opinions and our impressions and judgments. We exaggerate how knowable the world is."[12] These core problems are not the cause of our misjudgments but are the products of the following insuperable limitations on prediction:

Trend Lines and Discontinuities

Intelligence forecasts are inescapably estimates of future action or events based on a rationalized understanding of past actions and events. For example, Farlandia is likely to respond to an airstrike with proxy terrorist attacks because that is what we have seen before and it fits within our understanding of the risk tolerance of their leadership. Analysts are very good at extrapolation or making these types of linear or evolutionary forecasts, and these probabilistic predictions often end up being correct.[13]

The frequency of getting these projections right often creates a false sense of confidence that things will muddle along as before, and this leads to estimates that miss course-altering discontinuities or changes. As one intelligence practitioner notes, "Discontinuities in history are the ultimate challenge for forecasting."[14]

This is not a particularly new discovery even within the IC. In 1983, Director of Central Intelligence William Casey formed the Senior Review Panel to study IC judgments that preceded large shifts or surprises in history. The panel found that the

most significant faulty estimates were due to "single outcome forecast[s]" based on the "prevailing wisdom of the times," which led to a "prejudice toward continuity."[15] In other words, the past is not always prologue.

Timing and Tipping Points

Our inability to forecast when abrupt changes or tipping points will precisely occur also constrain human predictions. Analysts are good at describing environments or dynamics that raise the risk of a shift from past behaviors or actions, but "no forecasting technique can predict the timing of that nonlinearity."[16] Nassim Taleb and Mark Blyth put it plainly when they said, "Political and economic events are unpredictable, and their probabilities are not scientifically measurable."[17]

Intelligence analysts can warn about the growing sophistication of al-Qa'ida attack plans and the underlying volatility in the Middle East, but they cannot predict when the planes hit the Twin Towers or when a Tunisian street vendor's self-immolation will spark regionwide unrest. The process leading up to a major shift in activity is gradual, but when a phenomenon ultimately breaks its pattern, it is often in "one dramatic moment" that serves as an unpredictable tipping point.[18]

Humans and Systems

Beyond the discontinuity and timing problems, the even more basic limitations on forecasting ability are the subjects of intelligence products: human beings with free will and complex systems such as foreign governments and networks whose actions are not deterministic. Much of individual human behavior and ac-

tivity "rests upon contingencies and chance," and often the individuals who analysts examine do not know themselves how they will act in a certain situation or what policy decision they may take.[19]

Humans are fickle beasts with diverse motivations that are not easily described in a two-page intelligence article. As one example, there are countless intelligence estimates claiming that a country will only take action if its leadership feels its hold on power is threatened, but can we truly understand all the ways a leader will feel himself to be on the ropes?

On the systems side, as Taleb and Blyth remark, "Governments are wasting billions of dollars on attempting to predict events that are produced by interdependent systems and are therefore not statistically understandable at the individual level."[20] A senior analyst once told me that even if he sat in a cabinet meeting of a target country, he would not be able to tell you what that country would necessarily do in the future.

This was not some show of personal humility or a slight dig at the target country's dysfunction; it was a recognition that so many players and interests are at play in such a complex system, and therefore the ultimate outcome is unpredictable. The problem of complex systems can be somewhat overcome in short-term assessments because all systems have a level of inertia that analysts can track and assess. However, the longer a complex system has to permutate and evolve, the more difficult it is to forecast its future character. The ac-

curacy of estimates also precipitously dropped when forecasts looked out past a few years in the future.[21]

What Analysis Can Do For You

Not all is lost for intelligence analysis. The answer to the above limitations is not to forgo estimative and probabilistic analysis and convert analysts into simple collators of raw intelligence reporting. As stated above, most estimates will be linear, and the IC excels in that area. On the difficult questions, where more uncertainty and complexity seeps in, intelligence analysts should be content with more humble approaches. Analysts must adopt a new ethos that is not centered on predicting future events.

