attributable to each of the seven major branches of the tree. A second group of mechanics was shown only an incomplete version of the tree: three major branches were omitted in order to test how sensitive the test subjects were to what was left out.

If the mechanics' judgment had been fully sensitive to the missing information, then the number of cases of failure that would normally be attributed to the omitted branches should have been added to the "Other Problems" category. In practice, however, the "Other Problems" category was increased only half as much as it should have been. This indicated that the mechanics shown the incomplete tree were unable to fully recognize and incorporate into their judgments the fact that some of the causes for a car not starting were missing. When the same experiment was run with non-mechanics, the effect of the missing branches was much greater.

As compared with most questions of intelligence analysis, the "car won't start" experiment involved rather simple analytical judgments based on information that was presented in a well-organized manner. That the presentation of relevant variables in the abbreviated fault tree was incomplete could and should have been recognized by the experienced mechanics selected as test subjects. Intelligence analysts often have similar problems. Missing data is normal in intelligence problems, but it is probably more difficult to recognize that important information is absent and to incorporate this fact into judgments on intelligence questions than in the more concrete "car won't start" experiment.

As an antidote for this problem, analysts should identify explicitly those relevant variables on which information is lacking, consider alternative hypotheses concerning the status of these variables, and then modify their judgment and especially confidence in their judgment accordingly. They should also consider whether the absence of information is normal or is itself an indicator of unusual activity or inactivity.

Oversensitivity to Consistency

The internal consistency in a pattern of evidence helps determine our confidence in judgments based on that evidence.[98] In one sense, consistency is clearly an appropriate guideline for evaluating evidence.

98. Amos Tversky and Daniel Kahneman, "Judgment under Uncertainty: Heuristics and Biases," *Science*, Vol. 185 (27 September 1974), 1126.

People formulate alternative explanations or estimates and select the one that encompasses the greatest amount of evidence within a logically consistent scenario. Under some circumstances, however, consistency can be deceptive. Information may be consistent only because it is highly correlated or redundant, in which case many related reports may be no more informative than a single report. Or it may be consistent only because information is drawn from a very small sample or a biased sample.

Such problems are most likely to arise in intelligence analysis when analysts have little information, say on political attitudes of Russian military officers or among certain African ethnic groups. If the available evidence is consistent, analysts will often overlook the fact that it represents a very small and hence unreliable sample taken from a large and heterogeneous group. This is not simply a matter of necessity—of having to work with the information on hand, however imperfect it may be. Rather, there is an illusion of validity caused by the consistency of the information.

The tendency to place too much reliance on small samples has been dubbed the "law of small numbers."[99] This is a parody on the law of large numbers, the basic statistical principle that says very large samples will be highly representative of the population from which they are drawn. This is the principle that underlies opinion polling, but most people are not good intuitive statisticians. People do not have much intuitive feel for how large a sample has to be before they can draw valid conclusions from it. The so-called law of small numbers means that, intuitively, we make the mistake of treating small samples as though they were large ones.

This has been shown to be true even for mathematical psychologists with extensive training in statistics. Psychologists designing experiments have seriously incorrect notions about the amount of error and unreliability inherent in small samples of data, unwarranted confidence in the early trends from the first few data points, and unreasonably high expectations of being able to repeat the same experiment and get the same results with a different set of test subjects.

Are intelligence analysts also overly confident of conclusions drawn from very little data—especially if the data seem to be consistent? When working with a small but consistent body of evidence, analysts need to consider how representative that evidence is of the total body of poten-

99. Tversky and Kahneman (1974), p. 1125-1126.

tially available information. If more reporting were available, how likely is it that this information, too, would be consistent with the already available evidence? If an analyst is stuck with only a small amount of evidence and cannot determine how representative this evidence is, confidence in judgments based on this evidence should be low regardless of the consistency of the information.

