Cognitive Biases and Intuitive Traps Most Often Encountered by Analysts: Which Structured Analytic Techniques Best Mitigate Their Impact?

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Abstract

Intelligence analysts work in high uncertainty environments and must deal with complex situations on a daily basis. One of the most serious and universal challenges for analysts is overcoming well-established cognitive biases and deeply-rooted intuitive traps. When teaching courses on critical thinking skills and structured analytic techniques, the authors used a survey method to collect data from analysts in the government and the private sector. Specifically, the analysts were asked to list the top five cognitive biases and intuitive traps they believed they were most susceptible to when conducting their analysis. This paper presents an analysis of the data. In the second half of the study, the authors suggest which Structured Analytic Techniques are likely to be the most effective in helping analysts overcome, avoid, or at least mitigate the biases and traps identified in this study.

Introduction

The purpose of this research is to initiate a process to assess empirically which cognitive biases and intuitive traps analysts are most likely to encounter. In particular, the focus is on those that pose the greatest obstacles to producing a high quality analytic product. This research is important because educators, trainers, mentors, and managers currently lack a solid, empirically-established understanding of which biases and traps are the most common and most important to counter. With such knowledge educators, trainers, mentors, and managers will be much more capable of helping analysts overcome these analytic biases and traps. For instance, if Confirmation Bias is more common than Groupthink, we should know this and we should teach to this fact accordingly.

Once it is established which biases and traps pose the greatest risks for analysts, attention should focus on which structured techniques are most effective in overcoming, avoiding, or at

least mitigating the biases and traps. Therefore, our research question is twofold. First, which biases and traps pose the greatest risk to analysts? And second, which Structured Analytic Techniques (SATs) are the most effective in helping analysts overcome, avoid, or mitigate the biases and traps?

Literature Review

How a person perceives information is strongly influenced by factors such as past experience, education, cultural background, and what that person is expected to do with the data. Our brains are trained to process information quickly, which often leads us to process data incorrectly or to not recognize its significance if it does not fit into established patterns (Kahneman 2011, Pherson and Pherson 2013, Dyèvre 2016).

Definitions. Such short cuts in our thinking processes are called **heuristics**—experience-based techniques that quickly produce a solution that is often good enough to solve the problem at hand. Some heuristics, such as the fight or flight instinct or knowing you need to take immediate action when you smell a gas leak, are helpful. Others are nonproductive. Analysts can err by over relying on heuristics or by misapplying them (Kahneman 2011, Pherson and Pherson 2013, Dyèvre 2016).

Defaulting to "rules of thumb" when problem solving can lead to **cognitive biases,** which we define as inherent thinking errors that people make in processing information too quickly or incorrectly. Cognitive biases prevent an analyst from accurately understanding reality even when all the needed data and evidence that she or he would need to form an accurate view is in hand. Some cognitive biases, such as Confirmation Bias or Hindsight Bias, impede analytic thinking from the very start. Others, such as Groupthink or Premature Closure, could lead to a correct decision if you are lucky based on a non-rigorous thought process. More often, they impede the

analytic process because they are misapplications of our desire for consensus and prevent us from considering a full range of possibilities (Kahneman 2011, Pherson and Pherson 2013, Dyèvre 2016).

Analysts can also fall victim to **intuitive traps** that are manifestations of cognitive biases. We define intuitive traps as shortcuts or mental mistakes that practitioners make when conducting their business (Pherson and Pherson 2013, Heuer and Pherson 2014). A classic example is when police detectives assume that the next case they are working will be like the previous case or when a general prepares to fight the last war instead of anticipating how the next war will have to be fought. While intuitive traps are the logical conclusions of bias, they are yet to be established in the literature. This paper seeks to contribute to our understanding of these traps.

Unfortunately for analysts, these biases and traps are quick to form and extremely hard to correct. After one's mind has reached closure on a particular issue, even a substantial accumulation of contradictory evidence is unlikely to force a reappraisal. Analysts often do not see new patterns emerging or fail to detect inconsistent data. An even larger concern is the tendency to ignore or dismiss outlier data as "noise." (Heuer 1999, Kahneman 2011, Dyèvre 2016).

While the literature discusses the presence, type, and possible consequences of bias, it does not discuss the prevalence of specific biases and analytic traps. Specifically, the degree to which certain biases and analytic traps are prevalent in the intelligence community—and even within the broader analytic community—is unknown. Therefore, this research is, as a necessity, exploratory in nature. Until we collect data on this phenomenon, we do not have sufficient insight to generate solid working hypotheses. This paper is a step toward developing that science.

While establishing certain cognitive biases and heuristics, the literature is lacking when it comes to establishing the prevalence of these limitations. Even though the literature is lacking, it is important to understand the prevalence of various cognitive biases, heuristics, and analytic traps. For instance, cognitive bias can affect the way in which people assess risks, which can lead to grave consequences if left unchecked (Yudkowsky 2008).