Intelligence analysis must remain a forward-looking and policy-relevant enterprise that provides its best forecasts. However, analysts must focus more on arming customers with an appreciation of life's complexities and uncertainties while also outlining how the key factors, pillars, and linchpins of an issue can lead to distinct futures with varying levels of likelihood.[a] Analysts already do this work, but they should fully embrace the fact that their jobs often will not be to reduce uncertainty about po-

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a. The IC already does these things both implicitly and explicitly. Nevertheless, taking them on as the "ethos" of the analytic cadre would give more purpose and confidence to analysts who grapple with the incongruity between their capacities and the expectations of policymakers.

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tential future outcomes but to inform their customers of the uncertainties and contingencies.

Armed with this analytic ethos, the next task for analysts is to educate policymakers on how their unique approaches to matters of national security can aid policymakers in their day-to-day jobs. The first goal would be to disabuse policymakers of the notion that the IC's access to secret information and specialists confers an ability to remove strategic surprise. Analysts must inform policymakers that discontinuities analysts have assessed as unlikely will occur, and while this may appear to some customers as misfeasance, it is an unavoidable aspect of our business. As Sherman Kent noted, we do not claim our assessments are infallible. Instead, we assert that we offer our "most deeply and objectively based and carefully considered estimate[s]."[22]

Even if the reception to such Bayesian nuance is lukewarm, analysts must then sell policymakers a positive vision of what they can provide in the realm of forecasting.[23] Policymakers often grapple with problems in terms of concrete questions and answers,[24] and the IC should strive to sell itself as a question-answering service. After all, questions are the "principal intellectual instruments available to human beings."[25] Analysts must show policymakers that despite their lack of clairvoyance, they are the best-equipped cadre in the US government to provide faceted and well-argued

answers on the following key questions that correspond to nearly all geopolitical, security, and economic issues:

What is the context and reality of the problem I am facing?

This is the most fundamental and empirical of questions a policymaker will ask of the IC analyst. Bowman Miller called this "explanatory intelligence" and Jack Davis referred to this type of analysis as probably the most valuable for policymakers who often prefer to "see themselves as the analysts of last resort."[26] *When answering this question, an intelligence analyst must outline the key actors and their interests and pathologies; the drivers that determine stability or uncertainty within the problem; and how the problem fits into either domestic or regional political dynamics. This interplay and complexity is often lost on mile-wide-but-inch-deep policymakers.*

So what does all this have to do with predictions and forecasting? Is the provision of context and explanations of observed trends just analysts acting as classified historians for policymakers? Not exactly. When explaining all the factors that go into a problem or issue, analysts should always take the opportunity to think about the most useful of questions an analyst can ask themselves: What is the "so what" for the policymaker? The analyst can start by responding to a policymaker's need to understand the brass tacks of an issue, but they should always key-in on a "so what" that addresses a policy

concern. This "realities" question is therefore the building block for all of the other questions below as it often explains why foreign actors act the way they do.

How does including information on new developments affect my problem/issue?

Policymakers are likely to most engage with the IC on this question because it will be the driving question behind both their taskings and the questions analysts ask themselves when they write current intelligence articles. This is the most frequent type of intelligence analysis done in the IC, and it is where analysts provide their most accurate forecasts. This is because most forecasts are linear judgments with very-near-term or immediate time horizons. A need to put new developments into the context of larger storylines of an issue that policymakers are tracking is the driving factor for nearly all current intelligence products.

In answering this question, intelligence analysts are responding to policymakers' desire to know the impact and implications of an event or development that is not entirely obvious. When outlining implications of a new event, analysts must think about how new developments are likely to affect the plans, intentions, and character of the actors and factors outlined in their response to the first question on the "realities" of a problem. And sometimes it is just as important when new developments will not alter those realities as when they do.

When responding to this question, analysts must remember the aforementioned limits on prediction and how humans often misread the importance of events. Analysts must think through

the circumstances under which the new development could signal a discontinuity and how its implications will play out within a complex web of humans and systems. This may mean explaining different potential outcomes and their implications (see below) or analysts could be focused more narrowly on conditional analytic responses: "This new development is likely to result in this action as long as these other factors remain."