Coping with Evidence of Uncertain Accuracy

There are many reasons why information often is less than perfectly accurate: misunderstanding, misperception, or having only part of the story; bias on the part of the ultimate source; distortion in the reporting chain from subsource through source, case officer, reports officer, to analyst; or misunderstanding and misperception by the analyst. Further, much of the evidence analysts bring to bear in conducting analysis is retrieved from memory, but analysts often cannot remember even the source of information they have in memory let alone the degree of certainty they attributed to the accuracy of that information when it was first received.

The human mind has difficulty coping with complicated probabilistic relationships, so people tend to employ simple rules of thumb that reduce the burden of processing such information. In processing information of uncertain accuracy or reliability, analysts tend to make a simple yes or no decision. If they reject the evidence, they tend to reject it fully, so it plays no further role in their mental calculations. If they accept the evidence, they tend to accept it wholly, ignoring the probabilistic nature of the accuracy or reliability judgment. This is called a "best guess" strategy.[100] Such a strategy simplifies the integration of probabilistic information, but at the expense of ignoring some of the uncertainty. If analysts have information about which they are 70- or 80-percent certain but treat this information as though it were 100-percent certain, judgments based on that information will be overconfident.

A more sophisticated strategy is to make a judgment based on an assumption that the available evidence is perfectly accurate and reliable,

100. See Charles F. Gettys, Clinton W. Kelly III, and Cameron Peterson, "The Best Guess Hypothesis in Multistage Inference," *Organizational Behavior and Human Performance, 10*, 3 (1973), 365-373; and David A. Schum and Wesley M. DuCharme, "Comments on the Relationship Between the Impact and the Reliability of Evidence," *Organizational Behavior and Human Performance, 6* (1971), 111-131.

spite their logically compelling implications, have less impact than does inferior but more vivid evidence."[96] It seems likely that intelligence analysts, too, assign insufficient weight to statistical information.

Analysts should give little weight to anecdotes and personal case histories unless they are known to be typical, and perhaps no weight at all if aggregate data based on a more valid sample can be obtained.

Absence of Evidence

A principal characteristic of intelligence analysis is that key information is often lacking. Analytical problems are selected on the basis of their importance and the perceived needs of the consumers, without much regard for availability of information. Analysts have to do the best they can with what they have, somehow taking into account the fact that much relevant information is known to be missing.

Ideally, intelligence analysts should be able to recognize what relevant evidence is lacking and factor this into their calculations. They should also be able to estimate the potential impact of the missing data and to adjust confidence in their judgment accordingly. Unfortunately, this ideal does not appear to be the norm. Experiments suggest that "out of sight, out of mind" is a better description of the impact of gaps in the evidence.

This problem has been demonstrated using fault trees, which are schematic drawings showing all the things that might go wrong with any endeavor. Fault trees are often used to study the fallibility of complex systems such as a nuclear reactor or space capsule.

A fault tree showing all the reasons why a car might not start was shown to several groups of experienced mechanics.[97] The tree had seven major branches—insufficient battery charge, defective starting system, defective ignition system, defective fuel system, other engine problems, mischievous acts or vandalism, and all other problems—and a number of subcategories under each branch. One group was shown the full tree and asked to imagine 100 cases in which a car won't start. Members of this group were then asked to estimate how many of the 100 cases were

96. Nisbett and Ross, p. 57.
97. Baruch Fischhoff, Paul Slovic, and Sarah Lichtenstein, *Fault Trees: Sensitivity of Estimated Failure Probabilities to Problem Representation*, Technical Report PTR- 1 042-77-8 (Eugene, OR: Decision Research, 1977).

Nisbett and Ross label this the "man-who" syndrome and provide the following illustrations:[94]

- "But I know a *man who* smoked three packs of cigarettes a day and lived to be ninety-nine."

- "I've never been to Turkey but just last month I met a *man who* had, and he found it . . ."

Needless to say, a "man-who" example seldom merits the evidential weight intended by the person citing the example, or the weight often accorded to it by the recipient.