In fact, political ideology and cognitive style can predict the decisions managers make (Tetlock 2000). Specifically, Murata, et.al. (2015) analyzed a set of case studies and found that cognitive biases, especially heuristic-based biases including Groupthink, Confirmation Bias, Overconfidence, Illusion of Control, Optimistic Bias, and Framing/Anchoring Effects negatively affect decision-making. In their cases studied, they found that bias has caused incidents, collisions, crashes, and disasters, resulting in the loss of life. Murata, et.al. (2015) therefore argue that eliminating or reducing this bias is critical to prevent incidents, collisions, crashes, and disasters.

While there is not much in the literature that specifically measures bias prevalence, the Cognitive Reflection Test (CRT) shows potential. The (CRT) measures the degree to which a person pauses to reflect upon an analysis. Performance on this test, more so than cognitive ability, predicts the degree to which a person is susceptible to cognitive bias (Topiak, et.al. 2011).

Even though the literature is rather nascent on the subject, below is a summary of what the literature does say on bias prevalence and possible mitigation strategies. For instance, hindsight bias is one of the most well-researched and understood cognitive biases. It is defined as the tendency for people with knowledge of the outcome to overestimate the likelihood of their ability to have predicted the outcome (Hawkins and Hastie 1990). Christensen-Szalanski and Willham (1991) conducted a meta-analysis on hindsight bias. From this study, they found that a

person's familiarity with a task and the type of outcome information can moderate this bias. It is likely that cognitive, not motivational factors drive hindsight bias. That being said, the effect was small (r = .17), and the bias is prevalent between 0% up to 7–27% in the general population.

There is also evidence that context matters. For instance, there is some evidence that the types of uncertainty that a person perceives can affect the prevalence of certain cognitive biases and heuristics used to cope with this uncertainty (Lipshitz and Strauss 1997). A geographically disbursed team may be more susceptible to Confirmation Bias, Framing Effects/Anchoring, and/or Groupthink. While Resnik (2009) does not refer to SATs specifically, the author suggests that these techniques, including Devil's Advocacy, may help alleviate these biases. Problem formulation is likely to affect analysts' cognitive processes. There is potential to improve this through development of and training in decision aids (Roth, et.al. 2010).

Inherent personal characteristics may also affect bias prevalence. For instance, even holding cognitive ability constant, people who are better critical thinkers tend to be less susceptible to cognitive bias (West, et.al, 2008). Supporting analysts in their critical thinking skills has potential to reduce cognitive bias (Kerstholt 2006). While some evidence suggests that women may be less biased than men (Bar-Tal and Jarymowicz 2010), we assume any gender effects are not statistically significant in this study.

People tend to have a blind spot with cognitive bias. It is easier to identify bias in others than it is in oneself. While it would seem intuitive that people with higher cognitive ability would be less susceptible to this blind spot, evidence suggests the opposite may be true. Also, people with a minimal blind spot are still just as susceptible to cognitive bias (West, et.al. 2012).

While awareness of cognitive biases is not sufficient to overcome them, training is necessary. Organizational processes such as checklists, along with tools show real promise to

help overcome biases (Dyèvre 2016). For example, there is some evidence that graphical evidence layout (a visualization technique) may help to alleviate Confirmation Bias (Cook and Smallman 2008).

Finally, while the literature on brainstorming efficacy is inconclusive at best, cultural forces are likely to be driving the success or failure of this technique to generate truly divergent thinking (Kalargiros and Manning 2015). Specifically, three main factors are key in the efficacy of brainstorming: team heterogeneity, mode of processing social information, and team member interaction (Zhao and Hou 2010). Problem structure also matters. Nominal groups perform better when presented with specialized problems, while groups perform better when presented with complex problems. However, there are diminishing returns to this advantage, as this decreases with increasing problem complexity (Kavadias and Sommer 2009). Also, in a brainstorming exercise, alternating asynchronous individual idea generation with group work can counter the effects of groupthink (Paulus, et.al. 2015).

Methodology

Assumptions. Before delving into our methodology, it is important to present and discuss a key assumption for this research. Specifically, we assume that intelligence analysts and analysts from other sectors, such as finance, insurance, law enforcement, and politics are equally susceptible to these cognitive biases and intuitive traps. The reason for this assumption is that all analysts must deal with risk and uncertainty and are faced with sufficiently comparable data environments. Also, there is little evidence to suggest that people who become intelligence analysts are sufficiently cognitively different than those who choose other analytic careers. Even if some differences can be identified, we assume they will not significantly impact how biases and traps affect their work processes. An additional assumption we are making is that analysts

who have retired from the field of intelligence analysis are equally influenced by cognitive biases and intuitive traps as those currently working in the field.