What are the ways this situation could play out?

At first glance, this could seem like a pedantic rephrasing of the "tell me what is going to happen" imperative that analysts hope to avoid hearing from policymakers. In reality, this question is framed this way because it directly assumes—as do most future studies scholars—that the future is plural and therefore requires an explanation of contingency scenarios.[27] A CIA review of NIEs in 1969 found that, "a good paper on a complicated subject should describe the trends and forces at work, identify the contingent factors or variables which might affect developments, and present a few alternative possibilities for the future, usually with some judgment as to the relative likelihood of one or another outcome."[28]

To be clear, analysts will not need to speak to all possible future scenarios every time they respond to this question, because many problems will have less uncertainty or have enough intelligence collection to be sufficiently answerable with linear and evolutionary analysis. Nevertheless, even in these instances analysts should be prepared to discuss the implications of lower probability outcomes.

In the same vein as the previous scenarios question, the most vital part of responding to these questions is outlining a strong set of signposts and indicators.

There is both a good way and a bad way to do futures analysis for policymakers. Providing a laundry list of scenarios without having done the legwork to assess their relative probabilities or the key signposts and indicators for each scenario will only add to the confusion of policymakers.[29] Future studies scholars say that the key in describing scenarios is to avoid laying out a logical procession of events that leads to that outcome, because futures will rarely come about that cleanly.

Instead, analysts should think about the environments necessary to produce future events. Analysts can then work back from understanding of the complex interplay between the key actors, complex systems, and driving forces of issues to provide signposts and indicators of moves toward a particular type of environment. Oftentimes there are multiple paths to the same endpoint. With this information, policymakers will better understand how future events and their subsequent policy actions could help to precipitate wanted outcomes and avoid unhelpful ones.

How do we get from here to there? and/or What should I be looking out for?

These two questions play off one another so intricately that analysts must always treat them together. Generally, policymakers have a Manichean-like desire to know two outcomes: the bad one for the national interest and the good one for the national interest. Analysts should do all they can to disabuse policymakers of expecting neat and tidy outcomes like these, but

often on issues there will be things that either fail or succeed or simply happen or not. When policymakers want to know about specific distinct futures, analysts can provide "what if" analyses that posit futures in which policymakers' dream or disappointment scenarios have occurred, and then work backwards to explain what mixture of necessary dynamics between key players and phenomena occurred to make the scenarios possible. Analysts routinely have to do analysis like this on events like outbreaks of social unrest or violence, because as the limits to our ability to predict have shown, there is rarely a silver bullet that will tell us when these things occur, but we can explain the environment that could produce them.

In the same vein as the previous scenarios question, the most vital part of responding to these questions is outlining a strong set of signposts and indicators that policymakers and analysts alike can monitor to determine whether a notional future is on the horizon or not. Although the answers to these questions and explaining the indicators will not end all surprise for policymakers, they will remain supremely valuable because they can "penetrate policy blinders and biases" of policymakers who often want to interpret events as inherently beneficial to their policy or policy goals.[30]

When a "what if" paper is done correctly, both analysts and policymakers should periodically revisit the signposts and indicators together, so that all sides are interpreting

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events through the same lens. The goal of this frequent review would be to create a "policy of equilibrium" for policymakers whose knowledge about the key aspects and potential for change in a system allows them to guard against potential shifts.[31]

How would "they" react to my different policy options?

When analysts open their inboxes to this question from customers there is almost a universal reaction of uneasy squirming. This instinctual reaction is due to an ingrained sense within intelligence officers that there is a firewall between them and policy. Intelligence analysts fear proximity to policy will make them champions of policy, instead of callers-of-spades.[32] *Analysts often take a dim view of how factors will align in response to a proposed policy, and they fear that sharing such a view will alienate their customers.*

However understandable these concerns, they are misguided because analysts can sometimes have no more direct impact than explaining to policymakers—who often think their policies are straightforward and well-designed—how complex foreign actors are likely to interpret US actions. This is a difficult task because, as British professor of strategic studies Patrick Porter has observed, "Policymakers' fearful anticipation of uncertainty when talking about the world contrasts with their confident pronouncements when talking about their own states' role in shaping it."[33]

What analysts must do in this situation is go beyond just listing the plans and intentions of adversaries and subjects and, instead, identify and explain the reasons actors have developed those plans and what motivates their intentions. From this starting point analysts can then explain, for example, how another round of sanctions is unlikely to break an enemy's will, because its leaders have developed workarounds and fostered a culture of resistance that sanctions only reinforce.