The most serious implication of vividness as a criterion that determines the impact of evidence is that certain kinds of very valuable evidence will have little influence simply because they are abstract. Statistical data, in particular, lack the rich and concrete detail to evoke vivid images, and they are often overlooked, ignored, or minimized.

For example, the Surgeon General's report linking cigarette smoking to cancer should have, logically, caused a decline in per-capita cigarette consumption. No such decline occurred for more than 20 years. The reaction of physicians was particularly informative. All doctors were aware of the statistical evidence and were more exposed than the general population to the health problems caused by smoking. How they reacted to this evidence depended upon their medical specialty. Twenty years after the Surgeon General's report, radiologists who examine lung x-rays every day had the lowest rate of smoking. Physicians who diagnosed and treated lung cancer victims were also quite unlikely to smoke. Many other types of physicians continued to smoke. The probability that a physician continued to smoke was directly related to the distance of the physician's specialty from the lungs. In other words, even physicians, who were well qualified to understand and appreciate the statistical data, were more influenced by their vivid personal experiences than by valid statistical data.[95]

Personal anecdotes, actual accounts of people's responsiveness or indifference to information sources, and controlled experiments can all be cited *ad infinitum* "to illustrate the proposition that data summaries, de-

94. Nisbett and Ross, p. 56.
95. Ibid.

then reduce the confidence in this judgment by a factor determined by the assessed validity of the information. For example, available evidence may indicate that an event probably (75 percent) will occur, but the analyst cannot be certain that the evidence on which this judgment is based is wholly accurate or reliable. Therefore, the analyst reduces the assessed probability of the event (say, down to 60 percent) to take into account the uncertainty concerning the evidence. This is an improvement over the best-guess strategy but generally still results in judgments that are overconfident when compared with the mathematical formula for calculating probabilities.[101]

In mathematical terms, the joint probability of two events is equal to the product of their individual probabilities. Imagine a situation in which you receive a report on event X that is probably (75 percent) true. *If the report on event X is true,* you judge that event Y will probably (75 percent) happen. The actual probability of Y is only 56 percent, which is derived by multiplying 75 percent times 75 percent.

In practice, life is not nearly so simple. Analysts must consider many items of evidence with different degrees of accuracy and reliability that are related in complex ways with varying degrees of probability to several potential outcomes. Clearly, one cannot make neat mathematical calculations that take all of these probabilistic relationships into account. In making intuitive judgments, we unconsciously seek shortcuts for sorting through this maze, and these shortcuts involve some degree of ignoring the uncertainty inherent in less-than-perfectly-reliable information. There seems to be little an analyst can do about this, short of breaking the analytical problem down in a way that permits assigning probabilities to individual items of information, and then using a mathematical formula to integrate these separate probability judgments.

The same processes may also affect our reaction to information that is plausible but known from the beginning to be of questionable authenticity. Ostensibly private statements by foreign officials are often reported though intelligence channels. In many instances it is not clear whether such a private statement by a foreign ambassador, cabinet member, or other official is an actual statement of private views, an indiscretion, part of a deliberate attempt to deceive the US Government, or part of an ap-

101. Edgar M. Johnson, "The Effect of Data Source Reliability on Intuitive Inference," Technical Paper 251 (Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences, 1974).

proved plan to convey a truthful message that the foreign government believes is best transmitted through informal channels.

The analyst who receives such a report often has little basis for judging the source's motivation, so the information must be judged on its own merits. In making such an assessment, the analyst is influenced by plausible causal linkages. If these are linkages of which the analyst was already aware, the report has little impact inasmuch as it simply supports existing views. If there are plausible new linkages, however, thinking is restructured to take these into account. It seems likely that the impact on the analyst's thinking is determined solely by the substance of the information, and that the caveat concerning the source does not attenuate the impact of the information at all. Knowing that the information comes from an uncontrolled source who may be trying to manipulate us does not necessarily reduce the impact of the information.