Methodology. As a first step, the authors are conducting surveys to assess the biases and traps that analysts perceive as posing the greatest risk to producing rigorous analysis. While this is self-reported, the purpose of the study is to build theory. Specifically, the results of this survey will inform future research by identifying a subset of biases and traps that can be used for more rigorous hypothesis testing.

In addition to the biases and traps questions, the authors have included demographic questions in the survey. The purpose of these questions is to identify any differences between age, experience, professional sector, and gender. While we expect that these differences, if they exist, will not be statistically significant, this assumption should be tested to the extent possible. The full survey is provided in Appendix 1.

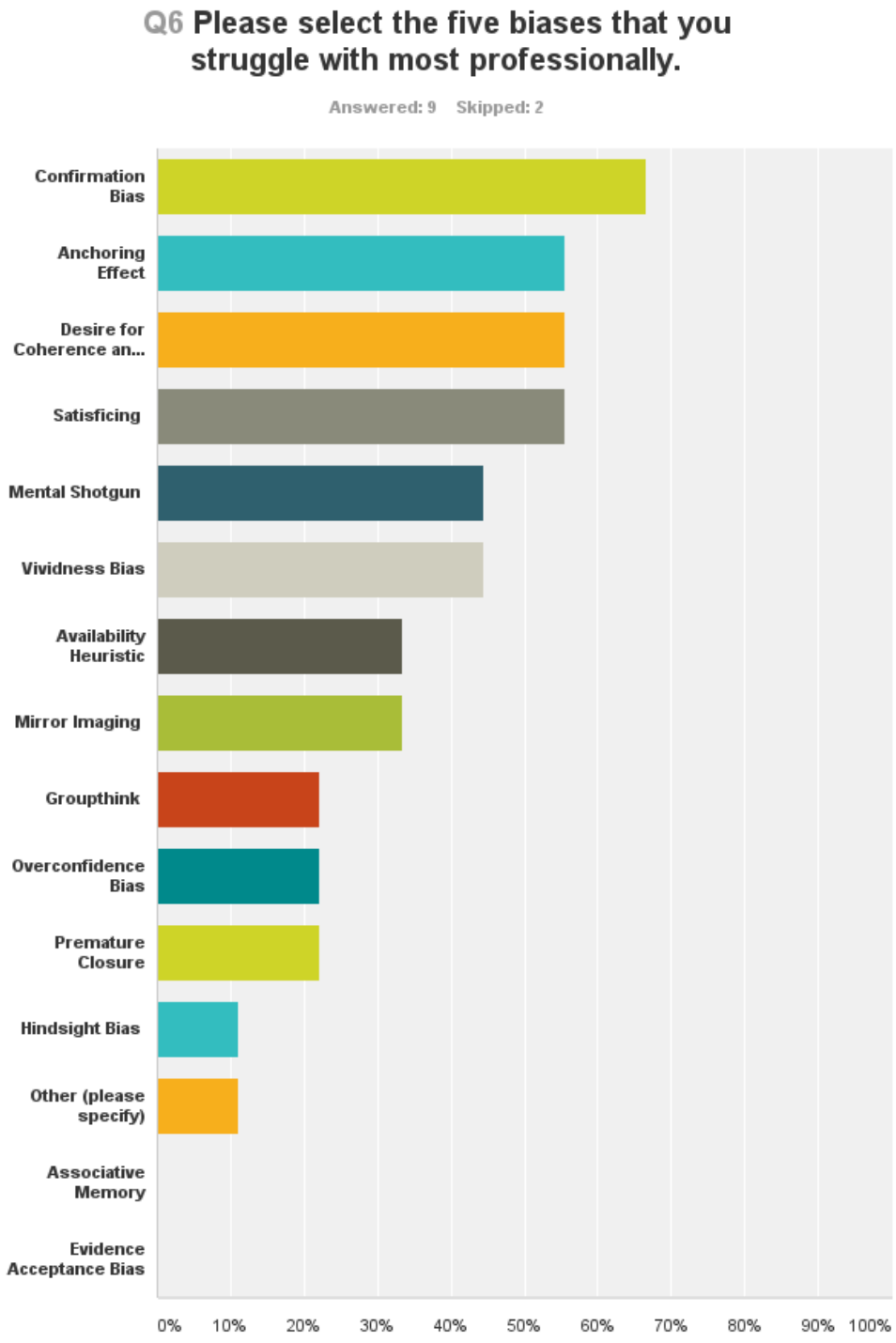
As data collection is still proceeding, sufficient responses have not yet been collected to perform hypothesis testing. However, we have enough responses to present a preliminary discussion of the results. Below we present this data, along with what it could mean for both future research and what it suggests in terms of possible SATs that would prove most effective in mitigating these biases and traps.

