Bust of Aristotle in the Long Room, Trinity College Dublin, Ireland. (Sonse, Wikimedia)

Applying Epistemology to Analysis

Making the Case for Abductive Reasoning

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The late Richards Heuer, an authority on intelligence analysis theory, whose work remains widely influential today, stated that his understanding of intelligence analysis is based on a review of "cognitive psychology literature" concerning "how people process information to make judgments on incomplete and ambiguous information."[1] While Heuer admitted that this approach "may not be wholly satisfactory to either psychologists or intelligence analysts," I think that Heuer fundamentally misunderstood the essence of intelligence analysis by reducing it to a psychological enterprise. Better intelligence analysis cannot be derived simply from understanding "mental processes" and "mistakes in thinking" if analysis is about producing knowledge.

Epistemology and Intelligence Analysis

Adjusting habits of thinking, avoiding bias, or understanding psychological tricks of the mind do not address the fact that intelligence analysis—with its goal of producing knowledge in the form of actionable insight leading to decision advantage—relies on the objectivity of epistemology, not on the subjectivity found in psychology giving accounts of mental states.[2] Heuer's focus on "the human cognitive process" and thus psychology, unfortunately, elides the rational and scientific nature of intelligence analysis's objective methodological function, the logical form of which does not depend on the human brain.

A science of analysis is misplaced if it focuses only on the subjective cognitive processes of the mind. In a sense, then, I have already admitted the thesis of this essay:

> *That intelligence analysis can be improved if it incorporates into both its theory and practice epistemological principles and concepts, considering that intelligence analysis is fundamentally epistemological where "epistemology" (from the Greek episteme, meaning knowledge or understanding) is taken to mean "the philosophical study of truth and knowledge."* [3]

Literature Review

There are two main schools of thought as regards epistemology and intelligence analysis. I have chosen the title of "formalism" to refer to the thinking of James Bruce, Roger George, and Martha Whitesmith on the one hand, and "psychologism" to refer to the thinking of Richards Heuer and Randolph Pherson, on the other.

Bruce's "Making Analysis More Reliable: Why Epistemology Matters to Intelligence" argues that the purpose of intelligence is "to create reliable knowledge" and that understanding epistemology "can help us produce better knowledge, and that some ways of producing knowledge are better than others."[4] His thesis is that "the reliability of intelligence judgments correlates directly with … the use of reliable epistemology."[5] Bruce lays out how analysis is a knowledge-building activity, and that, following the German philosopher Immanuel Kant, the attainment of knowledge requires cognition.[6]

In this way, information is inert and for information to become knowledge, human reasoning, logical judgment, and inference-making must act upon it and transform it into justified true belief. This is what I call the "formalist" approach to intelligence epistemology, as that term succinctly captures Bruce's and George's definitional approach to intelligence, defining "intelligence" as knowledge and knowledge as justified true belief.

Following Bruce and George, Martha Whitesmith in her "Justified True Belief Theory for Intelligence Analysis," attempts to answer the question, "what standards can be used to determine when we can be justified in believing something to be true?"[7] There, Whitesmith outlines her understanding of the meaning of intelligence analysis definition-by-definition, a familiar practice performed both by Bruce and George. While Bruce and George, as well as Whitesmith, justly draw attention to epistemology as a much-needed area of attention in the field of intelligence analysis theory, they stop short of following through in articulating how a defined epistemology of intelligence is to be practically applied. In other words, Bruce, George, and Whitesmith define intelligence epistemology in terms of knowledge and justified true belief, but do not articulate how it actually functions in a process of inquiry, such as intelligence analysis actually is.

Psychologism

Randolph Pherson and Richards Heuer both begin with practical applications of an intelligence epistemology which they reduce to critical thinking, which is further reduced to *behavioral psychology*. This is unfortunate because Pherson and Heuer never

succeed in establishing a coherent theory of knowledge beyond crafting psychological tools or tricks of thought intended to be applied in terms of basic human psychology. For Pherson and Heuer, intelligence failures of analysis occur due to the interference of human emotions or psychological bias.

However, their "psychologism," as I call it, makes no mention of logical errors in rational inference-making and evaluative reasoning. With Heuer's *Psychology of Intelligence Analysis* (1999) and Pherson's *Handbook of Analytic Tools & Techniques* (2011), one is left with numerous instructional mental steps or "tricks to watch for in thinking" rather than with any real understanding of how analysis takes place, the standards of epistemic justification, or the objective forms of reasoning and logic which produce and confirm or disconfirm knowledge. Thus, as both authors tend to reduce intelligence analysis to psychological acts, I call their outlook psychologism.