This is another question in which conditional responses shine and can balance against the limits of our ability to predict. When assessing how an actor will respond to a US policy shift or action, analysts can explain what constants must remain true to validate their assessments. And by identifying these key factors and constants, policymakers can then begin to craft policies that can target those things and therefore bring about the policy goal they seek.

The Road Ahead

So where do intelligence analysts go from here? They have checked their hubris at the door by recognizing the limitations of their forecasting ability. They have embraced a new ethos and an identity as "question answerers" who respond to sets of queries that should aid their customers, covering almost any policy topic. Those two things together are powerful, but analysts must resist the temptation toward self-congratulatory back-patting. There are even more ways for intelligence analysts to improve how they inform their customers. These measures include how analysts actually do their work on a daily basis, how managers review analysts, and how intelligence agencies build cadres of analysts best suited for the inherent challenges of providing estimates of future events.

Doing Analysis Better: Foundational Analysis and Speculative Thinking

A common thread in each of the responses to the key policymaker questions above is a strong understanding of the core actors and factors driving issues, which form the basis of both linear and speculative analyses. This requirement to really understand an issue's "environment" suggests that intelligence agencies must promote foundational analytic research even over current intelligence production.

On military accounts this may mean allowing analysts more time to do order of battle or work on political accounts, allowing more historical research on the interplay between key institutions and individuals. We must provide, as Jack Davis suggested, the same resources for research as we do for the production of current intelligence products, and work to build more robust research-oriented databases.[34]

Speculative analysis also needs to come in from the doghouse. If we are not great at predictions and spotting big changes, then we need to be comfortable with allowing more skeptical bottom lines based on if-then constructions or explanations of different futures and their relative assessed likelihoods. This fear of speculative analysis has led some analysts to adopt a "just make a call" approach when our predictive humility should resist such extremes. Alternatively,

sometimes paralysis sets in on tough issues as analysts grow uncomfortable writing an informed speculative piece and instead choose to write nothing at all. Managers should push mainline analysts to write these types of pieces and reward them for not "waiting for more reporting" or conducting what one IC senior called "hammer judgments" on issues that clearly were not hammer-ready.[35]

Additionally, our efforts to institutionalize alternative analysis have failed. It is true that some agencies require alternative analysis in finished production and others created entire product lines for "red cell" thinking. Nevertheless, these measures have worked against the value of such products. Often, alternative viewpoints are provided to demonstrate to policymakers we have thought about them, but the separation of these from mainline narratives only serves to reinforce—for both analysts and customers—that these events are so out in left field that they need not be taken seriously. Even the name "alternative analysis" begs the reader to dismiss the findings they may contain.

Instead of trying to show how outside-the-box we are thinking, we should put less likely—but more disruptive—futures back in the box of regular analysis. What potentially could be even more fruitful would be reframing this alternative analysis mission into what Miller called an IC "fire watch" that would have analysts, like park rangers, report a potential fire at the first hint of smoke. Analysts should have already laid out the alternative scenarios in current production, and then make updates on the relative increasing or decreasing likelihood of these potential out-

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comes, based on the observation of "smoke" or triggers.