Data/Analysis

Currently, the data contains responses of nine professionals with a background in national security intelligence analysis. All have worked in the US Intelligence Community (IC) as staff officers or contractors. All participants are familiar with the cognitive biases and intuitive traps selected for this study, as most are currently working as intelligence analyst instructors. While demographic data was collected, the number of responses was insufficient to produce meaningful

results. Below, in Figures 1 and 2, we present what the analysts identified as the cognitive biases and intuitive traps they believed posed the greatest risk to them as analysts.

Figure 1. Most Common Cognitive Biases

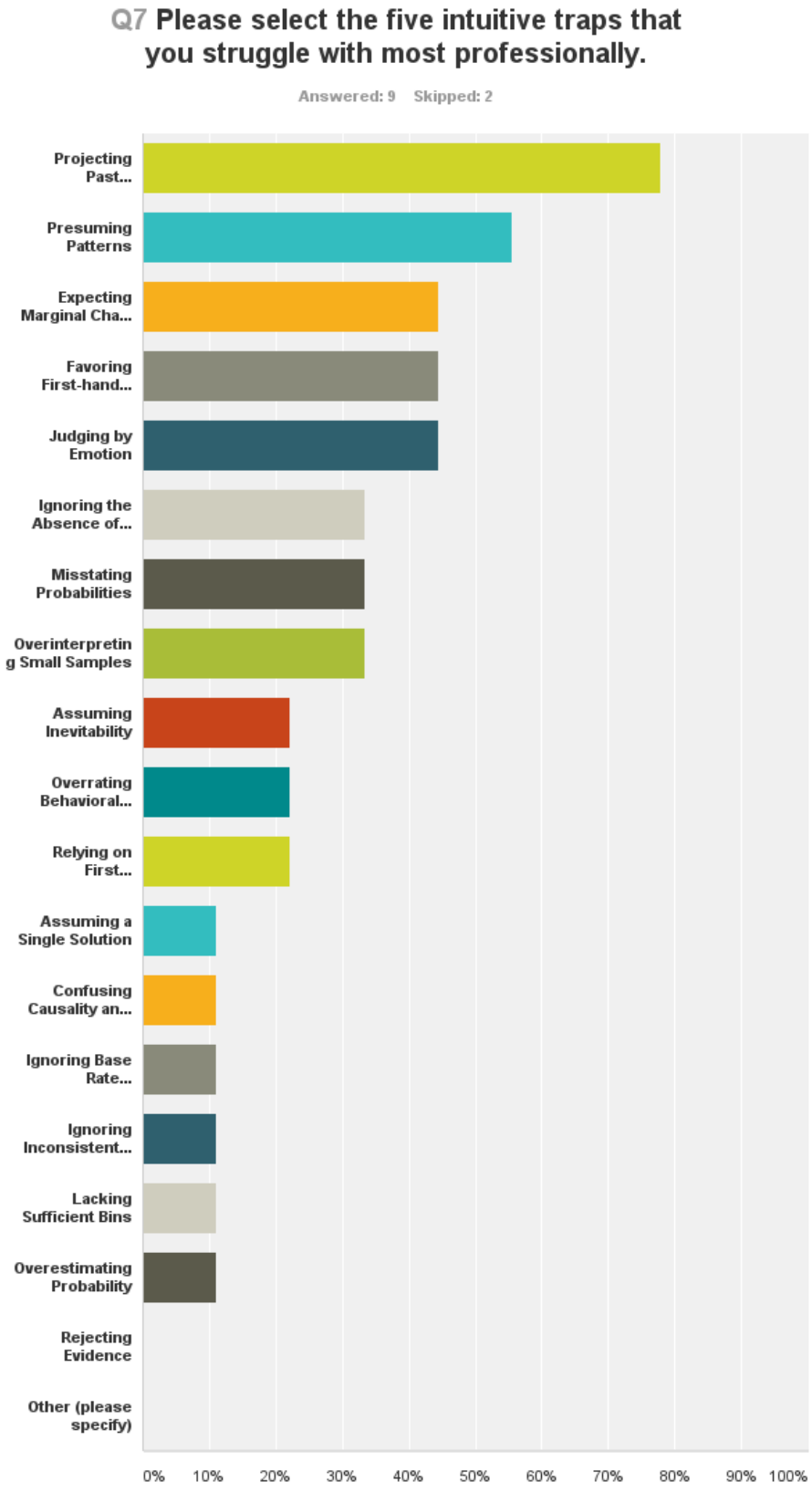


Cognitive Biases. The six most common cognitive biases identified by the analysts are: Confirmation Bias (67%), Anchoring Effect (56%), Desire for Coherence and Uncertainty Reduction (56%), Satisficing (56%), Mental Shotgun (44%), and Vividness Bias (44%). They are defined as follows:

- **Confirmation Bias:** Seeking only that information that is consistent with the lead hypothesis, judgment, or conclusion (Kahneman 2011, Pompian 2012, Dyèvre 2016).
- **Anchoring Effect:** Accepting a given value of something unknown as a proper starting point for generating an assessment (Heuer 1999, Kahneman 2011, Dyèvre 2016).
- D**esire for Coherence and Uncertainty Reduction:** Seeing patterns in random events as systematic and part of a coherent world (Kahneman 2011).
- **Satisficing:** Selecting the first answer that appears "good enough." (Heuer 1999, Heuer and Pherson 2014).
- **Mental Shotgun:** Lacking precision and control while making assessments continuously; providing quick and easy answers to difficult questions (Kahneman 2011).
- **Vividness Bias:** People tend to overweight the rare but vivid outcomes when assessing probability (Kahneman 2011).