In a way, Pherson and Heuer are the opposite of Bruce, George, and Whitesmith: they sacrifice theoretical substance for performative psychological reflection, chalking up failure to mere mistakes induced by human emotion or psychological bias; whereas Bruce, George, and Whitesmith, who, arguably in my estimation, make significantly more headway, have a solid theoretical foundation but lack the development of that foundation's actual application. Kant's insight that "concepts without perceptions are empty, perceptions without concepts are blind" seems apropos in this case because intelligence psychologism focuses on "doing" but without considering theory, while intelligence formalism offers theoretical basis but does not provide instruction as to how this basis can be actualized and carried out.[8]

It must be noted that Pherson does briefly mention the role of formal logic in relation to analysis-understood-as-psychology, highlighting Aristotle's principles from over 2,300 years ago as being foundational to sound reasoning in general, i.e., critical thinking.[9] However, Pherson proceeds to argue that understanding the differences between inductive, deductive, and abductive logic is unnecessary, mentioning the theory of abduction—the most commonly used sort of inference in intelligence—only in passing. Pherson further asserts that CIA analysts no longer need to grasp the distinctions of inductive, deductive, and abductive reasoning; instead, he emphasizes that the utility of analysis outweighs any understanding of formal logic.

While I partially agree with Pherson's claim that "the measurement of successful analytic products should be based on the utility of the product rather than on the logic employed," my claim is that effective analysis requires an understanding of what analysis entails.[10] Without comprehending the underlying logic of an analytic tool, how can one improve its utility and ensure its optimal use? Assessing a tool's efficiency involves not only recognizing that it works but understanding *how* and *why* it works as it does, as well as whether it is the best tool for a given situation. Thus, understanding basic principles and concepts in epistemology—the study of truth and knowledge, formal logic and proper reasoning, and the nature of epistemic justification—can help one to do intelligence analysis in a better way.

Abductive Reasoning

The logic of abduction is crucial for intelligence analysis because it enables analysts to generate the most plausible hypotheses for a given situation and evaluate which hypothesis best explains the available evidence.[11] This involves holistically synthesizing information and assessing how well it aligns with each hypothesis. Abductive reasoning effectively "fills in the gaps" when dealing with incomplete, contradictory, conflicting, or ambiguous information, identifying what hypothesis makes the most sense of all the evidence. In this section, I will discuss the logic of "abduction," a mode of reasoning created by the American pragmatist philosopher, Charles Sanders Peirce (1839–1914).[12] A discussion of abduction, as well

as its corollary epistemological principles and concepts, can help readers better understand the method of Abductive Hypothesis Matrix (AHM), which is offered here as a supplement or alternative to Pherson's and Heuer's Analysis of Competing Hypotheses (ACH). Presenting AHM demonstrates how epistemological principles and concepts can help enhance intelligence analysis.

The sort of epistemological principles and concepts this thesis will consider judges truth and knowledge in terms of the practical effects it produces in its application. The school of thought that understands the meaning of truth to be "downstream" in the results of its application and concrete practical effects, is the philosophy known as "pragmatism."[13] Peirce explicitly defines pragmatism as the logic of abduction. In his essay, "Pragmatism as the Logic of Abduction" (1903), Peirce describes "the function of pragmatism" as helping to "help identify unclear ideas and comprehend difficult ones."[14] Abduction serves as a natural mode of reasoning for problem-solving, enabling one to determine what is best to believe based on the strongest fit of evidence given the most compelling reasons for belief.

Scholars who study Peirce's concept of abduction contend that, "[A]bduction belongs to what the logical empiricists called the 'context of justification'—the stage of scientific inquiry in which we are concerned with the assessment of theories … [It is a] stage of inquiry in which we try to generate theories which may then later be assessed."[15] And,

> *Peirce's work suggests an understanding of abduction not so much as a process of inventing hypotheses but rather as one of adopting hypotheses, where the adoption of the hypothesis is not as being true or verified or confirmed, but as being a worthy candidate for further investigation. On this understanding, abduction could still be thought of as being part of the context of discovery. It would work as a kind of selection function, or filter, determining which of the hypotheses that have been conceived in the stage of discovery are to pass to the next stage and be subjected to empirical testing. The selection criterion is that there must be a reason to suspect that the hypothesis is true, and we will have such a reason if the hypothesis makes whichever observed facts we are interested in explaining a matter of course. This would indeed make better sense of Peirce's claim that abduction is a logical operation.*[16]

Peirce was the first to introduce a "trichotomy" of inference, recognizing that only abduction, as compared to deduction (the logic of proof) or induction (the logic of support), could address the reason for *why* a hypothesis should be preferred based on reasons other than a limited number of observations appearing to support it. As such, abductive hypotheses are ventured "on probation."[17] Peirce wrote:

> *Abduction is preparatory. It is the first step of scientific reasoning.… Nothing has so much contributed to present chaotic or erroneous ideas of the logic of science as failure to distinguish the essentially different characters of different kinds of reasoning.*[18]

Both being ampliative and scientific, induction and abduction are similar in that each manner of reasoning infers non-necessary conclusions rather than logically necessary ones.[19] For Peirce, induction "infers the existence of phenomena such as we have observed in cases that are *similar,"* whereas abduction "supposes something of a different kind from what we have directly observed, and frequently from something which it would be impossible for us to observe directly."[20]

Already, it should be evident how abductive reasoning is crucially important for intelligence analysis. Abductive reasoning draws inferences concerning phenomena that cannot be observed directly as well as evidence that might be incomplete, conflicting, non-repeatable, or simply ambiguous.