Persistence of Impressions Based on Discredited Evidence

Impressions tend to persist even after the evidence that created those impressions has been fully discredited. Psychologists have become interested in this phenomenon because many of their experiments require that the test subjects be deceived. For example, test subjects may be made to believe they were successful or unsuccessful in performing some task, or that they possess certain abilities or personality traits, when this is not in fact the case. Professional ethics require that test subjects be disabused of these false impressions at the end of the experiment, but this has proved surprisingly difficult to achieve.

Test subjects' erroneous impressions concerning their logical problem-solving abilities persevered even after they were informed that manipulation of good or poor teaching performance had virtually guaranteed their success or failure.[102] Similarly, test subjects asked to distinguish true from fictitious suicide notes were given feedback that had no relationship to actual performance. The test subjects had been randomly divided into two groups, with members of one group being given the impression of above-average success and the other of relative failure at this task. The subjects' erroneous impressions of the difficulty of the task

102. R. R. Lau, M. R. Lepper, and L. Ross, "Persistence of Inaccurate and Discredited Personal Impressions: A Field Demonstration of Attributional Perseverance," paper presented at 56th Annual Meeting of the Western Psychological Association (Los Angeles, April 1976).

analyzing and had fewer contacts with nationals of that country than their academic and other government colleagues. Occasions when an analyst does visit the country whose affairs he or she is analyzing, or speaks directly with a national from that country, are memorable experiences. Such experiences are often a source of new insights, but they can also be deceptive.

That concrete, sensory data do and should enjoy a certain priority when weighing evidence is well established. When an abstract theory or secondhand report is contradicted by personal observation, the latter properly prevails under most circumstances. There are a number of popular adages that advise mistrust of secondhand data: "Don't believe everything you read," "You can prove anything with statistics," "Seeing is believing," "I'm from Missouri. . ."

It is curious that there are no comparable maxims to warn against being misled by our own observations. Seeing should not always be believing.

Personal observations by intelligence analysts and agents can be as deceptive as secondhand accounts. Most individuals visiting foreign countries become familiar with only a small sample of people representing a narrow segment of the total society. Incomplete and distorted perceptions are a common result.

A familiar form of this error is the single, vivid case that outweighs a much larger body of statistical evidence or conclusions reached by abstract reasoning. When a potential car buyer overhears a stranger complaining about how his Volvo turned out to be a lemon, this may have as much impact on the potential buyer's thinking as statistics in *Consumer Reports* on the average annual repair costs for foreign-made cars. If the personal testimony comes from the potential buyer's brother or close friend, it will probably be given even more weight. Yet the logical status of this new information is to increase by one the sample on which the *Consumer Reports* statistics were based; the personal experience of a single Volvo owner has little evidential value.

Recognizing and avoiding biases under such circumstances is particularly difficult. Most of the biases discussed in this chapter are unrelated to each other and are grouped together here only because they all concern some aspect of the evaluation of evidence.

The Vividness Criterion

The impact of information on the human mind is only imperfectly related to its true value as evidence.[92] Specifically, information that is vivid, concrete, and personal has a greater impact on our thinking than pallid, abstract information that may actually have substantially greater value as evidence. For example:

- Information that people perceive directly, that they hear with their own ears or see with their own eyes, is likely to have greater impact than information received secondhand that may have greater evidential value.

- Case histories and anecdotes will have greater impact than more informative but abstract aggregate or statistical data.

Events that people experience personally are more memorable than those they only read about. Concrete words are easier to remember than abstract words,[93] and words of all types are easier to recall than numbers. In short, information having the qualities cited in the preceding paragraph is more likely to attract and hold our attention. It is more likely to be stored and remembered than abstract reasoning or statistical summaries, and therefore can be expected to have a greater immediate effect as well as a continuing impact on our thinking in the future.