Of the 14 cognitive biases on the list, all but three were selected by at least two analysts. This would suggest that analysts encounter a wide array of cognitive biases when doing their work. Confirmation Bias and the Anchoring Effect are frequently cited in the literature as posing serious threats to good analysis. Further research may reveal if certain biases are encountered more frequently in one field of analysis versus another. For example, are financial intelligence analysts influenced by different biases than law enforcement or national security analysts?

Figure 2. Most Common Intuitive Traps


Q7 Please select the five intuitive traps that you struggle with most professionally.
Answered: 9 Skipped: 2
Projecting Past...
Presuming Patterns
Expecting Marginal Cha...
Favoring First-hand...
Judging by Emotion
Ignoring the Absence of...
Misstating Probabilities
Overinterpretin g Small Samples
Assuming Inevitability
Overrating Behavioral...
Relying on First...
Assuming a Single Solution
Confusing Causality an...
Ignoring Base Rate...
Ignoring Inconsistent...
Lacking Sufficient Bins
Overestimating Probability
Rejecting Evidence
Other (please specify)
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Intuitive Traps. The five most common intuitive traps are: Projecting Past Experiences (78%), Presuming Patterns (56%), Favoring First-Hand Information (44%), Judging by Emotion (44%), and Expecting Marginal Change (44%). They are defined as follows:

- **Projecting Past Experiences:** Assuming the same dynamic is in play when something seems to accord with an analyst's past experiences (Heuer and Pherson 2014).
- **Presuming Patterns:** Believing that actions are the result of centralized planning or direction and finding patterns where they do not exist (Kahneman 2011).
- **Expecting Marginal Change (Incrementalism):** Focusing on a narrow range of alternatives representing marginal, not radical, change (Heuer 1999).
- **Favoring First-Hand Information:** Allowing information we receive directly to have more impact that what we learn or are told second hand.
- **Judging by Emotion (Halo Effect):** Accepting or rejecting everything another group member says because the analyst likes or dislikes everything about that person. Also referred to as the Halo Effect (Kahneman 2011, Dyèvre 2016).

Eleven of the 18 intuitive traps on the list were cited by at least two analysts and only one was not cited at all, again suggesting that analysts encounter a wide range of intuitive traps on a daily basis. Projecting Past Experiences, Expecting Marginal Change, and Over-interpreting Small Samples are commonly cited in the literature as traps analysts often fall prey to in their work.

Structured Analytic Techniques

Structured Analytic Techniques (SATs) help analysts avoid, overcome, or at least mitigate these common cognitive biases and intuitive traps. Structured techniques also help analysts (Heuer and Pherson 2014):

- Avoid intelligence and other analytic failures
- Reduce error rates
- Increase accountability
- Make the analysis more transparent to other analysts and decision makers
- Embrace more collaborative work practices

As this research is exploratory, we have focused on hypothesis development. Based on these results and the relevant literature on the topic (Pherson and Pherson 2013, Heuer and Pherson 2014) , we hypothesize that the following seven techniques show the most promise for further testing.

- **Key Assumptions Check.** This technique constitutes a systematic effort to list and question the assumptions that guide an analyst's interpretation of evidence and reasoning. Key Assumptions Check has particular potential to mitigate the following biases and traps: Affect Heuristic, Anchoring Effect, Favoring First-Hand Information, Mental Shotgun, Mirror Imaging, Projecting Past Experiences, and Vividness Bias (Heuer and Pherson 2014).
- **Starbursting.** This is a form of brainstorming that focuses on generating questions rather than answers. The technique focuses on questions commonly used by journalists: Who, What, How, Where, When, and Why? The technique has proven particularly useful in mitigating the following biases and traps: Anchoring Effect, Vividness Bias, Mental Shotgun, Satisficing, and Over-interpreting Small Samples/Law of Small Numbers (Heuer and Pherson 2014).
- **Argument Mapping.** This technique is used to test a single hypothesis using logical reasoning. Argument maps graphically separate the claims and evidence to help break down complex issues and communicate the reasoning behind a conclusion. The process

of creating the argument map also helps to identify key assumptions and gaps in logic. Argument Mapping has potential to mitigate the following biases and traps: Affect Heuristic, Confirmation Bias, Desire for Coherence and Uncertainty Reduction, Favoring First-Hand Information, and Mental Shotgun (Pherson and Pherson 2013, Heuer and Pherson 2014).