While Peirce wrote in 1861 that "an operation upon data resulting in cognition is an inference," abduction is intended to provide a "formal account" that is "unpsychologistic logic."[21] Believing abduction to be the only form of reasoning capable of producing new knowledge (as induction *a posteriori* states a generalization), it is a method of "actual facticity" calibrating what is known *a posteriori* with what most likely could be—what is the case but is currently not known to be the case—*a priori.*

In other words, deductive reasoning *a priori* infers a necessary effect from cause, inductive reasoning *a posteriori* generalizes a cause from a limited number of observed effects, and abduction *a posteriori* infers a cause explaining a limited number of observed effects. Abduction is in this way a form of enthymematic reasoning. Nicholas Rescher, in his *Cognitive Pragmatism: The Theory of Knowledge in Pragmatic Perspective* (2001), demonstrates how the logic of abduction works:[22]

First example.

Premise: p

Premise: x

—

Stated Conclusion: p + q

Where it is inferred abductively that x = q[23]

Second example.

Premise: x > 3

Premise: x

—

Stated Conclusion x > 5

Where it is inferred abductively that x ≠ 4 and x = 6.[24]

Compare this with inductive and deductive reasoning. Peirce laid out how forms of inference operate with respect to a thesis by identifying a "rule," "case," and "result" in each of the premises and conclusion, forming deductive, inductive, and abductive arguments, respectively. (Note that Peirce here referred to abduction as "hypothesis.") From Peirce's "Deduction, Induction, Hypothesis" (1870)[25]:

Deduction: Rule – All the beans from this bag are white

Case – These beans are from this bag

Result – These beans are white

Induction: Case – These beans are from this bag

Result -These beans are white

Rule – All the beans from this bag are white

Hypothesis [i.e., abduction]: *Rule - All the beans from this bag are white*

Result – These beans are white

Case – These beans are from this bag[26]

As can be seen in the case of induction, we generalize from a number of cases taken to be true that same thing is true of a whole class. To understand Hypothesis, i.e., abduction, imagine you walk into a room and see on one table a bag of white beans, and on another table a few loose white beans. Observing this phenomenon, it can be asked, what is an explanation for the white beans on the table? Presumably one could reason that someone broke into the room and mischievously laid on the table white beans taken from somewhere else; but, the *best* hypothesis—considering the evidence—is that the beans were taken from the bag on the other table, given the evidence of both tables of beans being white.

How, then, is abduction to be used as a logical tool in a way that affords the best explanation? By what criteria does one judge a hypothesis to be a *good* explanation as compared to its rivals? Understanding this is crucial for successfully employing the abductive scoring method in the Abductive Hypothesis Matrix (AHM). Duoven puts it like this:

In textbooks on epistemology or the philosophy of science, one often encounters something like the following as a formulation of abduction:

> *Given evidence E and candidate explanations H1,…, Hn of E, infer the truth of that H1 which explains E best, provided H1 is satisfactory/good enough qua explanation.*
>
> [Abduction's] *appeal* [is to] *to the so-called theoretical virtues, like simplicity, generality, and coherence with well-established theories; the best explanation would then be the hypothesis which, on balance, does best with respect to these virtues.*[27]

The "force" of abductive reasoning is the force of the *explanation* a hypothesis provides, given the evidence, i.e., how the hypothesis makes sense of a reality. It so happens that when it is true that *H* best explains *E,* that if *E* is true, then it is likely that *H* is true as well. This agrees with Lowenthal's characterization that intelligence is not about truth, but about "proximate reality."[28]

Abductive Hypothesis Matrix

A hypothesis, Heuer tells us, is a "potential explanation or conclusion that is to be tested by presenting and collecting evidence."[29] Methodologically, Analysis of Competing Hypotheses (ACH) identifies hypothesis-alternatives that then are pitted against each other "competing for the analyst's favor" rather than by "evaluating their plausibility individually."[30] Because ACH is able to entertain multiple hypotheses simultaneously, we are told that the analyst will have an easier time "establishing the likely truth or falsity" of each hypothesis applying the scientific concept of falsification to each.[31] There are eight steps to ACH, as follows.[32]

- Identify possible hypotheses to be considered
- Compile evidence and arguments for and against each hypothesis
- Prepare a matrix with hypotheses listed across the top and evidence down the side
- Delete evidence that appears to have no diagnostic value
- Using the remaining evidence, try to disprove, rather than prove, the likelihood of each hypothesis where hypotheses with evidence against them are discounted as "unlikely"
- Analyze sensitivity by considering the consequences of the above analysis
- Report conclusions
- Identify milestones for future observation

The key with ACH is to "seek evidence that disproves hypotheses" where, for a disproved hypothesis, "there is positive evidence it is wrong."[33] One starts with a full set of alternative possible hypotheses looking to disprove each using the evidence in the matrix, not begin with the most likely alternative possible hypothesis seeking evidentiary support. The goal is to refute the hypotheses where "the most probable hypothesis is the one with the least evidence against it."[34]

Building on Heuer's *Psychology of Intelligence Analysis* (1999), Pherson, in a section dedicated to ACH his *Critical Thinking for Strategic Intelligence* (2016), states that "ACH is the application of Karl Popper's philosophy of science to the field of intelligence analysis."[35] In this section of his book, Pherson relegates abductive reasoning strictly to the realm of hypothesis generation—rather than identifying a structured way that abduction could be used in the testing of hypothesis and their evaluation. His main concern is falsifiability, which Pherson defines as "eliminating hypotheses… tentatively accepting only those hypotheses that cannot be refuted."[36] Emphatically, Pherson states that, "It only takes one or a few items of compelling inconsistent data to discard an entire hypothesis from serious consideration."[37] So, one piece of "inconsistent data" is enough: if *any* evidence counts against a particular hypothesis, then that hypothesis is thrown out.