Intelligence analysts generally work with secondhand information. The information that analysts receive is mediated by the written words of others rather than perceived directly with their own eyes and ears. Partly because of limitations imposed by their open CIA employment, many intelligence analysts have spent less time in the country they are

92. Most of the ideas and examples in this section are from Richard Nisbett and Lee Ross, *Human Inference: Strategies and Shortcomings of Social Judgment* (Englewood Cliffs, NJ: Prentice-Hall, 1980), Chapter 3.
93. A. Paivio, *Imagery and Verbal Processes* (New York: Holt, Rinehart & Winston, 1971).

and of their own performance persisted even after they were informed of the deception—that is, informed that their alleged performance had been preordained by their assignment to one or the other test group. Moreover, the same phenomenon was found among observers of the experiment as well as the immediate participants.[103]

There are several cognitive processes that might account for this phenomenon. The tendency to interpret new information in the context of pre-existing impressions is relevant but probably not sufficient to explain why the pre-existing impression cannot be eradicated even when new information authoritatively discredits the evidence on which it is based.

An interesting but speculative explanation is based on the strong tendency to seek causal explanations, as discussed in the next chapter. When evidence is first received, people postulate a set of causal connections that explains this evidence. In the experiment with suicide notes, for example, one test subject attributed her apparent success in distinguishing real from fictitious notes to her empathetic personality and the insights she gained from the writings of a novelist who committed suicide. Another ascribed her apparent failure to lack of familiarity with people who might contemplate suicide. The stronger the perceived causal linkage, the stronger the impression created by the evidence.

Even after learning that the feedback concerning their performance was invalid, these subjects retained this plausible basis for inferring that they were either well or poorly qualified for the task. The previously perceived causal explanation of their ability or lack of ability still came easily to mind, independently of the now-discredited evidence that first brought it to mind.[104] Colloquially, one might say that once information rings a bell, the bell cannot be unrung.

The ambiguity of most real-world situations contributes to the operation of this perseverance phenomenon. Rarely in the real world is evidence so thoroughly discredited as is possible in the experimental laboratory. Imagine, for example, that you are told that a clandestine source who has been providing information for some time is actually under hostile control. Imagine further that you have formed a number

103. Lee Ross, Mark R. Lepper, and Michael Hubbard, "Perseverance in Self-Perception and Social Perception: Biased Attributional Processes in the Debriefing Paradigm," *Journal of Personality and Social Psychology, 32*, 5, (1975), 880-892.
104. Lee Ross, Mark R. Lepper, Fritz Strack, and Julia Steinmetz, "Social Explanation and Social Expectation: Effects of Real and Hypothetical Explanations on Subjective Likelihood," *Journal of Personality and Social Psychology, 33*, 11 (1977), 818.

of impressions on the basis of reporting from this source. It is easy to rationalize maintaining these impressions by arguing that the information was true despite the source being under control, or by doubting the validity of the report claiming the source to be under control. In the latter case, the perseverance of the impression may itself affect evaluation of the evidence that supposedly discredits the impression.

Chapter 10

Biases in Evaluation of Evidence

Evaluation of evidence is a crucial step in analysis, but what evidence people rely on and how they interpret it are influenced by a variety of extraneous factors. Information presented in vivid and concrete detail often has unwarranted impact, and people tend to disregard abstract or statistical information that may have greater evidential value. We seldom take the absence of evidence into account. The human mind is also oversensitive to the consistency of the evidence, and insufficiently sensitive to the reliability of the evidence. Finally, impressions often remain even after the evidence on which they are based has been totally discredited.[91]

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The intelligence analyst works in a somewhat unique informational environment. Evidence comes from an unusually diverse set of sources: newspapers and wire services, observations by American Embassy officers, reports from controlled agents and casual informants, information exchanges with foreign governments, photo reconnaissance, and communications intelligence. Each source has its own unique strengths, weaknesses, potential or actual biases, and vulnerability to manipulation and deception. The most salient characteristic of the information environment is its diversity—multiple sources, each with varying degrees of reliability, and each commonly reporting information which by itself is incomplete and sometimes inconsistent or even incompatible with reporting from other sources. Conflicting information of uncertain reliability is endemic to intelligence analysis, as is the need to make rapid judgments on current events even before all the evidence is in.