- **Analysis of Competing Hypotheses (ACH).** This technique applies cognitive psychology, decision science, and the scientific method to hypothesis testing and general analysis. Specifically, people using ACH identify a mutually exclusive, comprehensively exhaustive (MECE) set of alternative hypotheses, systematically evaluate for consistency or inconsistency of the relevant information with each hypothesis, and reject hypotheses that contain too much inconsistent data. The most likely hypothesis isn't the one with the most confirming information but with the least disconfirming information. This technique has potential to mitigate the following biases and traps: Affect Heuristic, Anchoring Effect, Confirmation Bias, Favoring First-Hand Information, Ignoring Inconsistent Evidence, Premature Closure, Satisficing, and Vividness Bias (Heuer 1999, Heuer and Pherson 2014).
- **Classic Quadrant Crunching™.** This technique is an application of Morphological Analysis. It uses key assumptions and the opposites of these assumptions to generate a wide set of alternative outcomes in a systematic, structured way. By compelling analysts to reframe an issue from a wide range of perspectives, identify and challenge assumptions, and examine several combinations of key variables, it increases the chance of avoiding surprise. Classic Quadrant Crunching™ has potential to mitigate the following biases and traps: Confirmation Bias, Desire for Coherence and Uncertainty Reduction, Expecting

Marginal Change, Mental Shotgun, Lacking Sufficient "Bins," and Presuming Patterns (Heuer and Pherson 2014).

- **Indicators Generation and Indicators Validation.** Indicators are a pre-established set of observable phenomenon that are periodically reviewed to track current events and anticipate future trajectories. A validated set of indicators are Observable/Collectible, Valid, Reliable, Stable, and Unique. The use of Indicators has the potential to mitigate the following biases and traps: Desire for Coherence and Uncertainty Reduction, Expecting Marginal Change, Hindsight Bias, Satisficing, and Ignoring the Absence of Information (Heuer and Pherson 2014).
- **Premortem Analysis and Structured Self-Critique.** This technique walks people through the hypothetical scenario of assuming that the analysis is spectacularly wrong before producing the final report and then identifying what could have caused this result. Analysts who are involved in producing the report first brainstorm what could have caused the analysis to be wrong and then work their way through a set of checklists of what has shown to be a problem when writing previous papers. Premortem Analysis and the Structured Self-Critique have the potential to mitigate the following biases and traps: Confirmation Bias, Expecting Marginal Change, Favoring First-Hand Information, Projecting Past Experiences, and Vividness Bias (Klein 2007, Heuer and Pherson 2014).

Limitations/Directions for Future Research/Conclusions

As the nature of this study is exploratory, the best we can do at this point is provide the basis for a set of testable hypotheses to explore in future research. The data we used is a biased, nonrandom sample of analysts. Because of this, the results of this study should be treated as a first step, and should not be seen as empirically conclusive. The authors will be updating this

research as additional data is collected. Specifically, the institutional review board approval covers up to 500 analysts across various professions. This will be sufficient data to have a solid empirical basis for further hypothesis development. These hypotheses can then provide the basis for further empirical testing.

The cognitive biases, intuitive traps, and Structured Analytic Techniques identified in this paper are just a beginning. Once we have a more definitive set of biases and traps, we can then test for the SATs. This can be done by developing psychometric evaluations to assess more rigorously the prevalence of cognitive bias and intuitive traps. This approach, including sample questions, is described in Psychology of Judgment and Decision Making (Plous 1993).

It is important to gain a better understanding of which biases and traps are most prevalent and the best ways, empirically, to mitigate them. Therefore, we propose experiments to test the efficacy of the SATs identified in mitigating these biases and traps. To do this, we suggest testing the bias prevalence before training in these techniques, immediately after training, and then one year post-training to determine the long-term efficacy of the techniques and training.

In addition to the small sample size, a key limitation to this study is its nonrandom, biased sampling. We plan to continue collecting data to incorporate larger numbers and analyst perspectives across several professional domains. While the sampling is not completely random at this point, we will continue collecting data until we have a sufficiently large sample for rigorous hypothesis formulation.

Another limitation of this study involves the degree to which respondents understand the biases and traps. For the sample included in this paper, all respondents had a solid understanding of each bias and trap because they have taught this material in class and experienced the impact of the biases and traps in their daily work as analysts. As the authors move forward to a broader

sample, we cannot assume that all analysts will have the same level of understanding. We will take additional steps to ensure that respondents have sufficient understanding of the concepts to provide informed and meaningful responses.