For Pherson, this process is essentially the opposite of abduction in that it is antithetical to a coherence theory of truth. While we are told that consistency of hypotheses with the evidence

should factor, one nevertheless proceeds by negation and disconfirmation rather than with fit established by evidence. If we are to take Pherson at his word, then disconfirming hypotheses (what Pherson interprets as falsification) is dependent upon the extent of the evidence available and whether any conflicting evidence is present. Pherson does state that a "robust flow of data" is required for ACH to operate, but then states that it also "ensures all reasonable alternatives are considered." Certainly, by now, if one is familiar with scientific falsifiability and the epistemology of Karl Popper's idea of falsifiability through logical contradiction, the inherent logical problems and rational deficiency of ACH should be apparent.

Problems With ACH

Structured analytic techniques (SATs) are designed to be structured methods that can reduce cognitive bias in that the justification and reasoning process for believing a hypothesis to be likely, plausible, or true is made explicit. As it stands, ACH is the most commonly used SAT in intelligence analysis. Unfortunately, ACH is simply assumed to work well and function without cognitive bias.

Only one proper empirical academic study has ever been done assessing the effectiveness of ACH, and that is Dhami, Belton, and Mandel's "The 'Analysis of Competing Hypotheses' in Intelligence Analysis," published in *Applied Cognitive Psychology* 33(6) (2019): 1080–90. (The Cheike 2004 study, mentioned by Whitesmith in her *Cognitive Bias in Intelligence Analysis*, was an internal corporate technical report and not a peer-reviewed academic paper and empirical study.)

Notably, the results of the study by Dhami, et al.—as well as the non-academic Cheike 2004 study—indicated that ACH is not effective, and problematically so. The recommendation was that a new SAT with greater capability of handling nuance, complexity, and conflicting data/evidence be found. As noted in the literature review, Whitesmith's text does not claim to be a formal academic empirical study, but rather is an effort—much like this article—to bring attention to the deficiencies of ACH.

By Whitesmith's account, this deficiency is due to ACH's methodologically inherent risk of cognitive bias, while on my account it is due to ACH's inherent ampliative potential for analytic misjudgment found within the procedural mis-implementation of falsifiability. This means there is a need to incorporate epistemological concepts and principles in order to provide a better framework within which to perform analytical judgment. Whitesmith explicitly asks: "Does ACH provide a theoretically valid framework for establishing epistemic justification?" Her answer, and the answer conjectured here is, "no."

Recall that Pherson states that "ACH is the application of Karl Popper's philosophy of science to the field of intelligence analysis." Science, however, is not concerned with making claims that a theory is true or probably true. Rather, on the account that science operates on the basis of empirical data and using falsifiability, the primary concern of scientific investigation is with the *testing* of theories, critically, and showing how they are false. In other words, the only "conclusion" scientific inquiry ever draws is that a particular theory is wrong. Karl Popper, in his *The Logic of Scientific Discovery* (1934), titles this critical testing and falsifying of purported theories "falsification." Falsification is an observation that shows a theory is false, not in the sense that evidence is inconsistent or that a theory or hypothesis lacks support but that theories (hypotheses) are capable of logical contradiction in an evidentiary, empirical manner.

It was Popper's view that falsifiability, while involving empirical data, employs in falsification deductive logic in which "a theory is falsified only if we have accepted basic statements that logically contradict it." To say that a theory or hypothesis is falsified is not to claim that an alternate theory or hypothesis has been at the same time shown likely to be "true" or "more plausible." To survive falsification means, deductively and critically, that there are

no basic statements or observation claims that contradict the theory under scrutiny that rule it out and prohibit it. In other words, for Popper, hypothesis testing is about making conjectures and searching for refutations in which "theories about the world are never, strictly speaking, confirmed." At best, if a hypothesis passes falsification one can say that the hypothesis avoided disconfirmation for the time being, but this in itself gives us no new positive information.

As opposed to what is commonly believed, Popper's notion of falsifiability means that science does not proceed by inductive logic establishing general claims that can be "falsified"—i.e., overturned—by future observations. That is, it is not the case that observing a number of white swans and claiming "All swans are white" is scientific, because the conclusion is supported inductively by empirical observations and is subject to revision should a black swan be found. This is not how falsification works. Instead, science, using falsification, uses the deductive form of *modus tollens* in which a hypothesis or theory is evaluated in a testable, repeatable way in which there is sufficient data to test the theory by negating a necessary condition. The deductive logical form is as follows:

If theory T is true, then we should observe O

We do not observe O

Therefore, theory T is false

As can be seen in the above, falsification is *deductive* and takes the form of *modus tollens*.

If p then q p q Not q ~ q

———

Therefore, Not p :// ~ p

This is all that falsification does. It does not claim a hypothesis is true because evidence seems to suggest alternate hypotheses are false.