The analyst has only limited control over the stream of information. Tasking of sources to report on specific subjects is often a cumbersome and time-consuming process. Evidence on some important topics is sporadic or nonexistent. Most human-source information is second hand at best.

91. An earlier version of this chapter was published as an unclassified article in *Studies in Intelligence* in summer 1981, under the same title.

Chapter 11

Biases in Perception of Cause and Effect

Judgments about cause and effect are necessary to explain the past, understand the present, and estimate the future. These judgments are often biased by factors over which people exercise little conscious control, and this can influence many types of judgments made by intelligence analysts. Because of a need to impose order on our environment, we seek and often believe we find causes for what are actually accidental or random phenomena. People overestimate the extent to which other countries are pursuing a coherent, coordinated, rational plan, and thus also overestimate their own ability to predict future events in those nations. People also tend to assume that causes are similar to their effects, in the sense that important or large effects must have large causes.

When inferring the causes of behavior, too much weight is accorded to personal qualities and dispositions of the actor and not enough to situational determinants of the actor's behavior. People also overestimate their own importance as both a cause and a target of the behavior of others. Finally, people often perceive relationships that do not in fact exist, because they do not have an intuitive understanding of the kinds and amount of information needed to prove a relationship.

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We cannot see cause and effect in the same sense that we see a desk or a tree. Even when we observe one billiard ball striking another and then watch the previously stationary ball begin to move, we are not perceiving cause and effect. The conclusion that one ball *caused* the other to move results only from a complex process of inference, not from direct sensory perception. That inference is based on the juxtaposition of events in time and space plus some theory or logical explanation as to why this happens.

There are several modes of analysis by which one might infer cause and effect. In more formal analysis, inferences are made through procedures that collectively comprise the scientific method. The scientist advances a hypothesis, then tests this hypothesis by the collection and statistical analysis of data on many instances of the phenomenon in question. Even then, causality cannot be proved beyond all possible doubt.

The scientist seeks to disprove a hypothesis, not to confirm it. A hypothesis is accepted only when it cannot be rejected.

Collection of data on many comparable cases to test hypotheses about cause and effect is not feasible for most questions of interest to the Intelligence Community, especially questions of broad political or strategic import relating to another country's intentions. To be sure, it is feasible more often than it is done, and increased use of scientific procedures in political, economic, and strategic research is much to be encouraged. But the fact remains that the dominant approach to intelligence analysis is necessarily quite different. It is the approach of the historian rather than the scientist, and this approach presents obstacles to accurate inferences about causality.

The procedures and criteria most historians use to attribute causality are less well defined than the scientist's.

> The historian's aim [is] to make a coherent whole out of the events he studies. His way of doing that, I suggest, is to look for certain dominant concepts or leading ideas by which to illuminate his facts, to trace the connections between those ideas themselves, and then to show how the detailed facts became intelligible in the light of them by constructing a "significant" narrative of the events of the period in question.[105]

The key ideas here are coherence and narrative. These are the principles that guide the organization of observations into meaningful structures and patterns. The historian commonly observes only a single case, not a pattern of covariation (when two things are related so that change in one is associated with change in the other) in many comparable cases. Moreover, the historian observes simultaneous changes in so many variables that the principle of covariation generally is not helpful in sorting out the complex relationships among them. The narrative story, on the other hand, offers a means of organizing the rich complexity of the historian's observations. The historian uses imagination to construct a coherent story out of fragments of data.

The intelligence analyst employing the historical mode of analysis is essentially a storyteller. He or she constructs a plot from the previous

105. W. H. Walsh, *Philosophy of History: An Introduction* (Revised Edition: New York: Harper and Row, 1967), p. 61.

the tendencies of groups of people, not make statements about how any specific individual will think.

I believe that conclusions based on these laboratory experiments can be generalized to apply to intelligence analysts. In most, although not all cases, the test subjects were experts in their field. They were physicians, stock market analysts, horserace handicappers, chess masters, research directors, and professional psychologists, not undergraduate students as in so many psychological experiments. In most cases, the mental tasks performed in these experiments were realistic; that is, they were comparable to the judgments that specialists in these fields are normally required to make.