Reforming the Culture: Checking Work and Building Diverse Teams

Most intelligence agencies primarily hold analysts accountable for how well they handle process and adhere to high analytic standards. Agencies promote analysts not because their forecasts were right, but because they showed mastery of the accepted analytic practices that lead to strong analysis. Intelligence agencies must mesh this process accountability with outcome accountability. Statistician Nate Silver's work showed that forecasters perform better when they are accountable for the accuracy of their forecasts because it forces them to frequently update their work based on new information.[36]

Many IC agencies are already doing good work on reviewing products for accuracy, but there should be a requirement that analysts personally review their own work. How correct and calibrated for probability they were in their assessments should play into the types of training those analysts receive and their career advancement. Additionally, if an analyst consistently litters forecasts with weasel words that cannot be judged for accuracy in the future, they are skirting their duties and will require adjustments to their approaches. Some may argue that the effect of analysis on policy decisions makes it impossible to judge analytic work fairly. This will undoubtedly be true

in some circumstances, but these events will be the exception, not the rule. Fear of being overly influential on policy should not hold back intelligence agencies from doing more to check the work they produce.

Intelligence agencies also need to rethink how they approach the creation of analytic teams. Tetlock's studies showed that the best forecasts came from diverse teams of individuals who were not all subject-matter experts but brought with them unique skill sets and various ways of thinking. These teams fostered environments of collaboration, but also the diverse perspectives and open-mindedness of their members allowed individuals to challenge each other's work and push each other to make more nuanced and, ultimately, accurate forecasts.

So in practice what could this mean? Well, instead of managers looking to find the right balance among military, political, leadership, and economic analysts on a team, they should be looking to have a group of individuals who can break down problems in different ways. For example, a branch chief should look to find the right mix of convergent and divergent thinkers, individuals with different proclivities for different mindsets and biases, and analysts from different geographic and socioeconomic backgrounds. Teaching analysts about order of battle or political psychology is far easier than breaking them of natural, innate biases.

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Preparing the Next Generation: Superforecasters and AI

The IC should also use the most recent research on how individuals with certain traits are better forecasters and incorporate those findings into how it hires, trains, and positions analysts. Often, hiring advisers are looking for individuals who look most like themselves in job interviews. For the IC this usually means having an advanced degree, very good grades, strong writing skills, and subject-matter expertise or previous career experience in a related field. While these are all good things that probably are strong indicators of good performance as intelligence analysts, what if we dug a little bit deeper?

Mellers and Tetlock say the best forecasters have a mix of high cognitive abilities, good previous political knowledge, an open-minded approach to problems, strong inductive reasoning and pattern detection capabilities, high levels of fluid intelligence, a nondogmatic approach to their beliefs, a balance between competitiveness and collaboration, and a commitment to self-improvement.[37]

Hiring in the IC should look to prioritize these characteristics over, for example, the grades of applicants during their freshman or sophomore years of college. Tetlock also observed that superforecasters are partly created and partly made, and individuals improved their forecasting abilities with training focused on improving these traits. Through the process of analysts' "checking their work," some routine biases or analytic proclivities may become apparent that can be remedied using targeted training.

Intelligence agencies must find ways to harness the power of new information-processing technologies without falling into the trap of expecting these advances to transform IC forecasts and predictions. As senior CIA officer Joseph Gartin noted in this journal in June 2019, advancements in artificial intelligence (AI), "big data," and machine learning will undoubtedly have an influence on the work of intelligence analysts in the future.[38] While I will not try to predict the specific ways in which these technological advances will transform the work of intelligence analysts, it is clear that the processing of raw information that feeds analytic

forecasts will become more automated and less reliant on diligent work by individual analysts.[39] Nevertheless, the desire for this technological progress to emancipate intelligence analysts from prediction purgatory is easily overstated.

An article in an issue of *Science* that focused on the future of prediction found that these technological advances were able to notice heightened tensions and potential early-warning signals of political violence, but they could not by themselves predict them because of the "inherent limitations imposed by massive historical complexity and contingency in human systems."[40] The authors did highlight how "big data" and machine learning could improve assessments by enabling more "limited spatial and temporal" scope; these enablers represent advances the IC would do well to begin incorporating now. These tools could help analysts do their bread-and-butter linear assessments better and generate more realistic future scenarios. The incorporation of these tools, however, must also come with an understanding that even the most advanced efforts at predictive modeling will not be able to overcome limits on prediction.

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