ACH's understanding and use of falsification claims that the most likely true hypothesis is the hypothesis with the least amount of evidence counting against it. But this is not the meaning of scientific falsification. Science does not claim that hypothesis *H1* is most likely true because a limited number of observations and evidence appear to count against hypotheses *H2* and *H3*. Again, science never claims a theory is true (even likely to be true based on discounting evidence counting "against" alternate theories). This is because science understands that new observations can always prove a preferred alternate theory wrong, and in the case of ACH, new evidence or missed evidence could contribute to discounting a preferred hypothesis that was selected on the basis of the fact that there happened to be evidence absent which would count against it.

Popper identifies this mistake in thinking (misuse of falsification or pseudo-falsifiability) as an instance of aspiring deduction failing by falling into inductive generalization. The hypothesis with the least amount of evidence counting against it simply may have not been subjected to the relevant findings or fitting evidence, whether present yet outside of the data-set or somehow concealed or distorted within the data-set.

Therefore, essentially ACH is subject to two errors of reasoning and logical misjudgment: the *ad ignorantiam* fallacy and fallacy of affirming the consequent. The *ad ignorantiam* fallacy is where a hypothesis, theory, or proposition is claimed to be true because there is no or little verifiable evidence counting against it (or, conversely, when a hypothesis, theory, or proposition is claimed to be false because there is no or little verifiable evidence counting for it). As Aristotle pointed out in his *De Anima,* however, absence of evidence should not be interpreted as evidence of absence. Before discussing ACH and affirming the consequent, let's look at an example of ACH's insufficiency due to *ad ignorantiam*.

India Nuclear Testing

Suppose an intelligence analyst is tasked with evaluating competing hypotheses concerning whether India is testing nuclear weapons.

The majority of the collected data does not indicate any evidence of nuclear testing—there are no seismic activity reports, satellite imagery, or radiation readings that would suggest nuclear testing is taking place. All observable evidence seems to refute or "count against" the hypothesis that India is testing nuclear weapons. However, according to the principle of falsification, if hypothesis *H* is true then we should observe a set of expected outcomes, *O*. If *O* is not observed in a standard scientific test of falsifiability, we may deductively reject *H* as false by *modus tollens*. For instance, if the hypothesis "India is testing nuclear weapons" implies we should observe increased seismic activity or radiation signatures, and these are not observed, we could conclude that *H* is false. In this case, the absence of evidence that would confirm *H* seems to refute the hypothesis.

Notice, however, how this reasoning reveals a critical flaw in ACH, which assumes that evidence, or *the lack thereof*, is sufficient to weigh the competing hypotheses. To see the deficiency in this approach, one must ask: *If India were testing nuclear weapons, would we expect to observe clear evidence of that testing?* If India were taking measures to conceal its activities (e.g., using underground testing or advanced masking techniques), it is entirely possible that no observable evidence would be generated, even if the hypothesis were true. It is simply not logically possible for ACH to meaningfully apply scientific falsifiability in such a case.

The India example shows how intelligence analysis, as practiced in competitive environments of uncertainty and in the presence of incomplete states of information, cannot help but misapply falsification as a failed form of logical judgment. In order to show that India *is* testing nuclear weapons without sufficient or deductive proof, we would either need to draw inductive inference of probability or abductive inference of best explanation, or we would otherwise need to *affirm the consequent* of a hypothetical conditional statement—that is, affirm as necessary what in reality is only sufficient—which is a logical fallacy and leads to an unsound conclusion. For example, one may claim "If *p* obtains then *q* event will occur," and test whether *p* has occurred by looking for event *q*. But to affirm a consequent *q* (versus negating it, as in modus tollens) is a fallacy, i.e., incorrect reasoning. Thus:

Fallacy of Affirming the Consequent.

Premise: If p then q p q

Premise: q q

Conclusion: p :// p

A conditional statement is "If *x* then *y*" where *x* is the antecedent, which is sufficient, and *y* is the consequent, which is necessary. Rendered into an argument:

Premise: "If it rains then the sidewalk will be wet."

Premise: "The sidewalk is wet."

Conclusion: "Therefore, it rained."

This is incorrect reasoning (a formal fallacy, i.e., formal not material logic) because while it is *sufficient* to say that it rained, one cannot say so *necessarily*. It is possible that the sidewalk became wet in some other way, such as someone spraying it with a garden hose, or something spilled, or someone had been washing a car. The conclusion *may* be true, but it is not *necessarily* true. Therefore, the argument is not a valid form of reasoning. Using the India example of affirming the consequent:

Premise: "If India is testing nuclear weapons, then there will be seismic activity."

Premise: "There was seismic activity."

Conclusion: "India is testing nuclear weapons."

The conclusion does not follow necessarily, as the argument affirms as necessary evidence which is in reality only sufficient. Thus, it is a logically invalid inference. We do not *know* that India is testing nuclear weapons necessarily as the seismic activity could have been produced some other way, such as an earthquake or some other natural event.