Some margin for error always exists when extrapolating from experimental laboratory to real-world experience, but classes of CIA analysts to whom these ideas were presented found them relevant and enlightening. I replicated a number of the simpler experiments with military officers in the National Security Affairs Department of the Naval Postgraduate School.

> The apparent distance of an object is determined in part by its clarity. The more sharply the object is seen, the closer it appears to be. This rule has some validity, because in any given scene the more distant objects are seen less sharply than nearer objects. However, the reliance on this rule leads to systematic errors in estimation of distance. Specifically, distances are often overestimated when visibility is poor because the contours of objects are blurred. On the other hand, distances are often underestimated when visibility is good because the objects are seen sharply. Thus the reliance on clarity as an indication of distance leads to common biases.[90]

This rule of thumb about judging distance is very useful. It usually works and helps us deal with the ambiguity and complexity of life around us. Under certain predictable circumstances, however, it will lead to biased judgment.

Cognitive biases are similar to optical illusions in that the error remains compelling even when one is fully aware of its nature. Awareness of the bias, by itself, does not produce a more accurate perception. Cognitive biases, therefore, are, exceedingly difficult to overcome.

Psychologists have conducted many experiments to identify the simplifying rules of thumb that people use to make judgments on incomplete or ambiguous information, and to show—at least in laboratory situations—how these rules of thumb prejudice judgments and decisions. The following four chapters discuss cognitive biases that are particularly pertinent to intelligence analysis because they affect the evaluation of evidence, perception of cause and effect, estimation of probabilities, and retrospective evaluation of intelligence reports.

Before discussing the specific biases, it is appropriate to consider the nature of such experimental evidence and the extent to which one can generalize from these experiments to conclude that the same biases are prevalent in the Intelligence Community.

When psychological experiments reveal the existence of a bias, this does not mean that every judgment by every individual person will be biased. It means that in any group of people, the bias will exist to a greater or lesser degree in most judgments made by most of the group. On the basis of this kind of experimental evidence, one can only generalize about

90. Tversky and Kahneman, ibid.

events, and this plot then dictates the possible endings of the incomplete story. The plot is formed of the "dominant concepts or leading ideas" that the analyst uses to postulate patterns of relationships among the available data. The analyst is not, of course, preparing a work of fiction. There are constraints on the analyst's imagination, but imagination is nonetheless involved because there is an almost unlimited variety of ways in which the available data might be organized to tell a meaningful story. The constraints are the available evidence and the principle of coherence. The story must form a logical and coherent whole and be internally consistent as well as consistent with the available evidence.

Recognizing that the historical or narrative mode of analysis involves telling a coherent story helps explain the many disagreements among analysts, inasmuch as coherence is a subjective concept. It assumes some prior beliefs or mental model about what goes with what. More relevant to this discussion, the use of coherence rather than scientific observation as the criterion for judging truth leads to biases that presumably influence all analysts to some degree. Judgments of coherence may be influenced by many extraneous factors, and if analysts tend to favor certain types of explanations as more coherent than others, they will be biased in favor of those explanations.

Bias in Favor of Causal Explanations

One bias attributable to the search for coherence is a tendency to favor causal explanations. Coherence implies order, so people naturally arrange observations into regular patterns and relationships. If no pattern is apparent, our first thought is that we lack understanding, not that we are dealing with random phenomena that have no purpose or reason. As a last resort, many people attribute happenings that they cannot understand to God's will or to fate, which is somehow preordained; they resist the thought that outcomes may be determined by forces that interact in random, unpredictable ways. People generally do not accept the notion of chance or randomness. Even dice players behave as though they exert some control over the outcome of a throw of dice.[106] The prevalence of the word "because" in everyday language reflects the human tendency to seek to identify causes.