A final limitation is the self-reporting of biases and traps that respondents believe pose the greatest risk to producing rigorous analytic products. We assume some inaccuracy here, in that people do not always have (nor should they be expected to have) completely accurate insight into their biases. This is not an obstacle we can address until we get to the stage where we have more rigorous psychometric testing in place. In fact, this is a main reason we are limiting the outcome and purpose of this research to the development of hypotheses for future testing.

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Appendix 1: Survey

Biases and Traps Phase 1

1. Cognitive Biases and Intuitive Traps Most Often Encountered by Analysts

Analysts work in high uncertainty environments and deal with complex situations daily. One of the most serious and universal challenges for analysts is finding ways to overcome—or at least mitigate—cognitive biases and intuitive traps. The purpose of this study is to identify the biases and traps that are most prevalent, and the degree to which current training and education methods mitigate these biases and traps. When teaching courses on critical thinking skills and structured analytic techniques, the researchers intend to survey analysts in the government and the private sectors, along with students aspiring to become analysts. This research is intended to contribute to the judgment and decision making (JDM) literature as a first step in assessing the most (and least) prevalent biases within and across sectors. The research is also intended to inform pedagogy by identifying the most (and least) effective methods to help analysts mitigate these biases. We are asking you to take part in this study because we need your help in identifying the biases that most challenges analysts and which techniques and teaching methods are most helpful to professionals like yourself.

Also keep in mind:

- Whether or not you participate is up to you. In no way will this affect your class performance, positively or negatively.
- You can choose not to participate.
- You can agree to take part and later change your mind.
- Your decision will not be held against you in any way.
- During the class, any data collected will only be accessed in the aggregate to look at the class as a whole and only for teaching purposes.

There are three phases of this study. You will have the opportunity to answer questions at the beginning of class, after the class is over, and one year after class has ended. Each phase takes approximately 10 minutes to complete. If you agree to participate, you will be asked to complete an online survey regarding the biases you struggle with and a brief series of quiz-type questions. If you do not agree to participate, this will not be held against you in any way. You can also choose to not answer any of the questions and/or stop at any time. If you change your mind, simply exit the survey.

Risk to you is minimal. There is a risk of discomfort, as some of these questions ask you about biases you may struggle with. You can skip any question you do not wish to answer, or exit the survey at any point.

While there is no financial compensation, benefits include insights you may gain into your own biases as an analyst. At the end, you can see your results for your own personal reference. It is our hope that you can use this information to grow in your profession as an analyst.

This survey is being hosted by SurveyMonkey and involves a secure connection. Terms of use may be viewed at https://www.surveymonkey.com/mp/policy/terms-of-use/. The only personally identifiable information (PII) we are collecting is your email address. This is only used for two purposes. First, we will use this to send you the second and third surveys, if you consent. The second is as an identifier to track your progress before class, after class, and a year later. However, once data is collected we will delete your email address and replace this with a numerical identifier. All information not stored in SurveyMonkey's secure platform will be kept on a password protected flash drive only accessible by the research team. The results of the research study may be published, but no personal identifiable information will be used.

If you have questions, concerns, or complaints, or think the research has hurt you, notify the Principal Investigator, Mary C. Boardman, at mboardman@ga.ccu.edu or Randy Pherson, rpherson@globalytica.com.

This research has been reviewed and approved by the Institutional Review Board ("IRB") at Colorado Christian University. You may contact Dr. Sarah Scherling, Vice President for Academic Administration at sscherling@ccu.edu if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

* 1. Electronic Consent: Please select your choice below. Clicking on the "agree" button below indicates that:
• You have read and understood the above information
• You voluntarily consent to participate
• You are at least 18 years of age

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button. You can also simply exit your browser.

- ◯ Agree
- ◯ Disagree

Biases and Traps Phase 1

2.

2. What is your gender?

- ◯ Female
- ◯ Male

3. What is your age?

- ◯ 18 to 24
- ◯ 25 to 34
- ◯ 35 to 44
- ◯ 45 to 54
- ◯ 55 to 64
- ◯ 65 to 74
- ◯ 75 or older

4. How many years of professional experience do you have, not counting time spent as a full-time student?

5. Professional Sector (select all that apply):

Biases and Traps Phase 1

3.