The India nuclear-testing scenario demonstrates that a lack of evidence does not necessarily refute the hypothesis; instead, it might reflect the limitations of the data-gathering process or the deliberate concealment of activities. A form of reasoning other than falsification is required, such as inductive or abductive reasoning. ACH's reliance on existing evidence, without knowledgeably accounting for the potential absence of critical data, or the presence of ambiguous or conflicting data that could confirm or refute a hypothesis, risks corrupting analytic judgment by way of *ad ignorantiam* or the fallacy of affirming the consequent. The framework may erroneously dismiss a plausible hypothesis simply because the expected evidence is missing, even when such evidence would be unlikely or impossible to observe.

A scientifically robust method must incorporate considerations of missing, unobtainable, or conflicting data and recognize that falsification cannot be reliably applied when critical evidence is inherently inaccessible or suppressed. For example, abductive reasoning considers the possibility that the absence of expected evidence (e.g., seismic activity or radiation) could result from deliberate concealment measures, limitations in data collection, or other contextual factors making for ambiguity. Instead of outright rejecting the hypothesis "India is testing nuclear weapons," abductive reasoning *weighs its plausibility and "fit" against alternative explanations*.

Abductive Hypothesis Matrix

I wish to show that despite evidence that is conflicting or contrary to a hypothesis—evidence which normally would be refuted by ACH—such data can be retained and serve to help establish the overall explanatory power of a strong hypothesis. Unlike ACH, which misapplies falsifiability to navigate incomplete, ambiguous, or conflicting information—claiming to refute competing hypotheses and identify a "scientifically" justified true hypothesis—an abductive hypothesis matrix (AHM) would employ *abductive* reasoning, advancing through inference-to-best-explanation. This means that AHM evaluates hypotheses based on how well they cohere with evidence, not whether or not hypotheses have survived attempts to refute them—i.e., "the least disproved hypothesis." This reduces vulnerability to the common pitfalls found in ACH when assessing the likelihood and plausibility of hypotheses.

Comparing ACH and AHM on India Testing Nuclear Weapons

Imagine that analysts are tasked with determining whether India is testing nuclear weapons based on available intelligence. To use an AHM, analysts would:

- Identify the phenomenon: Start with clear observations.
- Gather evidence: Collect, list, and study relevant evidence that supports or relates to the phenomenon.
- Generate possible explanations: Think of multiple explanations that could account for the evidence. Add to the list all possible explanations.
- Rate the fit: Evaluate each explanation based on how well it matches the evidence, using a 1–5 rating system of "very weak fit" (1) to "very strong fit" (5).

Select the Best Explanation: Choose the explanation with the highest calculated fit rating as the most likely hypothesis, given its relative strength with respect to the evidence.

Evidence

E1 (Seismic Signals): MASINT detection of seismic activity is consistent with, though not necessarily identical to, underground nuclear tests.

E2 (Radioactive Isotopes): No measurable radioactive isotopes detected in MASINT.

E3 (Satellite Imagery): GEOINT imagery shows increased construction activity at known nuclear test sites.

E4 (Intelligence Reports): HUMINT suggest covert

operations occurring potentially linked to nuclear testing.

E5 (Historical Patterns): India has history of seismic events in the same region.

E6 (Expert Analysis): Geologists confirm the seismic patterns are ambiguous and represent natural events or nuclear testing.

Hypotheses

Hypothesis A (No Testing): India is not testing nuclear weapons.

Hypothesis B (Concealed Testing): India is conducting nuclear tests but concealing the activity.

Hypothesis C (Natural Seismic Activity): The observed phenomena are due to natural seismic activity, not nuclear testing.

AHM Calculation

Hypothesis B (Concealed Testing) is the strongest hypothesis because it best explains all available evidence. (A matrix of evidence with value ratings in this exercise would show B with 20 points in fit ratings, compared to 11 for A and 15 for C.) We can abductively infer that India would *not* allow there to be evidence of its tests, and so the fact that seismic activity is not identical with nuclear testing, but is nevertheless consistent with it, means that in light of increased construction at nuclear test sites and an increase in activity in covert nuclear programs, the interpretation of that ambiguous seismic activity being caused by hidden-underground nuclear testing in this context makes the most sense.

ACH Calculation

Hypothesis C (Natural Seismic Activity) is the most likely because it has the fewest (2) pieces of refuting evidence. (The other two hypotheses had three each.) ACH would look at the hypotheses *first* and establish whether the evidence is "for" or "against" each hypothesis. Here, the fact that ACH must choose between a "for" or "against," or between a "support" or "refute" determination for seismic activity that is consistent with, but not necessarily identical to, nuclear testing corrupts the nuance in judgment required to solve the ambiguity of information. As ambiguous and conflicting evidence is capable of different interpretation, ACH can only claim the evidence is consistent with the hypothesis or refutes the hypothesis. ACH would simply say that E1 is more consistent with Hypothesis C *if considered consistent or not on its own rather than holistically in light of the other evidence.*

Analysis of ACH and AHM Comparison

AHM assigns a stronger fit to the seismic activity being consistent with nuclear testing *given the whole of the other data.* The fact that there is increased construction at sites associated with nuclear testing means that an abductive inference would associate a stronger fit with seismic activity that matches nuclear testing even though it is not identical. This is compared to ACH which would simply regard the evidence as "for" or "support" in both cases of nuclear testing and seismic activity, leading to the conclusion that the least refuted/disconfirmed hypothesis is C because the least positive evidence counts against it. *A whole-of-evidence approach considering the complexity, nuance, and ambiguity of the data is required, thus abduction in AHM is the preferred SAT to analyze this intelligence question.*