106. Ellen J. Langer, "The Psychology of Chance," *Journal for the Theory of Social Behavior,* 7 (1977), 185-208.

People expect patterned events to look patterned, and random events to look random, but this is not the case. Random events often look patterned. The random process of flipping a coin six times may result in six consecutive heads. Of the 32 possible sequences resulting from six coin flips, few actually look "random."[107] This is because randomness is a property of the process that generates the data that are produced. Randomness may in some cases be demonstrated by scientific (statistical) analysis. However, events will almost never be perceived intuitively as being random; one can find an apparent pattern in almost any set of data or create a coherent narrative from any set of events.

Because of a need to impose order on their environment, people seek and often believe they find causes for what are actually random phenomena. During World War II, Londoners advanced a variety of causal explanations for the pattern of German bombing. Such explanations frequently guided their decisions about where to live and when to take refuge in air raid shelters. Postwar examination, however, determined that the clustering of bomb hits was close to a random distribution.[108]

The Germans presumably intended a purposeful pattern, but purposes changed over time and they were not always achieved, so the net result was an almost random pattern of bomb hits. Londoners focused their attention on the few clusters of hits that supported their hypotheses concerning German intentions—not on the many cases that did not.

Some research in paleobiology seems to illustrate the same tendency. A group of paleobiologists has developed a computer program to simulate evolutionary changes in animal species over time. But the transitions from one time period to the next are not determined by natural selection or any other regular process: they are determined by computer-generated random numbers. The patterns produced by this program are similar to the patterns in nature that paleobiologists have been trying to understand. Hypothetical evolutionary events that seem, intuitively, to have a strong pattern were, in fact, generated by random processes.[109]

Yet another example of imposing causal explanations on random events is taken from a study dealing with the research practices of psy-

107. Daniel Kahneman and Amos Tversky, "Subjective Probability: A Judgment of Representativeness," *Cognitive Psychology*, 3 (1972), 430-54.
108. W. Feller, *An Introduction to Probability Theory and Its Applications* (3rd Edition; New York: Wiley, 1968), p. 160.
109. Gina Bari Kolata, "Paleobiology: Random Events over Geological Time," *Science*, 189 (1975), 625-626.

PART III—COGNITIVE BIASES

Chapter 9

What Are Cognitive Biases?

This mini-chapter discusses the nature of cognitive biases in general. The four chapters that follow it describe specific cognitive biases in the evaluation of evidence, perception of cause and effect, estimation of probabilities, and evaluation of intelligence reporting.

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Fundamental limitations in human mental processes were identified in Chapters 2 and 3. A substantial body of research in cognitive psychology and decisionmaking is based on the premise that these cognitive limitations cause people to employ various simplifying strategies and rules of thumb to ease the burden of mentally processing information to make judgments and decisions.[89] These simple rules of thumb are often useful in helping us deal with complexity and ambiguity. Under many circumstances, however, they lead to predictably faulty judgments known as cognitive biases.

Cognitive biases are mental errors caused by our simplified information processing strategies. It is important to distinguish cognitive biases from other forms of bias, such as cultural bias, organizational bias, or bias that results from one's own self-interest. In other words, a cognitive bias does not result from any emotional or intellectual predisposition toward a certain judgment, but rather from subconscious mental procedures for processing information. A cognitive bias is a mental error that is consistent and predictable. For example:

89. Much of this research was stimulated by the seminal work of Amos Tversky and Daniel Kahneman, "Judgment under Uncertainty: Heuristics and Biases," *Science*, 27 September 1974, Vol. 185, pp. 1124-1131. It has been summarized by Robin Hogarth, *Judgement and Choice* (New York: John Wiley & Sons, 1980), Richard Nisbett and Lee Ross, *Human Inference: Strategies and Shortcomings of Human Judgment* (Englewood Cliffs, NJ: Prentice-Hall, 1980), and Robyn Dawes, *Rational Choice in an Uncertain World* (New York: Harcourt Brace Jovanovich College Publishers, 1988). The Hogarth book contains an excellent bibliography of research in this field, organized by subject.