6. Please select the five biases that you struggle with most professionally.

- [ ] Anchoring Effect
- [ ] Associative Memory
- [ ] Availability Heuristic
- [ ] Confirmation Bias
- [ ] Desire for Coherence and Uncertainty Reduction
- [ ] Evidence Acceptance Bias
- [ ] Groupthink
- [ ] Hindsight Bias
- [ ] Mental Shotgun
- [ ] Mirror Imaging
- [ ] Overconfidence Bias
- [ ] Premature Closure
- [ ] Satisficing
- [ ] Vividness Bias
- [ ] Other (please specify)

7. Please select the five intuitive traps that you struggle with most professionally.

- [ ] Assuming Inevitability
- [ ] Assuming a Single Solution
- [ ] Confusing Causality and Correlation
- [ ] Expecting Marginal Change
- [ ] Favoring First-hand Information
- [ ] Ignoring the Absence of Information
- [ ] Ignoring Base Rate Probabilities
- [ ] Ignoring Inconsistent Evidence
- [ ] Judging by Emotion
- [ ] Lacking Sufficient Bins
- [ ] Misstating Probabilities
- [ ] Overestimating Probability
- [ ] Overinterpreting Small Samples
- [ ] Overrating Behavioral Factors
- [ ] Presuming Patterns
- [ ] Projecting Past Experiences
- [ ] Rejecting Evidence
- [ ] Relying on First Impressions
- [ ] Other (please specify)

Appendix 2: List of Cognitive Biases

- **Confirmation Bias.** Seeking only that information that is consistent with the lead hypothesis, judgment, or conclusion.
- **Evidence Acceptance Bias.** Accepting data as true unless it was immediately rejected when first reviewed. Focusing more on the coherence of the story than the reliability of the underlying data.
- **Hindsight Bias.** Claiming the key items of information, events, drivers, forces, or factors that actually shaped a future outcome could have been easily identified.
- **Mirror Imaging.** Assuming that others will act the same as we would, given similar circumstances.
- **Vividness Bias.** Focusing attention on one vivid scenario while other possibilities or potential alternative hypotheses are ignored.

Selected heuristics that—when misapplied—can impede analytic thinking:

- **Anchoring Effect.** Accepting a given value of something unknown as a proper starting point for generating an assessment.
- **Associative Memory.** Predicting rare events based on weak evidence or evidence that easily comes to mind.
- **Availability Heuristic.** Judging the frequency of an event or category by the ease with which instances of this comes to mind.
- **Desire for Coherence and Uncertainty Reduction.** Seeing patterns in random events as systematic and part of a coherent world.
- **Groupthink.** Choosing the option that the majority of the group agrees with or ignoring conflicts within the group due to a desire for consensus.
- **Mental Shotgun.** Lacking precision and control while making assessments continuously; providing quick and easy answers to difficult questions.
- **Premature Closure.** Stopping the search for a cause when a seemingly satisfactory answer is found before sufficient information can be collected and proper analysis can be performed.
- **Satisficing.** Selecting the first answer that appears “good enough.”

Appendix 3: List of Intuitive Traps

- **Favoring First-hand Information.** Allowing information we receive directly to have more impact that what we learn or are told second hand.
- **Ignoring the Absence of Information.** Not addressing the impact of the absence of information on analytic conclusions.
- **Projecting Past Experiences.** Assuming the same dynamic is in play when something seems to accord with an analyst's past experiences.
- **Expecting Marginal Change.** Focusing on a narrow range of alternatives representing marginal, not radical, change.
- **Judging by Emotion.** Accepting or rejecting everything another group member says because the analyst likes or dislikes everything about that person. Also referred to as the Halo Effect.
- **Lacking Sufficient "Bins."** Failing to remember or factor something into the analysis because the analyst lacks an appropriate category or "bin" for that item of information.
- **Over-interpreting Small Samples.** Overdrawing conclusions from a small sample of data that is consistent.
- **Ignoring Inconsistent Evidence.** Discarding or ignoring information that is inconsistent with what the analyst expects to see.
- **Confusing Causality and Correlation.** Inferring causality inappropriately; assuming that correlation implies causation. Also referred to as Perceiving Cause and Effect.

Additional Intuitive Traps

- **Assuming a Single Solution.** Thinking in terms of only one likely (and predictable) outcome instead of acknowledging that "the future is plural" and several possible outcomes should be considered.
- **Presuming Patterns.** Believing that actions are the result of centralized planning or direction and finding patterns where they do not exist.
- **Assuming Inevitability.** Assuming that an event was more certain to occur than actually was the case. Also referred to as the Illusion of Inevitability.
- **Relying on First Impressions.** Giving too much weight to first impressions or initial data, especially if they attract our attention and seem important at the time.
- **Overrating Behavioral Factors.** Overrating the role of internal determinants of behavior (personality, attitudes, beliefs) and underestimating the importance of external or situational factors (constraints, forces, incentives). Often referred to as Fundamental Attribution Error.
- **Rejecting "Unimportant" Evidence.** Continuing to hold to an analytic judgment when confronted with a mounting list of evidence that contradicts the initial conclusion.
- **Ignoring Base Rate Probabilities.** Failing to accurately assess the likelihood of an event when faced with statistical facts and ignoring prior probabilities or base rates.

- **Misstating Probabilities.** Miscommunicating or misperceiving estimates of subjective probability (most likely, could, probable).
- **Over-estimating Probability.** Overestimating the probability of multiple independent events occurring in order for an event or attack to take place.