Conclusion

Given that the thesis of this essay is that *epistemology* – i.e. the philosophical study of truth and knowledge, including formal logic, proper reasoning, and epistemic justification – *can help to improve intelligence analysis*, I should note that Sherman Kent in his seminal *Strategic Intelligence for American World Policy* (1949) titles the very first chapter of that work as "Intelligence is Knowledge," wherein he states that, fundamentally, intelligence is a kind of knowledge upon which a successful "course of action can be rested."[38] What distinguishes intelligence as knowledge from other forms of knowledge—as obviously while all intelligence is knowledge yet not all knowledge is intelligence, just as while all Californians are Americans but not all Americans are Californians—is that

intelligence is the kind of knowledge that ensures one's welfare and security "will not suffer" nor one's "undertakings fail."[39]

In essence, intelligence as knowledge, i.e., epistemology, is pertinent to *maintaining welfare* and sustaining or maximizing *a dominant axiological category of value*, whether that means promoting (and protecting the loss of) "good," "utility," "advantage," "control," "power," etc. In the context of intelligence, knowledge achieves protection from suffering and security against failure by being a basis upon which optimal choices might be made and best courses of action pursued. In this way, intelligence—now understood as knowledge which produces *actionable insight*—is knowledge that leads to *decision advantage*. This is why Kent states: "In a small way it [intelligence] is what we all do every day … when almost anyone decides upon a course of action he usually does some preliminary intelligence work."[40]

In advancing the claim that *intelligence analysis* is fundamentally *epistemological,* this thesis has sought to demonstrate that the methodological framework of intelligence work must be grounded not in the psychological constraints of subjective cognition but in the objective epistemological principles of logic and knowledge. By critically examining the inadequacies of the Analysis of Competing Hypotheses, particularly its misapplication of falsifiability and its vulnerability to cognitive biases, I have argued that a superior analytic framework is one which incorporates an epistemologically self-aware methodology – in this case, abductive reasoning. The Abductive Hypothesis Matrix offers an alternative to ACH, as it utilizes inference to the best explanation rather than quasi-falsifiability. This epistemological reorientation not only enhances the analytic process but also aligns intelligence analysis with the broader aim of producing actionable insight.

Moving forward, an epistemological reorientation through the application of abductive reasoning, with its emphasis on coherence and inference-driven justification, provides a model for analytical disciplines grappling with incomplete or ambiguous information in competitive environments of uncertainty. Future research might explore the integration of AHM within strategic, operational, and tactical intelligence frameworks, testing its efficacy in real-world decisionmaking contexts.

More broadly, this thesis invites a reconsideration of how intelligence as a discipline defines and evaluates knowledge and incorporates into its methodology philosophical principles and concepts derived from epistemology, inviting a more dynamic, yet conceptually rigorous, understanding of epistemic justification. In this light, the practical value of epistemology becomes clear: intelligence analysis, at its best, is not merely the practice of acquiring information but is the disciplined pursuit of justified, true belief: actionable insight leading to decision advantage.

I close with this extended quote from Nicholas Rescher (1929–2024), a predominant representative of pragmatism, contemporary originator of abductive reasoning, and Peirce's modern philosophical heir:

> *It is a situational imperative for humans to acquire information about the world. We have questions and we need answers. The requirement for information, for cognitive orientation within our environment, is as pressing a human need as that for food itself. The quest for cognitive orientation in a difficult world represents a deeply practical requisite for us.… For us, knowledge is thus an acute practical need. And this is where philosophy comes in, in its attempt to grapple with our basic cognitive concerns and commitments. Philosophy is an inquiry that seeks to resolve problems arising from the incoherence of the matter with our most basic commitments, i.e., the matter of our practical commitments at any level, whether personal, social, economic, religious, ethical, or scientific.… The demand for understanding and knowledge, for cognitive accommodation to one's environment, for "knowing one's way about," is one of the most fundamental requirements of the human condition.*[41] ■

Endnotes

A Note re. the below citations to the work of Charles Sanders Peirce:

Citations to Charles S. Peirce's works are to the eight-volume Collected Papers of Charles Sanders Peirce, the two-volume Essential Peirce, and the eight-volume Writings of Charles S. Peirce. Citations give the collection abbreviation, followed by volume and paragraph number. For example, Peirce CP3: 154 refers to "On the Algebra of Logic" (1880) published in The Collected Papers of Charles Peirce volume 3, paragraph 154. Peirce EP1: 200 refers to "On the Algebra of Logic" (1880) published in The Essential Peirce volume 1, page 200. Peirce W4: 163 refers to "On the Algebra of Logic" (1880) published in Writings of Charles S. Peirce volume 4, page 163. CP numbers are paragraph numbers, EP and W numbers are page numbers.

1. Richards Heuer, *Psychology of Intelligence Analysis* (Martino Fine Books, 1999), vii.
2. Admitting one's psychological biases concerning data/information is not providing to the decisionmaker knowledge *about* that data/information. It is certainly not providing to the decision-maker actionable insight, but rather only a report about one's personally affected beliefs.
3. "The term "epistemology" comes from the Greek words "episteme" and "logos." "Episteme" can be translated as "knowledge" or "understanding" or "acquaintance", while "logos" can be translated as "account" or "argument" or "reason." Matthias Steup and Ram Neta, "Epistemology," *The Stanford Encyclopedia of Philosophy* (Winter 2024), ed. Edward N. Zalta and Uri Nodelman. https://plato.stanford.edu/archives/win2024/entries/epistemology/.
4. James Bruce, "Making Analysis More Reliable: Why Epistemology Matters to Intelligence," in *Analyzing Intelligence*, 2nd edition, edited by Roger George & James Bruce (Georgetown University Press, 2014), 135.
5. Bruce, 35.
6. See Immanuel Kant, *Critique of Pure Reason* (1781, revised second edition 1787), translated by Werner S. Pluhar (Hackett Publishing, 1996).
7. Martha Whitesmith, "Justified True Belief Theory for Intelligence Analysis," *Intelligence and National Security* 37, No. 6 (2022): 835–49.
8. Kant, introduction.
9. Randolph Pherson and Katherine Pherson, *Critical Thinking for Strategic Intelligence* 2nd ed. (SAGE Publications, 2016), 172.
10. Pherson and Pherson, 176.
11. Peirce derived the word "abduction" from the Greek term α π α γ ω γ η (meaning "kidnapping" in Greek), ironically "kidnapping" it from Aristotle's term α ν α γ ω γ η (meaning "reduction" in Greek) used in the Prior Analytics. Peirce wrote, "[I]t is necessary to recognize three radically different kinds of arguments … recognized by the logicians of the eighteenth century, although those logicians quite pardonably failed to recognize the inferential character of one of them. Indeed, I suppose that the three [kinds of argument were first] given by Aristotle in the Prior Analytics … [where he] evidently was groping for that mode of inference which I call by the … name of Abduction." CP5: 144.
12. For a biographical account and intellectual history of Charles Sanders Peirce, see: Joseph Brent, *Charles Sanders Peirce: A Life* (Indiana University Press, 1998). Peirce's modern philosophical heir, Nicholas Rescher (1928–2024), was a philosopher whose ideas are constantly at work in the background of this thesis as he, too, was a primary originator of the theory of abductive reasoning. For more on Rescher see the Suppl. Vol. *Autobiography* of Nicholas Rescher's *Collected Papers*, In addition to his individual works referenced in this thesis, citations to Rescher's collected works are to the fourteen-volume Nicholas Rescher *Collected Papers*, 14 volumes, edited by Nicholas Rescher (Ontos Verlag, 2005–06). The Suppl. Vol. Autobiography is the 15th addition to that collection but, being a supplement and an autobiography, it did not receive a volume number. (It was published in 2010.) The fact that Rescher initially was a philosophical researcher in analytic methodology at the RAND Corporation during the 1950s is extraordinarily relevant to this thesis.
13. Two recent books providing a short but very good and conceptually thorough summary of pragmatism are: John Shook, *Pragmatism* (The MIT Essential Knowledge Series), (MIT Press, 2023) and Robert and Scott Aiken (eds.), *The Pragmatism Reader* (Princeton University Press, 2011).
14. C.S. Peirce, EP 2:226; CP 5:180–212; EP 2:226–41.
15. Igor Douven, "Abduction" in *The Stanford Encyclopedia of Philosophy* (Winter 2024), Zalta & Nodelman (eds.); https://plato.stanford.edu/entries/abduction/index.html.

16. Douven, "Abduction."
17. Peirce, CP8: 388.
18. Peirce, CP7: 218.
19. I use the term "non-necessary" because Peirce rightly distinguishes between probability and possibility. While all probabilities are possibilities, not all possibilities entail probabilities. A possibility simply means that something is not ruled out by logical contradiction and can occur, whereas a probability involves a quantifiable likelihood that it may occur. See John E. Freund, *Introduction to Probability* (Dover Publications, 1973).
20. Peirce, CP2. 640.
21. Peirce, CP7: 219
22. Nicholas Rescher, *Cognitive Pragmatism: The Theory of Knowledge in Pragmatic Perspective* (University of Pittsburgh Press, 2000), 123.
23. Ibid.
24. Ibid.
25. Peirce, CP2: 619–44.
26. Peirce, CP2: 623.
27. Douven, "Abduction."
28. Mark Lowenthal, *Intelligence: From Secrets to Policy* (CQ Press, 2023), 6–8.
29. Heuer, 95.
30. Ibid., 93.
31. Ibid., 95.
32. Ibid., 95.
33. Ibid., 98.
34. Ibid., 108.
35. Pherson and Pherson, 199.
36. Ibid., 200.
37. Ibid., 200.
38. Sherman Kent, *Strategic Intelligence for American World Policy* (Princeton University Press, 2025), vii.
39. Ibid., 3.
40. Ibid., vii.
41. Rescher, *Axiogenesis: An Essay in Metaphysical Optimalism* (Lexington Books, 2010), 2–4. ■